Current Techniques

6

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6.1 Adipose Tissue Transplantation According to Coleman

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Transplantation of autologous adipose tissue as per Coleman involves an open technique, which was introduced in the year 1988 by Coleman [1]. The multistage procedure can be subdivided into three phases [2]. This involves the phases shown in Table 6.1.

Table 6.1 Procedure of transplantation of autologous adipose tissue as per the Coleman technique

Phase	Measure
I	Harvesting of a fat suspension
II	Processing of the fat suspension
III	Return of the pure fat suspension

Fig. 6.1 Coleman harvesting needles

Harvesting of the fat suspension is done using the tumescence technique, during which the quantity of tumescence solution should correspond to the harvested quantity of the fat.

Finally, a blunt 11G needle (about 3 mm) with a double opening (Fig. 6.1), which is attached to a 10 mL syringe, is introduced into the subcutaneous tissue through a prick incision. By gently pulling up the plunger, a negative pressure is produced, through which the fat can be aspirated into the syringe in the smallest portions. Depending upon the plunger rise, an under-pressure of up to 0.52 bar can be generated [3].

- Coleman recommends a lift of 1–2 cm^3 for fat harvesting.

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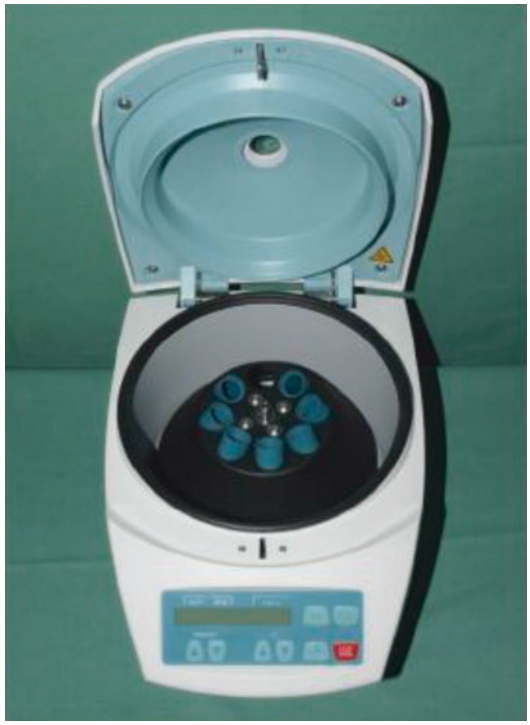

Fig. 6.2 Hettich centrifuge

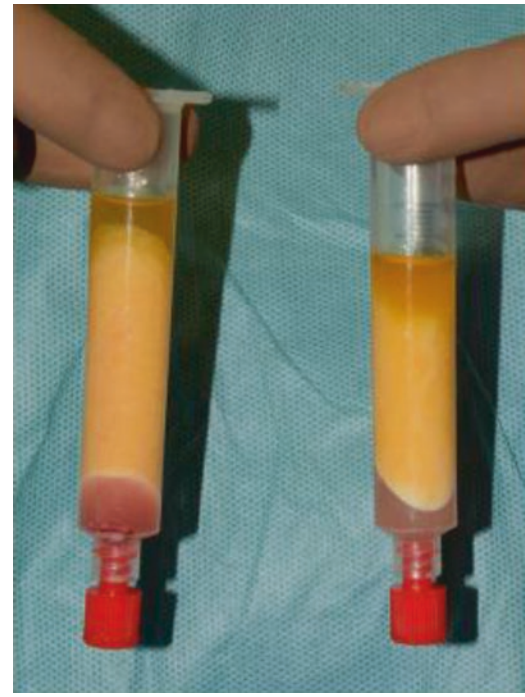

Fig. 6.3 Three-layered cleaning up after centrifuging

As soon as a sufficient quantity of fat suspension has been harvested, the syringes are closed at the cone and are centrifuged in sterile containers in a centrifuge (e.g. Medilite, Mentor, etc.) for 3 min at 3000 rpm (Fig. 6.2). This corresponds to a gravitational force of 920 *g*. Higher gravitational forces are not recommended by Coleman, because the tissue could get damaged [2].

- **During the process of centrifuging, very strict attention has to be paid in maintaining the sterility (open process)**.

Typically, three layers are formed after centrifuging. The uppermost layer consists of free fat from destroyed adipocytes; the lower layer is of blood, lidocaine and Ringer solution as well as detritus (debris), and the central layer contains the fat tissue (Fig. 6.3).

In further steps, the oil layer is pipetted out, and the residue can be removed using the so-called absorbent cotton (Fig. 6.4). The liquid left above the cone is drained out from the bottom of the syringe (Fig. 6.5).

Fig. 6.4 Removal of the oily residue

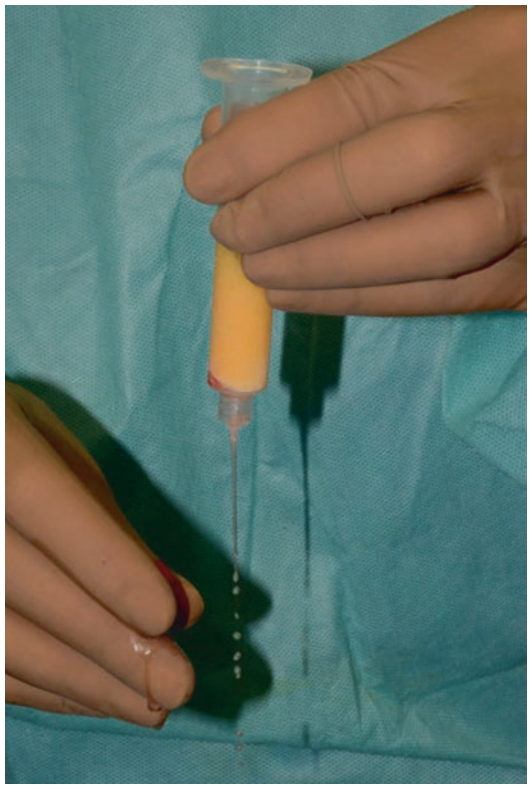

Fig. 6.5 Removal of the aqueous base

Fig. 6.6 Apportioned pure fat

The remaining purified fat can be transferred into a 1 mL syringe with the help of a double luer cone and is now ready for the reinjection (Fig. 6.6).

The transplantation of the fat suspension is done while using the Coleman technique by the Coleman needles I, II or III, which have a diameter of 14 or 16G (Mentor) (Fig. 6.7).

- **The Coleman technique is presently the most widely used technique and is considered a reference standard even in scientific publications**.

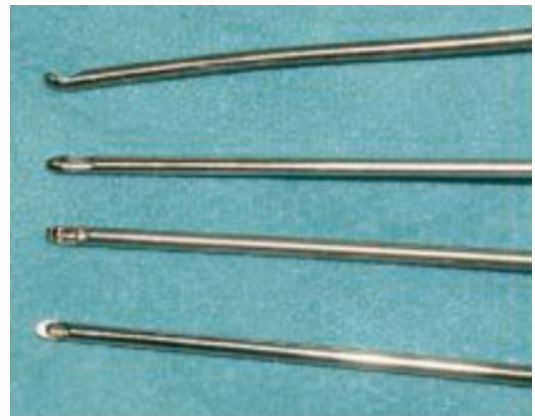

Fig. 6.7 Coleman needles, type I

6.2 Other Alternative Methods of Transplantation of Adipose Tissue

Hans Oliver Rennekampff and Christian Herold

6.2.1 Phase Separation Using Sterile Compresses

The spreading out of lipo aspirates onto sterile compresses is an established and cost-saving technique. This is because no other equipment is required except a suction needle, a drain tube and sterile compresses. Even the infiltration can be done using the suction needle and the drain tube.

The mechanical trauma and the exposure to room air are considered as potential disadvantages.

In an experimental work, a more superior separation of the oil phase, a higher content of stem cells of the fat graft and a more superior survival of the graft in a naked mouse model could be proved as against a filter-based technique and the Coleman technique [4]. But the greater amount of time required was shown as a disadvantage, and therefore, this technique is recommended only for small volume grafts.

In the papers published by Salinas et al. [5], it could similarly be shown that the phase sepa-

ration using sterile compresses represents a possibility to concentrate the harvested fat suspensions to even 90%.

6.2.2 Filter-Based Systems

6.2.2.1 Shippert Process

Shippert System
- Tissu-Trans Filtron
- Shippert Medical Technologies
- Marketingv in Germany through Asclepios Medizintechnik

This harvesting and processing technique of a fat suspension was introduced in the year 2006 by Ron D. Shippert [6]. Harvesting fat as per the Shippert technique is a closed suction and processing processs. The **Shippert System** (Tissu-Trans Filtron, Shippert Medical Technologies) consists of a large lumen suction hose and different large filter receiver flasks (100 mL, 300 mL, 500 mL, 1200 mL, 2000 mL; Fig. 6.8).

Properties of the Tissu-Trans Filtron System
- Large lumen hose system
- Standardized reduced suction
- No centrifuging
- Filter system 800 µm for removal of debris, oil and liquids
- Scrubbing process is possible
- Avoidance of an open fat transfer (as per [6])

A reduced vacuum is used for suctioning in the tumescence technique, typically with up to 3-mm-diameter needles and as against the classical liposuction. R. D. Shippert recommends an under-pressure of about −250 to −500 mmHg.

The receiving flasks have an in-built filter function with a bore diameter of 800 µm (Fig. 6.9). Through the integrated filter, one can separate oil, water and soluble additives like epinephrine. After harvesting of the necessary fat

Fig. 6.8 Different large filter receiver flasks (100 mL, 300 mL, 500 mL, 1200 mL, 2000 mL) with an integrated filter system (© Shippert Medical Technologies Inc. with kind courtesy)

Fig. 6.9 Detailed view of the filter unit with pores 800 µm in diameter

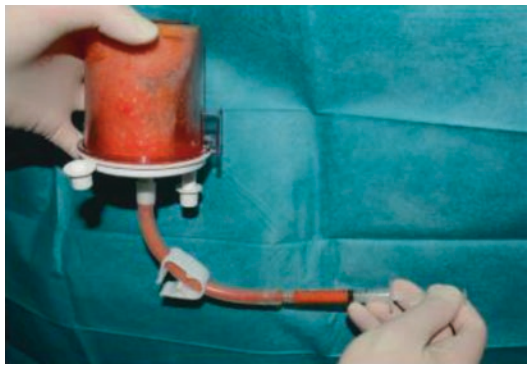

Fig. 6.10 Sterile extraction of the lipo aspirate for further use

suspension, it can be distributed via a transfer connector in a sterile manner into syringes with small volumes (Fig. 6.10).

Shippert points out that based on the design of the hose and filter system, several negative factors were eliminated or improved upon (see Summary). Thus the large lumen hoses further contribute in preventing a damage to the aspirate. The same argument is put forward even for the short hose lengths.

There is absolutely no need of centrifuging, so that, additionally, no personnel is required for manning the centrifuges. Also, there is no need

Fig. 6.11 (**a**, **b**) Aspirate of Tissu-Trans Filtron after 0 min (**a**) and 60 min (**b**). On the average, the original lipo aspirate contains 15% aqueous phase

for a waiting period during centrifuging. There is also no need of further manipulation of the fat tissue through stirring or peeling.

- **Since this is a closed-loop system, any possible contamination through the air or personnel is absolutely ruled out. As compared to other manual suction techniques, the lipo aspirate can be harvested with the help of the Tissu-Trans Filtron System under reproducible and constant under-pressure conditions**.

Thus the Tissu-Trans Filtron method can be used for harvesting the lipo aspirate under standard conditions, e.g. for clinical studies, during which a harvesting of tissue under conditions independent of study is required.

Individual studies [7] for the analysis of phase distribution in free fat (oil), fat suspension and aqueous phase yielded an average fat phase percentage of 85% of the originally suctioned out volume after 1 h (Fig. 6.11). Even after addi-

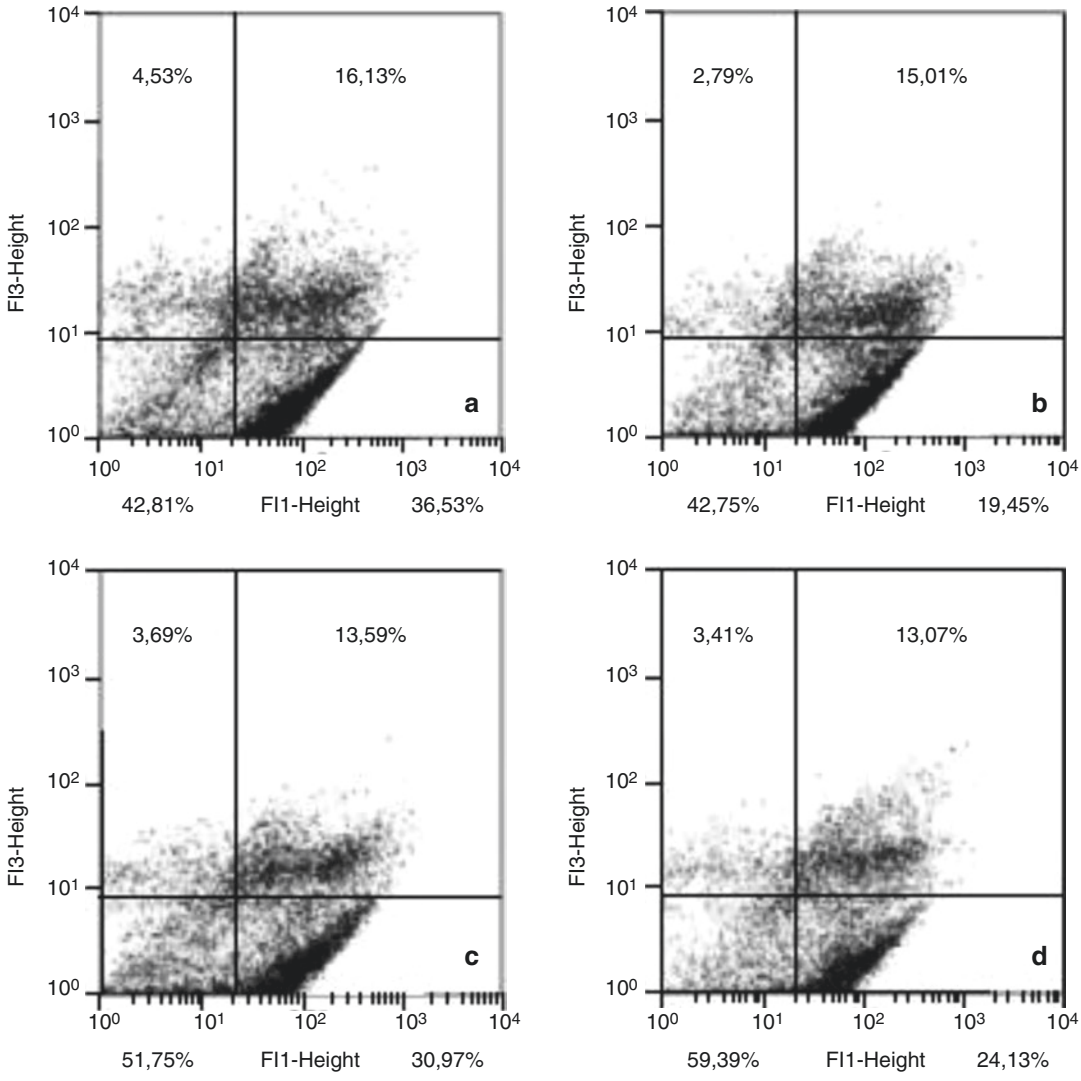

Fig. 6.12 (**a**–**d**) Examples of an evaluation of data of a female patient in the quadrant view, from top left to bottom right: (**a**) Tissu-Trans Filtron, (**b**) Coleman with 920 *g*, (**c**) centrifuging done as per Coleman with 1840 *g* centrifuged, (**d**) native adipose tissue, *x*-axis, Annexin-V FITC; *y*-axis, propidium iodide (PI). There are no significant differences in the number of vital cells (**c**) that are found during the processes adopted

tional experimental centrifuging, the fat phase percentage was recorded at 75–80% (own data). The aqueous fraction contains a high percentage of growth factors and adipocytokines (manuscript submitted). The residual liquid contained in the lipo aspirate should be taken into consideration during the planned autologous fat transplantation and the fat retention values to be achieved at the maximum. No oil phase can be detected after 60 min waiting period in any of the studied samples to a significant extent.

A comparable extremely low value for the residual oil fraction of 1% was recently shown by Fisher et al. [4]. No significant differences as against other extraction techniques could be proved [8] in the vitality test of the lipo aspirate harvested using the Shippert System and also in the lipo aspirate processed in the individual cells (Fig. 6.12).

Fat particles harvested using the Shippert method showed a diameter of 3 mm in the work done by Fisher et al. [4], and in this process, the

mean particle size of the filtered fraction that had to be discarded lay at 300 µm. Whereas hardly any vital cells and mainly debris were found by Fisher et al. in the discarded water-oil fraction after using the Shippert System, it is an open question as to whether the selected filter size of the Shippert System of 800 µm represents the optimum from today's viewpoint. In this area, further investigations are required, because even vital fat particles of around 300 µm were described as optimum in experimental in vivo models [9].

Significance

The advantages of the Tissu-Trans Filtron System lies in the simple handling of a closed-loop system: at the end of the aspiration process, we have a filtered fat suspension with a residual volume of liquid holding a growth factor for the infiltration.

The operator requires only a reduced effort for the harvesting process thanks to the mechanical suctioning as compared to aspiration by hand in the Coleman technique, which becomes a great advantage especially in the recovery of large volumes.

6.2.2.2 LipiVage

The ready-to-use, sterile single-use product (50 mL syringes) is directly connected to a liposuction pump. This is basically a closed-loop system. The oil-water fraction is removed through an integrated filter. With the help of an attached Luer lock transfer connector, sterile apportioning is possible in syringes of smaller volumes for injection [10].

LipiVage
- Genesis Biosystems, Lewisville, USA
- Marketing Germany: Polytech Health & Aesthetics GmbH

6.2.2.3 Pure Graft

This is also a closed double filter system in the form of sachets. At present, three different sizes are available (50 mL, 250 mL, 850 mL).

The fat suspension harvested is transferred into the sterile single-use sachet, is washed two times using Ringer's solution and can then be apportioned into 1 mL syringes for the lipo transfer. When using in the area of the face, one could prove a superior volumetric retention using the 3D surface scan (Vectra) as against fat transplantation, which was harvested using the Coleman technique (41% as against 32% after an average of about 17 months, [11]).

Pure Graft
- Solana Beach, CA, USA
- Marketing Germany: Aromando Medizin Technik

6.2.2.4 Revolve System

Revolve System
- Life Cell Inc. Branchburg, NJ, USA

The Revolve System is basically a closed-loop system, which in many aspects is comparable to the Shippert System. Even in case of this system, the fat suspension is collected in a single plastic container with in-built filter system, in which case the filter has a pore size of 200 µm. Also, there is an equipment for the active mechanical scrubbing and mixing of the fat graft through a propeller that has to be manually activated, which is integrated into the system. In case of the naked mouse model, one could prove a superior volumetric retention as compared to the Coleman technique [12].

6.2.3 Systems for the Enrichment of Stoma and Stem Cells

- **Legal specifications of the law on tissue transfer have to be followed in case of all systems, which include a further processing with the enrichment with stroma and stem cells. An advantage of stem cell enrichment could not be proven [13].**

6.2.3.1 Celution System

Celution System
- Cytori Therapeutics Inc., San Diego, CA, USA

Fat cells without centrifuging are cleaned through several scrubbing steps on the one hand in a closed-loop system, and on the other, stroma and mesenchymal stem cells as well as endothelial progenitor cells ("stroma vascular fraction") are harvested using human collagenase from a lipo aspirate on-site in a processing that takes about 2 h. Finally, the adipose tissue can be mixed with the stroma cell concentrate and injected with 10 mL syringes and applicator using 1 mm Coleman needles.

6.2.3.2 Other Systems

Other commercially available systems, which similarly are based on an enzymatic process, are:

- The **Multistation Minilab** (Multistation P&C International, Korea)
- The **Lipokit GT** (Medikan International Inc., Korea)

In addition, there is the possibility of a mechanical processing with:

- The **Fastem-Corios System** [14].

6.3 Pre-expansion Through the External Under-Pressure Expander (System BRAVA)

Norbert Heine

Even in the 1990s of the previous century, Roger Khouri developed a system for the volumetric augmentation through an external under-pressure expansion device [15]. His original aim was breast enlargement without surgical intervention, only through the intermittent wearing of a device with controlled under-pressure. But the enlargement achieved by this remains within limits; even for continuous success, one had to wear the device repeatedly.

With the emergence of autologous fat grafting into the female breast, two determining factors of this technique became soon evident:

- The quantity of the maximum transferable fat tissue per consultation
- The percentage of the tissue, which permanently survives [16]

In this connection, such questions are of interest as to which criteria determine the survival of the fat cells and the pre-adipocytes and as to how one can influence these.

The quality and the accepting capability of the receiving area are important for the survival of the injected fat tissue. Khouri soon discovered that the BRAVA System not only can be used for the permanent volumetric enlargement of the breast but also for the temporary expansion of the subcutaneous receiving area before the fat transfer. The oedema thus achieved of the subcutaneous area and the assumed neo-angiogenesis not only improve the survival conditions of the fat tissue introduced but also facilitate enhancing the quantity of injected material through volumetric increase of the receiving area [17].

The expansion of the tight and unyielding skin cover achieved over a period of several weeks and the scar attachments that may exist after the preliminary operations represent an advantage as against the sole fat transfer.

- The increasing hardening of the target tissue during the injection, which finally limits the further uptake of tissue, can be further pushed forward through the preliminary expansion.

6.3.1 Technique

The BRAVA System consists of:

- Two cups with semi-adhesive silicone boundary
- One hand pump for quick air expulsion
- An automatic pump (so-called Sport box), which sustains a continuous under-pressure of 15–30 mmHg (Fig. 6.13)

Biometric data are taken in order to select the expansion cups (see Summary).

Recording of Biometric Data Before the Mammary Expansion

- Upper and lower breast width
- Degree of ptosis
- Nipple to clavicle distance
- Bra size
- BMI, etc.

Fig. 6.13 Technology BRAVA System with a Sport box

Apart from these, the indications are recorded (aesthetic augmentation or reconstruction). The optimum size and configuration of the cups should be calculated from these data. This is because a slim, tall lady with small, tight breasts requires different cups as compared to a shorter patient with a slight ptosis.

When putting on the system for the first time, the patient is instructed in handling the system and in skin care. Both cups (during reconstruction, only on one side) are placed without tension on the skin in such a manner that the soft, semi-adhesive silicone boundary is fully in place all around and the entire tissue to be enlarged is left free (Fig. 6.14).

- **Especially in case of faulty structures, the inner boundary of the cup may have to be placed a little lower than the lower boundary of the breast**.

Fig. 6.14 A patient wearing the device of the BRAVA System

The hand pump and the Sports box are connected to the cups via a hose system. It is better to generate the under-pressure required using the hand pump, which will then be sustained by the electric pump. In case of a patient with a narrow thorax, the silicone boundary of the cups which initially are loosely positioned will now get attached automatically after production of the under-pressure.

- **The subsequent skin care and skin observation are of utmost importance. This is because skin irritation is amongst the most frequent complications and occasionally may lead to an interruption or even abandoning the treatment**.

Depending on individual tolerance, preference should be given to the care products delivered as part of the package, because other products could damage the silicone boundary of the set worn.

- **Skin care products other than those delivered as part of the treatment could lead to damage of the material**.

6.3.2 Application

The final outcome depends on how the system has been worn.

6.3.2.1 Preoperatively

One should strive for an uninterrupted wearing duration of about 8–10 h per day as far as possible, which should preferably be done during the nights. Frequent interruptions or lack of sealing could impair the chances of a success.

The required period of time depends on the quality of the tissue that has to be expanded and can be evaluated through inspection directly after taking off the cups. If these were worn correctly, a clear oedema of the tissue becomes visible after just a few days (Fig. 6.15).

- **The enlargement achieved at the end of the expansion should nearly correspond to the increase in volume that is expected postoperatively (Fig. 6.16).**

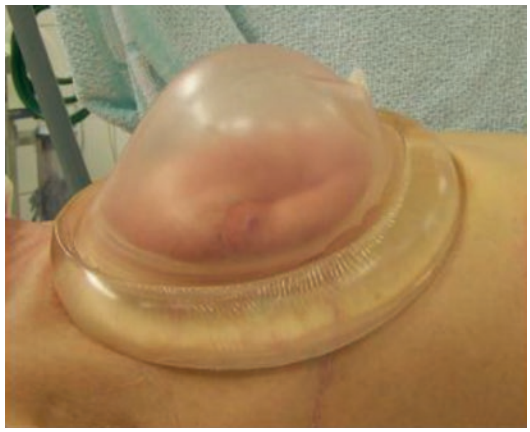

Fig. 6.15 Expansion underneath the cup

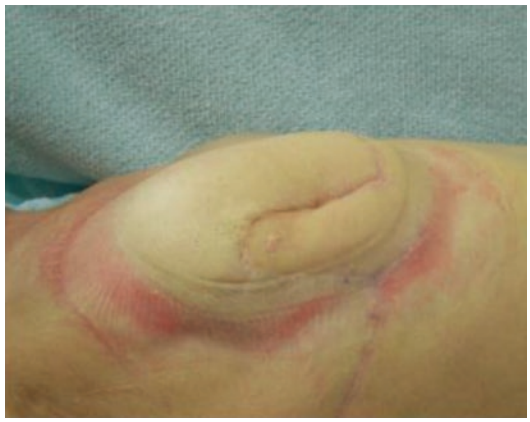

Fig. 6.16 Enlargement and expansion of the scars; the (temporary) expansion volume corresponds to the subsequent (permanent) filling result

On the average, a preoperative wearing duration of about 4–6 weeks is necessary. Thus the daily usage should be intensified while reaching the end of the planned period of wearing, and during the last few days before the planned intervention, no interruptions should take place. Whereas in case of a relatively loose skin cover and aesthetic indication, a period of 4 weeks is sufficient, tighter and smaller breast bulges or scars would require a significantly longer treatment after the mastectomy (Fig. 6.17).

Patients with radiation treatment represent a special group of indications. The irradiated tissue loses its elasticity; the tissue pressure rises disproportionately during the fat injection even after only a slight volume [18]. The total number of fat tissue transfers becomes significantly higher than in case of nonirradiated breasts. In this case, a preoperative preliminary expansion can not only result in a reduction of the individual sittings required but instead occasionally enable a permanent treatment success.

6.3.2.2 Postoperatively

Postoperatively, the system should be applied again after 24 h and should be further worn for a period of about 10–14 days. By this, the fat tissue introduced gets immobilized and gets stabilized as in the case of a skin graft until a revascularization ensures the permanent survival of the cells by means of regeneration of new blood vessels. Also, the postoperative expansion of the skin cover in the critical phase of the healing leads to a reduction of the tissue pressure.

Significance

It can be summarized that an external preexpansion can represent an aid for a significant improvement of the treatment success of an autologous fat transfer at the breasts. A good compliance of the female patient is important, which can be achieved only through a detailed counselling and demonstration before and during the treatment. Unreliable female patients should be identified early in the first consultation itself and critically indexed. Their consequent cooperation is essential if one wants to use the BRAVA method in order for the treatment to become a success (Fig. 6.18).

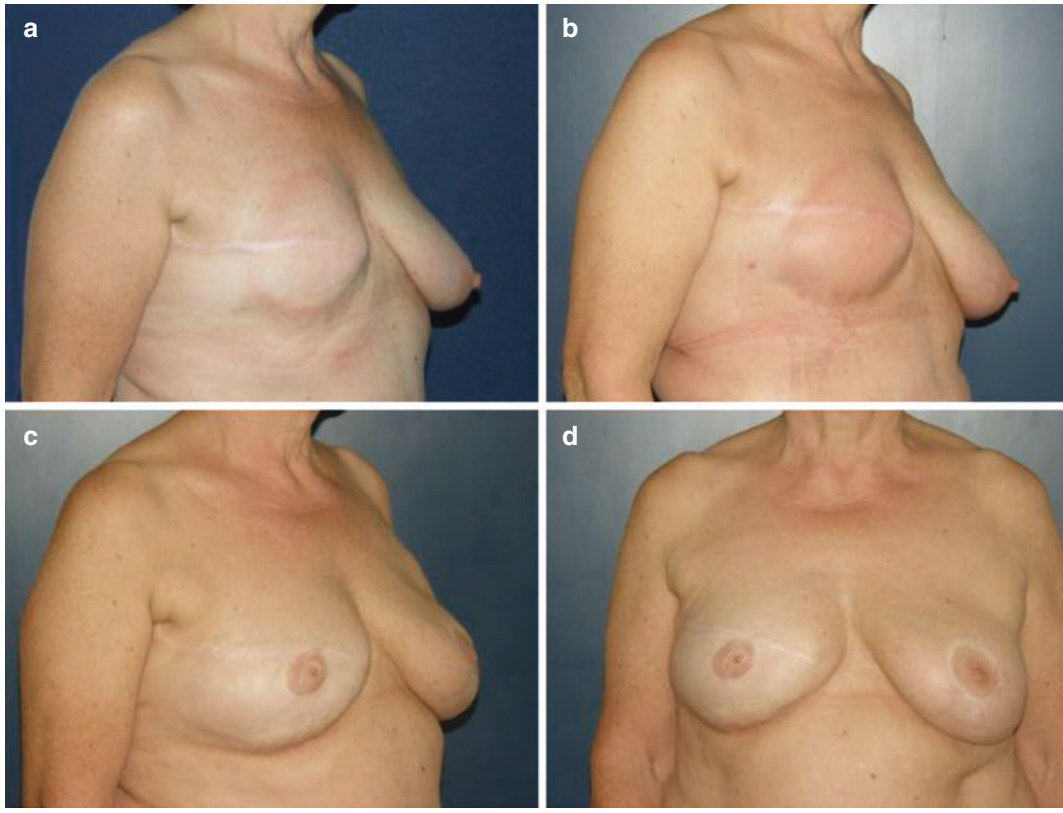

Fig. 6.17 (**a**–**c**) Condition after mastectomy to the right. (**a**) Pre-expansion with BRAVA, (**b**) second consultation: visible oedema and hyperaemia, (**c**, **d**) 4 years after autologous fat reconstruction, to the right, build-up of the nipple to areola complex (MAC build-up) and mastopexy, to the left

Treatment Objectives
- Enlargement of the recipient tissue
- Expansion of the skin cover
- Reduction of the tissue pressure
- Expansion of the scars
- Postoperative immobilization

6.3.3 The Treatment of Faulty Breast Structures Using the External Expansion System (BRAVA-AFT)

Apart from those patients who have the desire to have an aesthetic breast enlargement and breast reconstruction, there are also patients who have birth defects in the form of faulty growth of the mammary glands. These are another indication group that are in great demand for autologous fat injections.

It is precisely in this group of mostly young women that there exist inborn fibrotic structures (tubular breast; Fig. 6.19) or a partial to complete fibrotic transformation of the rudimentarily grown breast glands (Poland syndrome, Amazon syndrome), which can significantly encumber a fat injection as compared to a hypoplastic breast that is normal in growth. In case of the special anatomical situation of tubular breasts with fibrotic constriction of the lower quadrant, deficit skin cover caudal and loose prolapse of the nipple-areola complex, the injected fat often follows the gradient of the tissue pressure to the still sufficiently formed upper quadrant, without sufficiently emphasizing the filling in the area of the

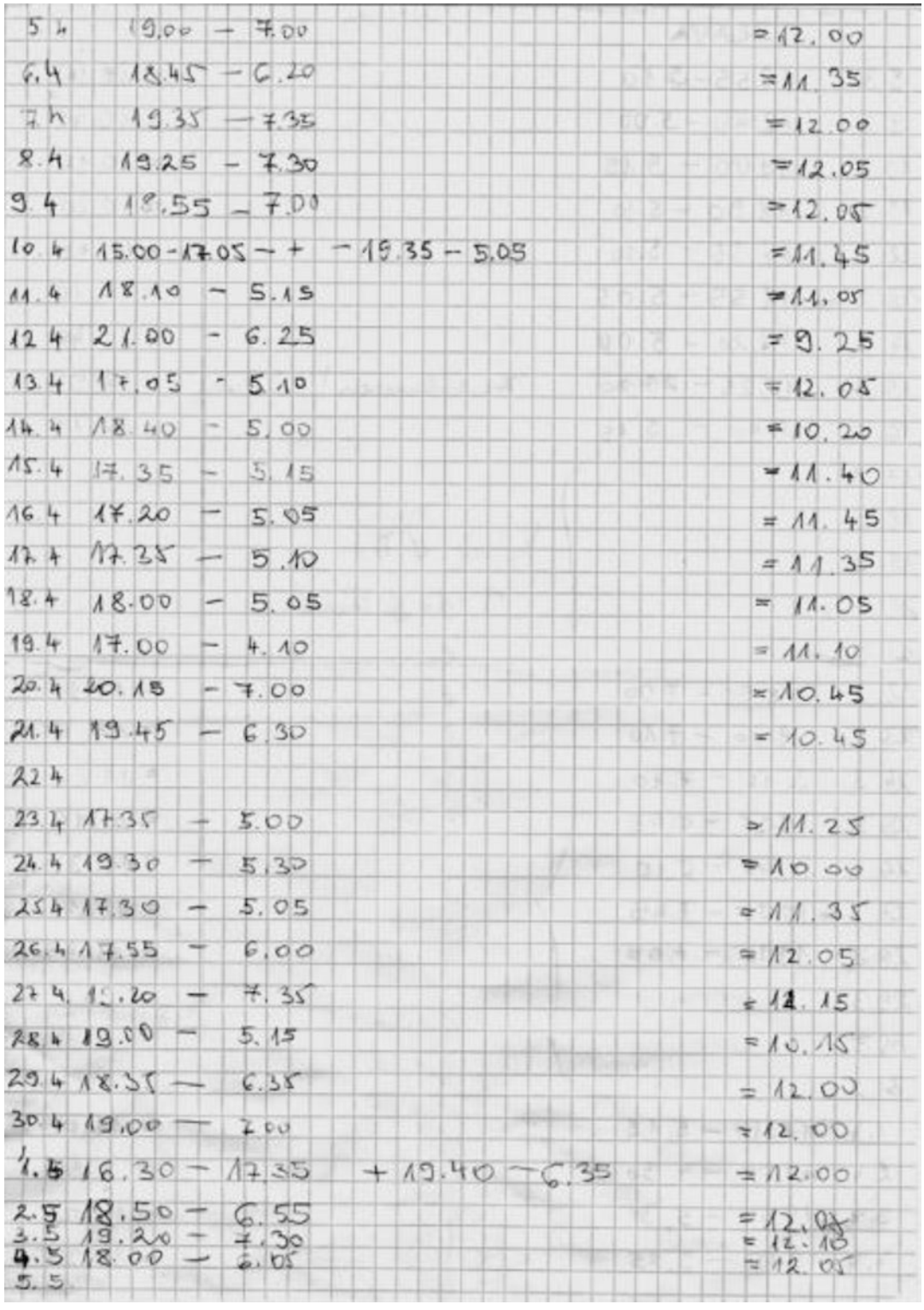

Fig. 6.18 Patient maintains a record of the daily duration of wearing the device

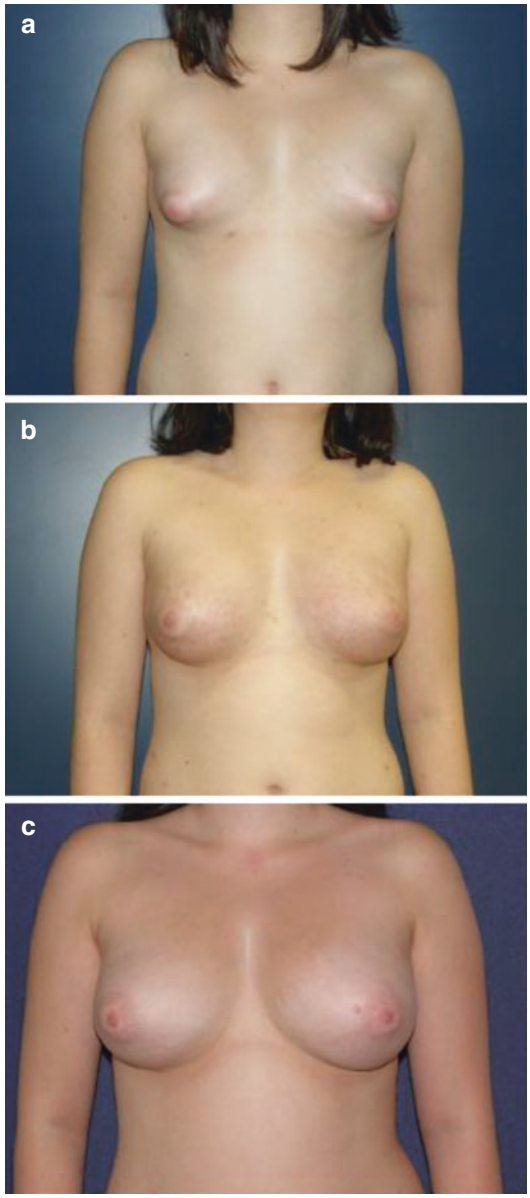

Fig. 6.19 (**a**–**c**) Tubular breasts. (**a**), (**b**) 1 week postoperatively after the pre-expansion, lipo filling and expanded 3D mesh Rigottomy technique; (**c**) 18 months postoperatively, the result is seen to be stable (1 OP)

lower breast, which is required for a natural shape and form.

The consequential external pre-expansion pays for this situation. Here it is important to position the cups at a significantly lower level. This is because as compared to the aesthetic augmentation, the lower breast fold has to be caudalized at a further point.

6.3.3.1 Preoperative

The patient should be painstakingly instructed in the use of the system. The cups should be selected in such a manner that through a relative excess size, the entire planned breast shape gets covered within the silicone cushion of the cups.

- **Note: Any pressure on the cups onto the fat tissue should essentially be avoided ("pressure kills fat")**.

The preoperative expansion phase is monitored by the plastic surgeon or the medically qualified personnel, and the success is checked. A clear sign for correct use is the visible oedema of the areola and of the transition to the boundary of the cups; a simple paling of the expanded skin would be due to the oedema-based thickening of the cutis.

- **At the end of the expansion, a volume and a breast shape should be achieved, which is expected after an operative lipo filling. Thus the injected fat temporarily replaces the temporary oedema that has occurred due to the expansion**.

If a visible effect has been achieved through the BRAVA System, then the patient should be extensively counselled again regarding how to wear the system and about the duration of wear and should be expanded for a further period of 2–3 weeks.

The duration of wear should mostly be individually matched and depends on the:

– Skin quality
– The thickness of the soft tissue cover
– The expansion of the existing scars

Inspections of the expansion result should be planned into the time table.

More important than other indications, the postoperatively expected volume should become visible at the end of the pre-expansion. The minimum duration of wear of 4–6 weeks must, if required, be extended to a further 2–4 weeks [19].

6.3.3.2 Intraoperative

In case of tubular deformities, the fibrous strands of the lower breast must be expanded through multiple, very small incisions in the connective tissue (within the meaning of the 3D mesh Rigottomy technique; Fig. 6.19) intraoperatively. Perforations are done using a 14–16G needle of the entire fibrotic portion of the subcutaneous connective tissue, without creating large hollow spaces in the process, in order to prevent a confluence of the injected fat tissue.

The system should be left to be worn up to in the OP and only removed directly before the operation, in order to sustain the effect of the oedema for the longest possible period of time.

Fat transplantation should be done following the general rules of operation; the fat is distributed with 2–2.5 mm needles three-dimensionally in the form of boxes (while avoiding bolus injections) in the smallest portions into the subcutis as well as in the pectoralis muscles. During the process, the max. quantity should be set to be somewhat higher due to the enlargement of the receiving area as against the conventional methods.

6.3.3.3 Postoperative

Starting from the first postoperative day, the BRAVA System device is worn again. Here one has to pay attention to a good skin care and a thorough cleaning of the silicone boundaries of the cups.

- **Eventually, one has to wait in case there is continuing secretion from the injection pricks until these become sufficiently attached**.

Postoperatively, one waits for the sealing of the secretion from the injection pricks, and thereafter, the device is worn for a further period of 2 weeks, in order to immobilize the tissue in the early phase of the blood vessel regeneration, and then the pressure is reduced through the surrounding soft part covering.

- **Note: Special care must be taken here, especially for the correct positioning of the cups. This will prevent any pressure effect through the push-up bra on the fat tissue injected**.

Special Note to Be Taken
- Lower positioning of the suction cups
- Sufficient formation of oedema
- Intraoperative 3D mesh

6.4 The BEAULI Protocol

Klaus Ueberreiter

In order to be able to harvest large volumes (>100 mL) quickly, reliably and in good quality, Ueberreiter developed the BEAULI protocol after several studies done beforehand in the year 2007 and finally tried out in a prospective, MRI-controlled, multicentral study [20, 21].

The technique is mainly based on a suction with the water jet equipment ("body-jet"; Fig. 6.20) made by the company Human Med AG, Schwerin, Germany.

Fig. 6.20 Body-jet (© with kind courtesy of the company Human Med)

Fig. 6.21 Function of the body-jet needle (© with kind courtesy of the company Human Med)

This equipment uses a double-channelled needle (Fig. 6.21), which carries a tube in the centre, from which the tumescence solution is infiltrated in different pressures and volumes, controlled by a foot pedal not only before but also during the suctioning into the tissue. The following are important points to be considered:

– The conservation of the tissue particles through constant water flow
– The especially small size of the fat chunks to be transplanted of 0.7–1.2 mm [22], which are properly suited for a complete healing [23]

6.4.1 Preconditions for Aesthetic Augmentation

We accept only female non-smoker patients having a BMI of above 18. The most optimum suited are those female patients, who carry heavy fat deposits on the stomach or upper thighs, so that the operation results in a double benefit.

Before the intervention, it is taken into consideration as to from which region which quantity can be approximately suctioned out. Since in the vast majority of cases, at least two grafts have to be done at a space of at least 3 months, it is better to suction out from different regions in the consultations.

- **Suctioning can be done for a maximum of three times from an individual region**.

The following are the typical regions from which suctioning can be done easily:

– Abdominal area and hips/ flanks
– Outer thighs (“saddle bags”), inner thighs and knees
– Buttocks

It is highly recommended to inform the patient beforehand that per transplantation, approximately a half breast size in final volume can be gained. This corresponds to silicone implants of 100–150 mL. These small implants can be given in advance to the patients for inserting into the bra, so that they can get an idea as to what it feels like. If during this consultation it is felt that a much bigger augmentation is desired in a single operation, then one should generally advise against autologous fat augmentation.

- **In order to achieve an entire breast size volume harvesting, two grafts are required. These can be carried out within a space of 3 months. WARNING: Every excessive grafting (more than 250/ 300 ml per breast) will lead to apoptosis of the adipocites, reabsorption and even oily cysts**.

6.4.2 Analgesics and Sedation

The suctioning is carried out while the patient is under sedation with analgesics or even under local anaesthesia. But the job that is done under solely local anaesthesia is significantly slower. This is because one has to wait for the local anaesthesia to take effect.

A full anaesthesia is certainly also possible. But due to the lack of cooperation of the patient, suctioning becomes difficult, especially of the body reverse side. Also, there is an enhanced risk of injury due to a lack of muscular defence.

A good alternative is also the high epidural anaesthesia, which is being used with great advantage since several years in Helsinki. The patient is mobile during the entire operation but is free of pain.

6.4.3 Tumescence Solution

A solution of 500 mg of lidocaine and 1 mL of adrenaline 1:1000 in 1 L of normal saline solution is used for the purpose.

For Example
A solution of 150 mL of lidocaine 1% and 3 mL of adrenaline 1:1000 in 3 L of NaCl solution

In case of operation under local anaesthesia, one should also use sodium bicarbonate 8.4 mVal in a dosage of 12.5 mL per litre of solution to reduce pain during infiltration.

The use of prilocaine should be avoided due to the high toxicity for pre-adipocytes [24]. It is better to use larger containers of 3 or 5 L bags, depending on the experience; 1 to 2 L of solution is consumed for the harvesting of 500 mL of fat for a bilateral breast enlargement.

- **An important part of the protocol is the preheating of the solution to body temperature**.

6.4.4 Preparation

Single use underwear is provided to all the female patients in the ward which can be worn during the entire operation. Skin desinfection is most easily carried out while the patient is standing and then asked to sit back on the steril table. An uncompromised suctioning is thus possible even with the patient turning to the side several times without compromising on sterility.

In our clinic, we use pre-packed complete sets, which contain all the material required for the operation like covering cloth, gown, syringes, plaster, etc.

6.4.5 Operation

6.4.5.1 Suctioning

Small prick incisions are made using a number 11 scalpel at the areas marked out earlier, and finally through these, the respective region to be suctioned is infiltrated. As compared to the classical tumescence technique, only a base infiltration is done with small volumes of 100–200 mL per region. The injection strength is set at the body-jet to level 3–4 and in BodyJet Evo to “Long 4”.

In order to avoid haematoma in the breast region and to enlarge the space available for the uniform fat distribution, we infiltrate tumescence solution into each breast (about 200 mL per breast) not only in the subcutaneous area but also retro-glandular before the suctioning. The fat can be distributed easily in this manner. But this variant requires subsequent evaluation. The introduction of the solution into the breast is done in a sensible manner after infiltration of the expected areas.

Thereafter, the 2.5 mL infiltration needle is replaced by the 3.8 mL rapid harvesting needle.

The LipoCollector (Human Med AG) is interposed in the reverse flow to the suction tank (Fig. 6.22). The fat is retained in this, so that only excess flushing liquid again reaches the suction container.

The negative pressure is reduced to −500 in order to expose the fat to the least possible potentially damaging forces. A still lower under-pressure is, in principal, advantageous; however, the suctioning thus becomes more inefficient and slower. The suctioning is done with a setting of a spray jet strength of 1 on the scale of 1–5 (setting on the body-jet), during which a beginning is done with the region that was infiltrated first. Now care should be taken that the suctioned mixture of fat and tumescence solution will never become dry by means of almost constant use of the infiltration. This is important because fat cells can be more easily destroyed due to shearing forces than by an excess of pressure.

6.4.5.2 Processing the Graft

Liquid and fat are automatically separated in the LipoCollector. The liquid is suctioned into the waste container. About 600 mL of floating fat (scale of the LipoCollector) yields a sufficient quantity of 250–280 mL per side for an aesthetic breast enlargement on both sides after filling up

Fig. 6.22 LipoCollector (© the company Human Med with kind courtesy)

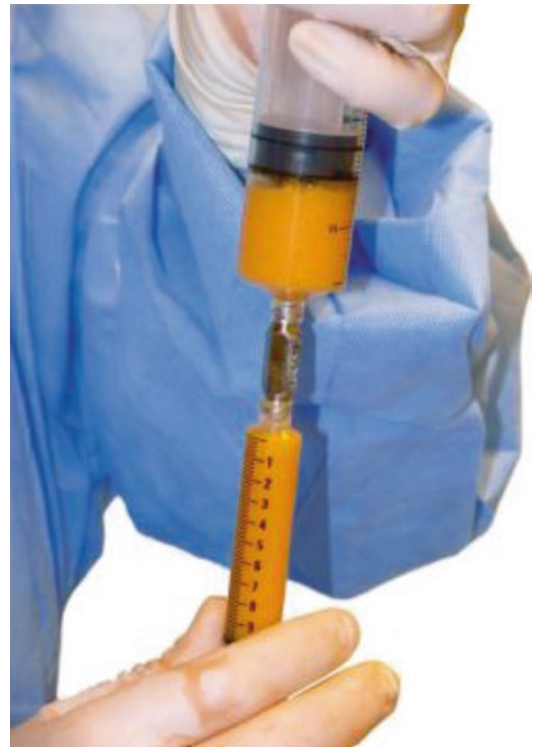

Fig. 6.23 Filling of the syringes

the syringes. With enough fat harvested the bottom valve is connected to the vacuum. This has to be reduced now to -200 mm Hg to avoif damage to the filter mesh. The oily debris which is drained with the waste liquid can vary widely between 10 and 100 ml. It does not contain any vital /stem cells. The filter does not allow for the real fat particles to pass.

The remaining fat is drawn into 50 cm^3 irrigation syringes. The larger syringes help to asses the amount of fat tobe grafted. The 50 cc syringes can be directly fitted to the cone of the 10 cm^3 Luer Lock syringes, which are used for the purpose of reinjection.

The Filling of the syringes is shown in Fig. 6.23.

6.4.5.3 Reinjection

- **A more precise control of the injected volume becomes possible by working with five syringes, respectively, each with 10 cm^3, as has been shown advantageous in practice**.

The harvesting of the smallest possible aliquots of fat cells is essential, as has been described above, for successful grafting. A uniform distribution is required in the tissue with strict avoidance of any accumulation of large quantities at one point, so that these small tissue units have good supply from the surrounding tissue until the first new vessels sprout in. This can most easily be accomplished by using a sufficiently long, blunt needle. We generally use a single pricking point—lateral about 2 cm below the sub mammary fold—per breast, in order to achieve the desired result (Fig. 6.24).

But if the surgeon feels more confident of achieving a uniform distribution through several pricks, then this is also certainly possible. In this case, a prick at the areola boundary can also be done. Just keep in mind that every prick leaves a tiny scar.

Two common procedures are used:

– The needle is moved back and forth with long plunger movements of about 10 cm length, and in doing so, the plunger is depressed, so that with a total of 10–20 piston movements, the content of the 10 cm^3 syringe is distributed in the tissue (Fig. 6.24).

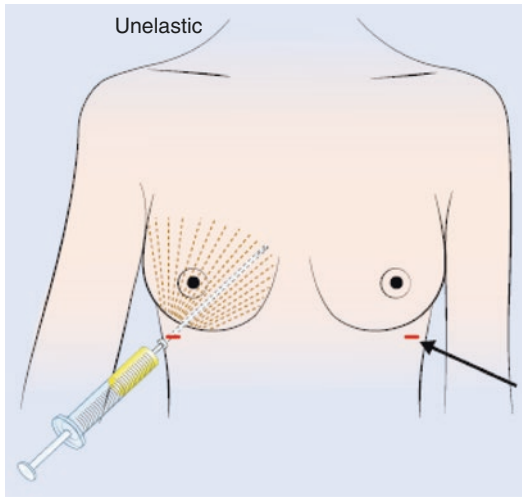

Fig. 6.24 Injection (drawn as per a diagram by K. Ueberreiter)

– The needle is pushed forward until it stops, and finally during withdrawal to a length of at least 10 cm, a volume of about 1 cm^3 is expressed. For the purpose of an exact dosing, a mechanical device can be used, which is placed on the syringe.

Depending on the site and position of the region to be filled up, the fat injection is given, until the area to be filled in bounces elastically, but is not filled up until it is hard.

- **In case of aesthetic augmentation, a volume of 200–300 mL can be transplanted per breast; in the vast majority of cases, it is about 250 mL in our premises**.

We could demonstrate in an MRI-controlled, prospective study that about 80% of the fat tissue harvested does heal. But only the pure fat component after centrifuging was used for the evaluation. This consists of 75% of the retransplanted, floating fat mixture [20, 25]. The rest of the 25% consists of the tumescence solution used from the detachment of the fat.

- **Thus one can assume an assured healing of the transplanted (gross) tissue of 60%. After healing, this corresponds (in case of an average grafted volume of 250 mL) to a volumetric gain of a half of the bra cup size**.

The pricking points should be closed with adhesive strips that have to be left on the skin for a period of about 10 days. Materials like the Omnistrip (R) of the company Hartmann have proven to be reliable and can be in place for the desired period, and even taking a shower is possible having them on. In a similar manner, the pricks after the suctioning are closed. It is recommended to clean the surrounding area of the wound previously with gauze pads dipped in alcohol, so that the plaster can get attached more reliably.

6.4.5.4 Postoperatively

A suitable compression garment is now worn for the compression of the suctioned region. The breast is kept warm through a spool of wide absorbent cotton. Any strong pressure by wearing a bra or excessive movement (through sports, massage) is to be avoided for a period of 4 weeks after the operation.

The patient is pointed out that the visual result corresponds (with the general swelling about 7–10 days postoperatively) to the long-term result after the second intervention. We recommend a "selfie" taken to our patients at this period. The next fat graft can be carried out 3 months later; one or several further transplantations are easily possible.

One example is shown in Fig. 6.25.

Summary for the Practice

The BEAULI (TM) Process described here for transplantation of autologous fat fulfils all the demands that are made for a successful fat tissue transplantation. This method has proved to be reliable, in the past 10 years worldwide in thousands of cases. The big advantages lie in the reliability in achieving the results, the simplicity and quickness in execution and the almost complete lack of any complications. No more than just 60 min are required for the execution of aesthetic mammary augmentation on both sides if one has had some practice. A big harvest can be

reaped with the gain of half a breast size in a single operation.

Other application possibilities include the replacement of silicone implants with one's own fat [26] as well as breast reconstruction after mammary carcinoma [27].

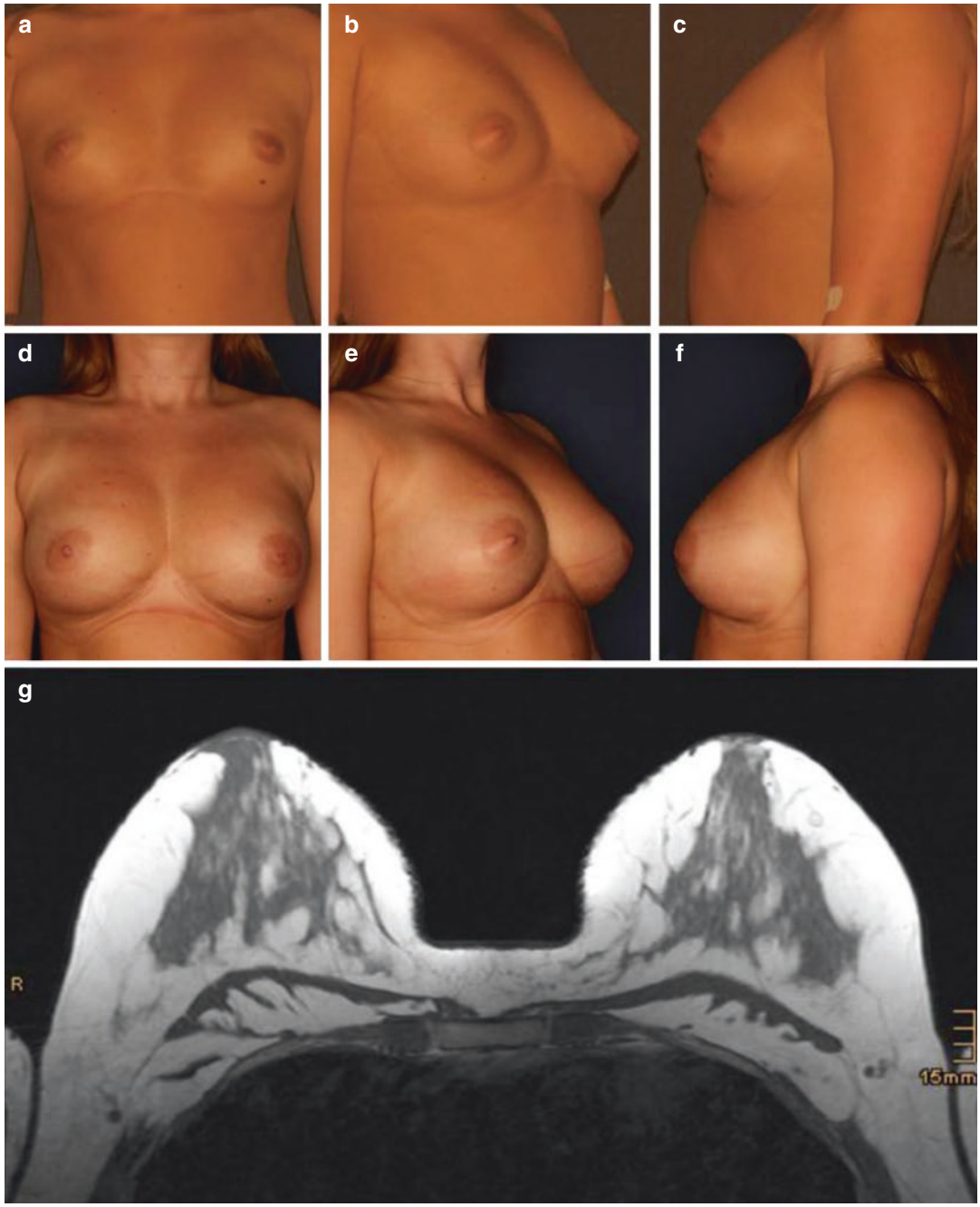

Fig. 6.25 (**a**–**g**) Clinical aspect before (**a**–**c**) and 5 years after treatment two times (**d**–**f**), (**g**) MRI—diagram 5 years postoperatively

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