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ORIGINAL PAPER

Jet-assisted fat transfer to the female breast: preliminary experiences

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Abstract

Background Nowadays, autologous fat grafting is used as a versatile tool for distinct touch-ups after performed breast reconstruction or aesthetic augmentation. Different approaches of fat harvest, filtering, and reinjection have been described in last three decades. After the first report in 2010, the Berlin Autologous Lipotransfer (BEAULI) method became one of the latest popular techniques in the field of large volume fat grafting. Preliminary experiences with the rising jet-assisted fat transfer in a large case series of two specialized European centers are presented.

Methods Retrospective analysis enrolled over 167 female nonsmokers with reconstructive or aesthetic indications treated with at least one procedure according to the standardized protocol of the BEAULITM technique from February 2010 to June 2012. Patients with weight changes >5 kg and endocrine or cardiovascular comorbidities have been excluded. Demographics and items of the treatment (i.e., grafted volumes per procedure) were

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H. E. Schaller · D. L. Hoppe University Department for Hand, Reconstructive and Plastic Surgery, Burn Surgery, BG Trauma Center, Schnarrenbergstrasse 95, 72076 Tübingen, Germany enlisted for evaluation. The first outcome has been estimated based on complications rate, pain report (VAS score), and digital photographs after at least 6 months of follow-up.

Results The included 132 patients (240 breasts) had a mean age of 39.7 years and underwent 487 autologous jet-assisted fat transfer procedures with minor complications (5.35 %) like tiny oil cysts formations or hematoma of the donor site. Low postoperative pain (88.6 % with VAS 1 to 4) has been reported during the first week, and final aesthetic evaluation showed good to excellent results. We observed a higher frequency of procedures, especially in irradiated patients (>3.62) compared to the rest of reconstructive cases (>2.78). The presented data helped us to differentiate the treatment according to the respective indications (reconstructive vs. aesthetic) and to optimize our intern protocol. Conclusions Water-jet-assisted liposuction with consecutive immediate mammary fat injection is a procedure with a short hospitalization and low complication rate. Based on the preliminary results in the use of the BEAULITM technique for breast reconstruction and aesthetic augmentation, the authors presume that it can be safely applied for these specific patient groups. Although further studies including long-term follow-up are certainly required to constantly control and compare the presented method to other autologous fat grafting techniques. Level of Evidence: Level III, therapeutic study.

Keywords Autologous fat grafting \cdot Breast reconstruction \cdot Tissue regeneration \cdot Breast augmentation \cdot Liposuction \cdot Lipofilling \cdot Water-jet

Introduction

Almost 120 years have passed since the first publication of reports on fat grafting [1]. Over the last 30 years, a particular interest has been raised on the use of autologous fat transplantation in the field of breast reconstructive and cosmetic surgery [2–4]. Nowadays, it is used as an established practice to correct a range of soft tissue defects of the breast caused by

disease, trauma, or aging [5–7]. The results, however, mainly depend on the grafting technique used and the experience of the surgeon [8, 9]. Key factors to promoting the attachment of the grafted fat include the diameter of the fat particles injected, the pressure applied while reinjected, and the use of additional supplements [10–13]. Besides contact with the vascular bed, the injection site is crucial for successful engraftment.

The water-jet-assisted liposuction (WAL) is a new surgical technique for the collection of small fat particles, virtually without blood loss, that can be immediately reinjected into the recipient area with or without further surgical procedures [14–16]. The following report describes a large numbered case series in breast surgery using the jet-assisted lipotransfer (J-AFT), also known as the Berlin Autologuos Lipotransfer (BEAULITM) technique [15].

Material and methods

A total of 167 female patients were treated with 592 procedures for either reconstructive or aesthetic indications with a water-jetassisted large volume lipotransfer (>150 ml) over a period of months in two European institutes for plastic surgery (Italy, Germany). Two senior surgeons performed the operations according to the standardized protocol of the BEAULITM method [15, 17]. All patients were treated according to the principles of Helsinki's declaration, explicitly informed about common complications, potential risks, and the experimental character of the method, especially for breast reconstruction. We included patients with soft tissue defects after oncologic breast surgery, mammarial hypotrophy, and asymmetry or tuberous deformity. Exclusion criteria were the following: deficient donor sites (prior liposuction, low BMI<18.0), heavy scaring, unrealistic expectations, heavy weight changes $(\pm 5 \text{ kg})$ in the last 6 months, and smokers. The final evaluation took place after pre- and postoperative standardized digital photo documentation in a follow-up period of at least 6 months (Mirror® Sotfware Version 7.2.10; Canfield Imaging System) and based on pain rate detection with VAS during the first 7 days.

Surgical technique

Preoperative markings were drawn on the donor sites while the patients were standing: abdomen, hips, thighs, and inner knees were the sites chosen by the patients. All patients underwent under analgesic sedation (remifentanil hydrochloride plus propofol) with spontaneous ventilation.

Adipose tissue harvest

The BEAULITM method is characterized by the harvesting of small vital fat cell clusters via WAL. The fat cell clusters are flushed out and aspirated at the same time. Prior to liposuction of



Fig. 1 Silicone tube system of the body-jet $\ensuremath{^{\ensuremath{\mathbb{R}}}}$ liposuction and harvesting machine

the target areas, 100 cc of Klein solution [18] were used for infiltration. The authors advise waiting at least 7 min in order to achieve effective local anesthesia and vasoconstriction before harvest.

A blunt-tip cannula with a diameter of 3.8 mm is connected under sterile conditions to the infiltrator/aspirator pump (bodyjet®, Human Med Inc., Germany/USA) through a single-use silicone tube (Fig. 1). The pump generates a low-pressure, fanshaped water-jet that is released into the subcutaneous tissue. The special shape of the cannula tip deflects the water-jet (Fig. 2). Continuous irrigation and standard aspiration at 0.5 bar is generated by the pump system during the harvesting. Thereby, the water-jet detaches microdroplets of fat, blood, and fibrous structures from the subcutaneous tissue. The aspirated fat particles are continuously transported to the sterile closed collecting system (LipoCollector[™], Human Med Inc., Germany/USA), where they are simultaneously filtered and washed (Fig. 3). Unwanted fibrous structures and liquids are mostly eliminated, while exposure of the fat to oxygen or contaminants is reduced to a minimum. In average, 230 to 500 cc (a mean of 342.5 cc) of fat tissue were harvested in the calibrated basket per session. The fat was subsequently extracted using syringes of 50 ml and decanted for 5-10 min. For immediate reinjection, excess fluid was removed from the base of the syringe and the fat was loaded into smaller



Fig. 2 Harvesting cannula (3.8 mm). Small fat particles are gently removed and collected through the side holes

Fig. 3 Up to 1,000 cc sterile lipoaspirate can be filtrated and collected in the sterile closed system (LipoCollectorTM)



syringes (10 ml, Luer-Lock). No centrifugation was done (Fig. 4).

Results

Fat transfer technique

The preoperative markings of the breast region were reevaluated before fat transplantation. In the case of hypotrophic or tuberous breasts, we positioned the entry incisions (≤ 2 mm) at the side of the breast and the top of the areola. Then the graft is deposited in a fan-shaped pattern in multiple passages using the BEAULITM injection cannula (2.0 mm with wings, Luer-Lock). We strictly avoided injecting the fat into the glandular part. The cannula is rapidly pulled back at each passage to enable good distribution within the tissue and prevent clumping. Two thirds of the total volume is transplanted into the subcutaneous plane. One third is injected under the glandular plane in order to gain projection. However, unrewarded overfill can lead to a high tissue pressure in the recipient area, which can reduce the graft's blood supply. Patients were wrapped in cotton bandaging to keep the breast area warm and to encourage vascular dilatation, without any outer pressure. The quantity of total fat transferred per surgery varied individually between 90 and 370 cc.



Fig. 4 Decanted and extracted fat particles in a 10-cm³ syringe after water-jet-assisted liposuction. They are unprocessed and ready for immediate reinjection

From February 2010 to June 2012, a total of 167 patients were treated by two senior surgeons with WAL in two different European centers. They performed over 487 procedures on the included 132 patients (240 breasts) aged from 19 to 59 years (average of 39.7 years) in the presented case series (Table 1). Eighty-three patients with mammary hypotrophy received a bilateral aesthetic breast augmentation. Tuberous breast deformities were corrected in 11 patients. Furthermore, nine patients with pure volume asymmetries were successfully restored. Moreover, 28 cases were breast reconstructions done subsequently to oncological surgery. The patients were placed under sedation for an average surgery time of 55 min (±14 min). Fat volume grafted differed between the aesthetic and the reconstructive patient groups. For bilateral aesthetic breast augmentations, we transferred in one procedure 150-220 cc (±40 cc) per side. For tuberous deformities or pure volume asymmetries, we injected 80-140 cc (±55 cc) to achieve a balanced breast shape. Soft

 Table 1
 Procedures performed on the included 132 patients aged from 19 to 59 years in the presented case series

Patients demographics	No. (%)	SD
Total patients treated with J-AFT	167	
Included patients	132	
Median age (years)	39.7	±9.3
Median weight (kg)	64.6	±8.2
Median BMI (cm ² /kg)	24.2	±4.4
Included breasts	240 (100)	
Bilateral hypertrophy	166 (69)	
Tuberous breast deformity	22 (9)	
Volume asymmetry	16 (7)	
Unilateral	2	
Bilateral	14	
Post-breast cancer	36 (15)	
Unilateral	10	
Bilateral	26	

tissue defects after breast cancer surgery were corrected with $50-130 \text{ cc} (\pm 20 \text{ cc})$. A lower degree of fat attachment was observed in this group of patients, which often required more than two procedures to achieve a balanced breast contour (>2.78), especially in the case of treatment with radiation (>3.62).

Hospitalization took an average of 2 days, but 67 % of the patients were discharged from the center on the same day of the operation after post-anesthesia recovery. Oral antibiotics were given in all patients for up to 5 days, and anticoagulants were prescribed in 12 high-risk patients after breast surgery. Low postoperative pain (88.6 % with VAS 1 to 4) has been reported during the first week. Postoperative ecchymosis appeared in all of the patients and was resolved after 13 days maximum. As a complication, liponecrotic pseudocysts (0.5-1.2 cm) were found via ultrasound in three patients (2.57 %), but they were all selfregenerated after a follow-up period of 12 months. Severe bruising of the donor site was treated conservatively in two patients (1.51 %). Furthermore, one patient requested additional volume with prosthesis after two lipotransfer sessions. In two irradiated oncologic patients, the treatment was stopped after five procedures because of the graft loss (1.51 %). A sample of fat tissue transplanted into the cosmetic surgery group was taken after 6 months and revealed a complete structural integration of the tissue in the recipient site (Fig. 5). Aesthetic outcome was evaluated good to excellent based on pre- and postoperative photo documentation; a high patient satisfaction was observed, too (Fig. 6). Short hospitalization, less pain, and natural breast contouring were mentioned as main advantages.

Discussion

Nowadays, various autologous fat grafting techniques have been established in the field of breast surgery [19–22]. The



Fig. 5 Sample of mammary subcutaneous adipose tissue 6 months after water-jet-assisted lipotransfer to the breast (Hematoxylin eosin stain, original magnification ×100)



Fig. 6 Forty-year-old patient, mammary hypotrophy, bilateral augmentation with 300 cc per side, evaluated as excellent first outcome after 10 months

procedures are generally easy to learn and may lead after a short training period to good reproducible results. Although, the literature indicates that major complications like infections, oilcysts formation, and donor site defects are basically related to technical errors and poor experience [23–25].

In the past, uniform standards conformable to law (e.g., the German Law on Tissue Transfer and Processing) and to the current state of the art have been elaborated in order to increase the patients safety [26-28]. But until today, several issues like the use of supplements (adipose-derived stem cells (ADSCs), platelet-rich plasma or fibrin, hormones), the pre- and postoperative care (nutrition, weight changes, antibiotics), or the graft's processing (centrifugation, enzymatic digestion) remained unclear [22, 29–33]. The described BEAULI[™] technique comprises standardized protocols for either aesthetic or reconstructive breast surgery patients [15]. Since 2010, they have been updated frequently after systematic clinical evaluation [34-37]. However, a rising request has been observed in the last 3 years, and nowadays, the method is used in many European institutions [35]. This case series of 132 patients emphasized the importance of standardized equipment and algorithms, which helped to guarantee a short operation time (55 ± 14 min) and a low complication rate (<5.30 %), leading to good to excellent results.

The fat's harvest is carried out in a sterile closed system with a low suction force, avoiding overly mechanical trauma or thermal damage [38]. A uniform quality of the graft is reached by the use of a 0.9-mm harvest cannula (Fig. 1), even though the aspiration pressure does not seem to affect the graft's viability compared to high shear stress by reinjection [10]. The WAL system uses nearly 70 % less tumescent fluid than other liposuction systems [39]. In this way, local swelling and bloating are minimized, preserving the contours of the target area throughout the whole procedure. With the LipoCollector[™] system, neither centrifugation nor additional washing are required, which may lead to longer processing and operation time [6, 13]. But further studies to confirm a higher proportion of ADSCs and cell

Fig. 7 MRI of the breast pre- and post-1 year shows the fat intake



viability compared to other sterile closed filtering systems are necessary.

In the presented patient groups, aesthetic vs. reconstructive, our results suggest a higher need of transferred fat due to irradiation damage [40, 41]. On average, the recently reported regenerative effect of the transferred ADSCs on the scar tissue has been documented after the first three sessions [42-44]. We easily combined the BEAULITM technique with other surgical procedures (e.g., expander, breast implants) for reconstructive purposes [45]. Due to the missing long-term results, all reconstructive patients signed up for the experimental use of lipotransfer in breast reconstructive surgery [46, 47]. In the aesthetic patient group, an increase of 1.5 cup size was remarked as insufficient by one patient. Further augmentation had to be carried out with breast implants. Detailed information about the options, oncologic risks, and limits of lipotransfer should be explained openly to the patient [48]. It is important to determine the patient's expectations in the first consultation in order to prevent both parts-surgeon and patient-from unpleasant consequences. Our follow-up protocol consists of frequent clinical and radiological (e.g., mammography, ultrasound) examinations on a regular basis [49, 50]. We also used MRI for either potential tumor detection or postoperative breast volumetry [51, 52] (Fig. 7). Recent quantitative measurements with serial MRIs for fat's volume survival and prediction have taken place, high fat intake [17, 53, 54]. Of course, further research on various autologous fat grafting techniques for different indications and long-term aspects is certainly required to maintain high patient's safety.

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Conflict of interest None.

Ethical standards This study has been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments. An institutional review board was not required as all reported devices were cleared for marketing by the FDA. All persons gave their informed consent prior to their inclusion in this study.

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