ROYAL BELGIAN SOCIETY FOR PLASTIC SURGERY

Breast Surgery

A Novel Approach for Tuberous Breast Correction Using Power-Assisted Liposuction, Loops, and Lipofilling (PALLL)

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Abstract

Background: Autologous fat grafting has recently gained popularity in breast and reconstructive procedures.

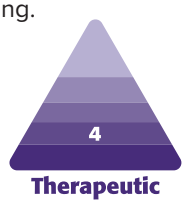
Objectives: The aim of this paper was to describe a tricomposite tuberous breast reconstruction that comprises matrix dissociation through extensive tunnelization, tissue recruitment with loops, and autologous fat transfer. This approach, called "matrix modeling," was implemented by the power-assisted liposuction, loops, and lipofilling (PALLL) technique as a method to expand the lower pole, reshape the breast, and increase breast volume.

Methods: Between 2014 and 2020, a total of 47 patients underwent tuberous breast correction by combined lipofilling and the use of breast loops. The patient population included patients with unilateral or bilateral tuberous breasts of any stage. Patients who were active smokers, lean, or who desired large breasts were excluded from the study.

Results: Of the 47 patients (mean age, 26 years), 31 had bilateral malformations. The mean recruited flap volume was 212 mL. A single session (mean transfer volume, 163 mL) was required in 34 cases (72%). A second session (mean transfer volume, 182 mL) was necessary in the remaining 28% of cases. Patients were very satisfied in 93% of cases and satisfied in 7% of cases. One infection was observed. The mean operative time was 67 minutes. Imaging performed preoperatively and 1 year postoperatively did not reveal any anomalies other than oil cysts (4%).

Conclusions: Tricomposite breast reconstruction by PALLL is a novel, simple, safe, and alternative technique for tuberous breast correction by remodeling the matrix. The aesthetic outcome is natural, implant free, and long lasting.

Level of Evidence: 4



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Tubular breast deformity is a congenital malformation that mainly occurs in young female patients,[1-3] and involves areolar herniation, breast ptosis, malposition of the inframammary fold (IMF) superiorly, lack of skin in the lower pole of the breast, constriction of the breast base, and reduced breast parenchyma. Since tuberous breast deformity was first described in 1976 by Ress and Aston,[4] many classifications have been established to evaluate the severity of each characteristic and treat the breast deformity accordingly.[5-9]

Several modalities of treatment have been proposed for tuberous breasts, including mammaplasty, breast implants, loco-regional flaps, or lipofilling.[4,8-17] Recently, fat grafting to treat tuberous breasts has become popular because it provides an autologous reconstruction with long-lasting

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Table 1. Algorithm for Tuberous Breast Deformity Correction With Power-assisted Liposuction, Loops, and Lipofilling

Deformity	Correction
Insufficient skin envelope/ base constriction/elevation of the inframammary fold	Incisionless advancement of a crescent from the breast surroundings, footprint loop + inframammary fold loop
Enlargement of the areola	Periareolar loop
Herniation	Liposuction behind the areola + crisscross retroareolar loop
Ptosis	If remains after footprint loop → parachute loop
Volume defect	Advanced crescent + lipofilling

results. However, due to the constricted nature of tuberous breasts and the limited amount of fat that can be injected per session, multiple sessions of fat grafting are often needed, and adipose storage can be a limiting factor.[17-22] Moreover, reshaping the breast, and correcting and defining the new IMF and breast footprint remain a major challenge in treating this deformity.

To achieve tuberous breast reconstruction with fat grafting alone, some authors have adopted a scarless advanced upper abdominal flap recruited into the breast and fixated it with internal threads and then added lipofilling. Others have opted for expansion with the BRAVA system or have combined lipofilling with percutaneous fasciotomies to improve recipient site capacity and breast shape.[19-21]

For the same purpose of achieving a minimally invasive autologous tuberous breast reconstruction and reshaping, we present our technique for remodeling the breast matrix based on power-assisted liposuction, loops, and lipofilling (PALLL). This method is a combination of our published techniques for scarless breast reduction and breast reconstruction.[23-25] For tuberous breasts, we recruit an adipocutaneous advancement flap from breast surroundings that we fixate with loops to reconstruct the breast footprint and the IMF. We treat areolar herniation and enlargement with liposuction and internal loops, and we further increase the breast volume with lipofilling. Moreover, we propose an algorithm that offers a tailored treatment for each deformity associated with tuberous breasts (Table 1).

METHODS

Patients and Study Design

In this study, we included patients operated on with unilateral and bilateral tuberous breasts with a small to a moderate breast size who desired a primary breast reconstruction and presented sufficient amounts of fat at donor sites with skin laxity at the upper abdomen and lateral thorax. We also selected patients who desired to avoid visible scars as well as those who refused to have breast implants. All patients operated previously with any technique for tuberous breast correction were excluded from the study, as were patients who desired large breasts, lean patients, and patients with unbalanced diabetes. Patients who presented with enlarged areola that needed reduction to half the size of the original and required skin excision were also excluded from the study.

A total of 47 patients (78 breasts) met our inclusion criteria and were enrolled in a prospective study from January 2014 to January 2020. All 47 procedures were performed by the senior author (M.A.). Sixteen patients had unilateral deformities, 31 patients had bilateral deformities, and all patients were female. We classified the different types of tuberous breasts following Grolleau's classification regrouping 3 degrees of deformations.[6] The 78 breasts consisted of 20 Type I deformities, 31 Type II deformities, and 27 Type III deformities (Table 2). Smokers were asked to stop smoking for 1 month before and after the procedure.

All of the 47 patients provided written consent forms and were given information regarding the surgical procedure and the benefits and risks of other surgical options. We informed all of our patients that wrinkling of the breast would occur in the early postoperative period and that edema would resolve in 6 months.

A preoperative clinical breast examination was performed for all patients. Photographs were taken preoperatively and postoperatively in the frontal, three-quarter, and lateral views on both sides with the arms in the resting position and elevated. The study adhered to the principles of the Declaration of Helsinki. We did not obtain an approval from an IRB or ethics committee because all patients underwent surgical procedures in a private practice.

Data Collection and Analysis

Demographic information about the patients, including age, gender, BMI, smoking status, and comorbidities such as hypertension, obesity, diabetes, coronary artery disease, and breast cancer, was recorded preoperatively. Perioperative data were documented, including the amount of fat grafted per breast, volume of recruited perimammary tissues, and procedure time. Complications of the breast including seroma, infection, thread extrusion, hematoma, wound dehiscence, skin necrosis (including areolar necrosis), pneumothorax, and thromboembolic events were studied. Local fat necrosis characterized by oil cysts or painful masses, as well as diffuse fat necrosis expressed through a painful breast, were analyzed. Pain was evaluated at 48 hours utilizing a visual analog scale. The data were classified in 3 groups according to Grolleau's breast deformity types. In order to measure their physical and psychological well-being, as well as

Table 2. Patient Demographics and Operative Data (N = 47 Patients)

	Deformity type (Grolleau)		
	I	II	III
Number of patients	12	20	15
Number of breasts	20	31	27
Mean age, years (range)	24 (19-34)	26 (19-42)	21 (19-32)
Mean BMI, kg/m^2 (range)	22 (19-26)	23 (18-25)	24 (20-27)
Number of smokers (%)	2 (4)	5 (10)	2 (4)
Mean volume of the crescent, mL (range)	180 (100-230)	200 (125-250)	240 (150-325)
Number of lipofilling sessions per breast (%)			
1 session	20 (100)	24 (76)	9 (32)
2 sessions	0	7(24)	18 (68)
Volume of fat injected per session, mL (range)			
First session	159 (80-170)	166 (80-190)	163 (80-220)
Second session		179 (70-190)	183 (60-200)
Loop used, number of patients (%)			
Footprint loop	12 (100)	20 (100)	15 (100)
Inframammary fold loop	12 (100)	20 (100)	15 (100)
Periareolar loop	1 (8)	4 (20)	12 (80)
Average operative time, minutes (range)	60 (45-81)	66 (43-80)	74 (42-83)
Follow-up, months (range)	52 (36-60)	48 (24-52)	47 (22-54)

their satisfaction with the surgical outcome, the patients received a paper questionnaire preoperatively and 6 months postoperatively. The questionnaire was given by our nurse and was anonymous.

An ultrasound with or without a mammography, depending on the age and medical history, was performed preoperatively for all patients. A second ultrasound was performed at 12 months postoperatively.

Preoperative Markings

Preoperative markings are drawn with the patient in a standing position. The midline, the horizontal interaxillary line, the anterior axillary line, and the IMF are marked. The breast is considered as a pie and separated into 8 zones (Figure 1A). Measurements of the breast's vertical and horizontal dimensions are taken and must be equal (Figure 1B).

Footprint Loop

The loops' design is marked. The first loop, the footprint loop, is marked in a circular pattern to mirror the contralateral breast's skin surface. The inner limit of the footprint is 1 cm laterally from the midline, and the distance between the nipple and this point is referred to as "x." The footprint loop then extends "x + 2" cm superiorly from the nipple, and "x – 1" cm inferiorly, following the breast footprint, so that the nipple will be at a 45:55 ratio on the breast (Figure 1A). Following an extensive subcutaneous tunnelization (Figure 2 and Supplemental Figure 3A, available online at www.aestheticsurgeryjournal.com), this loop will recruit adipocutaneous tissues from the upper abdomen and lateral thorax into the breast, increasing the breast volume and projection; as well as redefining the new breast footprint and IMF (Figure 3 and Supplemental Figure 3B,C).

IMF Loop

The path of the second loop is drawn in a triangular pattern, reaching superiorly the midpoint of the interaxillary line and inferiorly the new IMF (Figure 4 and Supplemental Figure 3D,E). This loop will better define the planned IMF.

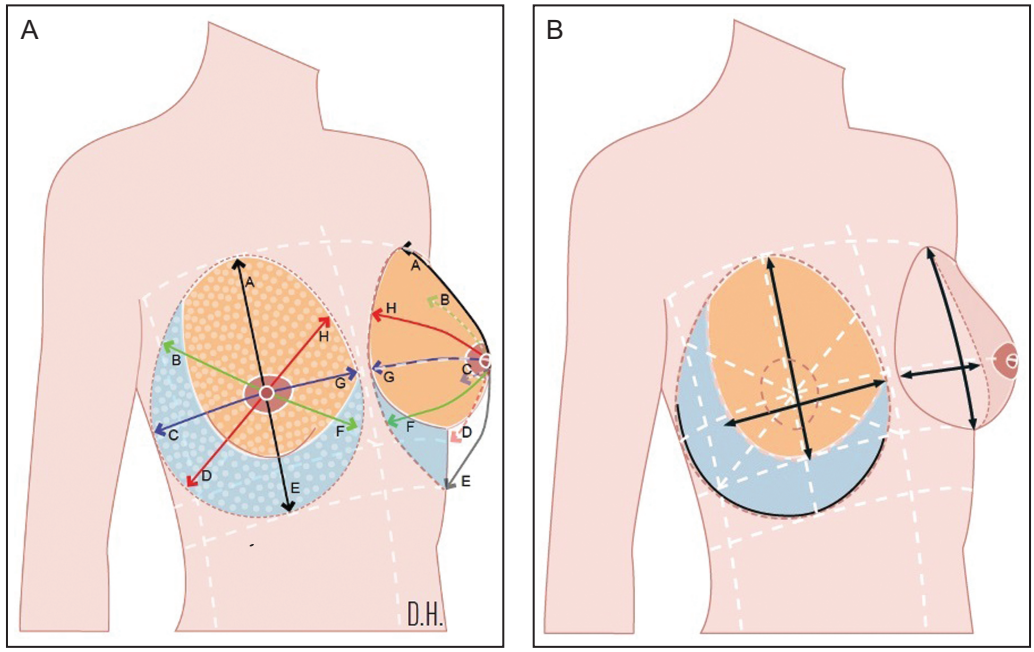


Figure 1. (A) The midline, anterior axillary line, interaxillary horizontal line, and inframammary fold are all marked first. A dotted line is used to draw the new footprint in a circular pattern. The breast is divided by 8 axes (axes A-H). A ninth and tenth zone, representing the areola and nipple, can also be depicted. The G axis represents the distance "x" between the nipple and a point located 1 cm laterally to the midline. This is the inner limit of the new footprint. The C axis measures "x + 2 cm," while the E axis measures "x – 1 cm," representing respectively the external and inferior limits of the new footprint. These landmarks are necessary for marking the footprint loop. The yellow crescent in the upper abdomen and lateral thorax represents the native breast; the blue crescent in the upper abdomen and lateral thorax represents the adipocutaneous flap that will be recruited further. (B) Both breasts must have the same vertical and horizontal proportions.

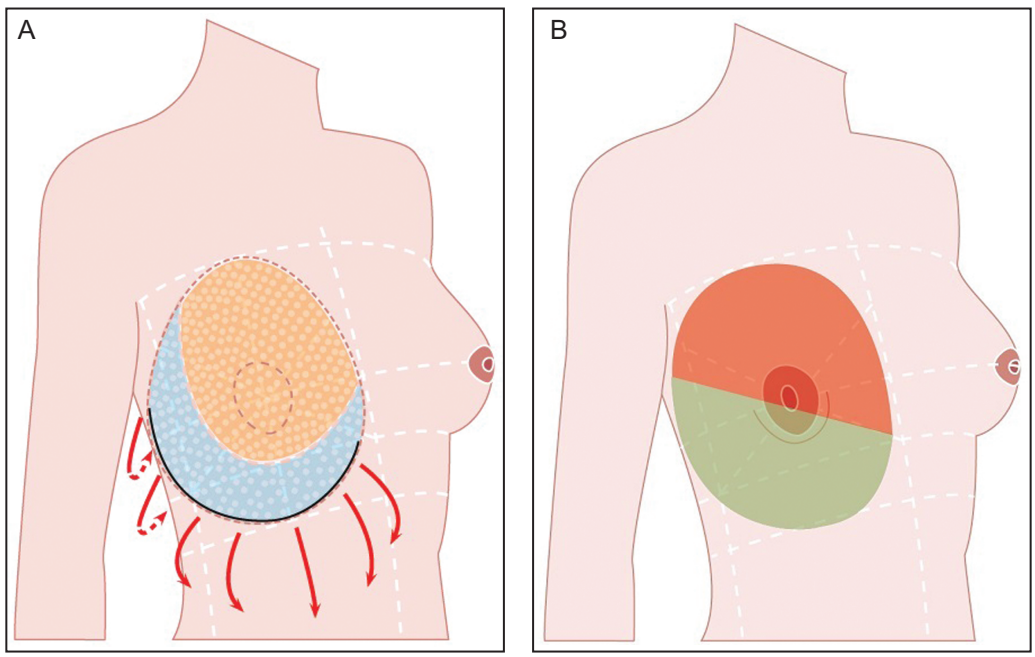


Figure 2. Three-quarter profile views. Tunnelizing the matrix from the deep and superficial planes, as well as expanding the matrix itself, are key steps of this procedure. (A) Tunnelization (shown with the red arrows) is performed in the upper abdomen, lateral thoracic area, and breast. (B) This procedure is carried out in a superficial plane in the lower quadrants of the breast (light green) and in a deep plane in the upper quadrants (light red). Liberation of the matrix's attachments to the pectoralis fascia by deep undermining is accomplished with a Molt elevator, facilitating the future recruitment of the flap.

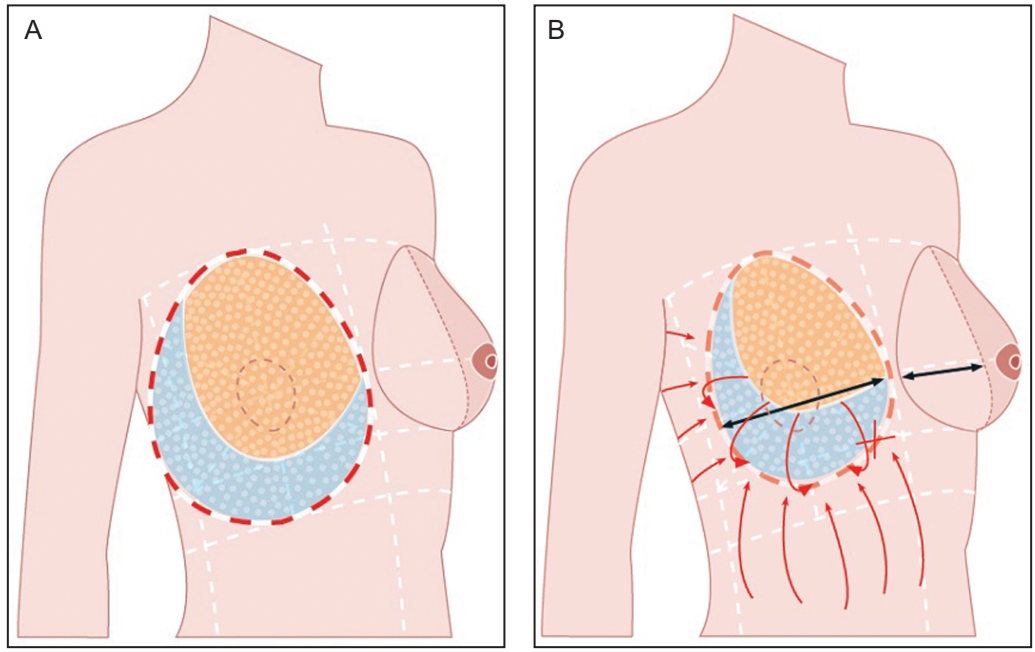


Figure 3. Three-quarter profile views. (A) The footprint loop is depicted as a series of red dotted lines. (B) To attain the same horizontal size of the breast footprint as the contralateral breast, the loop is marked in a circular pattern. The tightening of the loop's knot is depicted in this figure (red cross). The footprint loop will recruit skin and fat from the upper abdomen and lateral thorax toward the breast (red arrows) in a centripetal pattern along the breast axis. This increases the fat injection matrix and breast projection, but also determines the horizontal dimension of the breast footprint, as well as the lateral and inframammary folds.

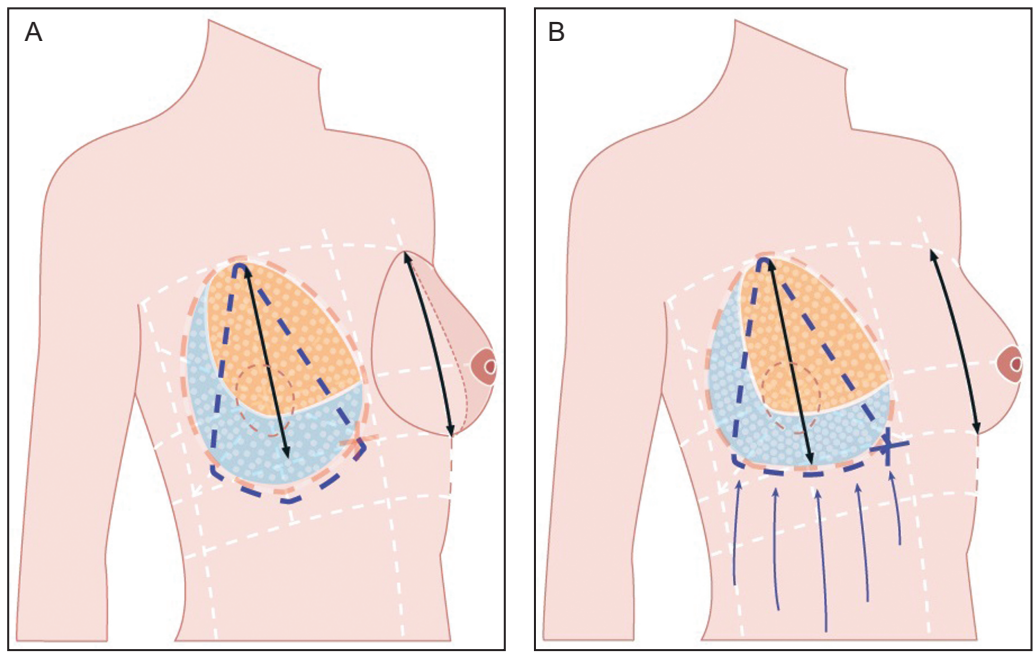


Figure 4. Three-quarter profile views. An IMF loop is designed in cases of IMF malposition. (A) This loop is drawn in a triangle design with the apex being the midpoint of the interaxillary axis, as indicated by blue dotted lines. It determines the vertical dimension of the breast footprint. (B) The tightening of the loop's knot is depicted (blue cross). The IMF loop will better define the IMF, suspend it along the breast axis for symmetry, recruit tissue from the upper abdomen, and augment the projection of the breast (blue arrows). IMF, inframammary fold.

Periareolar Loop

A third loop can be drawn in cases of areolar herniation or enlargement. It is marked along the areolar circumference, crossing the areola from 6 to 12 o'clock as well as 6 to 9 o'clock, 9 to 3 o'clock, and 3 to 6 o'clock (Figure 5). Preoperative markings are shown in the Video, available online at www.aestheticsurgeryjournal.com.

Surgical Technique

The patient is operated under general anesthesia and in a supine position with the arms abducted. An intravenous administration of 2 g of cefazolin is performed 30 minutes prior to the intervention. The procedure starts with the infiltration of the breast, upper abdomen, and lateral thorax with a solution composed of epinephrine 1:100,000 per liter of normal saline and 5 mL of tranexamic acid 0.5 g/5 mL, utilizing a power-assisted liposuction system (Lipomatic, Eva SP, EUROMI SA, Verviers, Belgium) linked to a 3-mm multihole blunt cannula.[26]

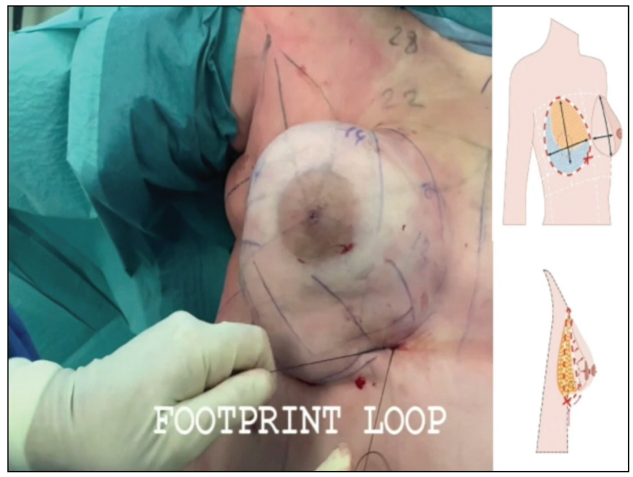
This is a key step for hydrodissection, liberation of the fibrotic tissue bands, and to obtain an internal expansion of the recipient site. An extensive multidirectional tunnelization is performed with the cannula detached from the suction system in a superficial plane between the skin and matrix as well as in a deep plane between the matrix and the fascia (Figure 2 and Supplemental Figure 3A).

This step will reduce the breast's fibrous tensile force and prepare the breast matrix for fat intake. Utilizing an osteotome, detachment of the deep attachments between the matrix and pectoralis fascia is performed along the initial and new IMF in the breast's lower pole until reaching the lateral pole. This will liberate the deep fibrotic tissue bands, "opening the breast as an umbrella," and enabling a redefinition of the new IMF to a lower position.

Infiltration and tunnelization of the perimammary tissues from the upper abdomen and lateral thorax are performed to detach the subcutaneous attachments and enable the recruitment of an adipocutaneous flap to the lateral and lower breast quadrants through the use of loops. These steps will generate two gliding planes: superficially between the skin and subcutaneous tissues, and deeper between the subcutaneous tissues and the fascia.

Power-assisted liposuction with a 3-mm multihole canula is then carried out in the upper abdomen and lateral thorax beyond the loop markings. This will enhance the release of the subcutaneous fibrous attachments, expand the tissue to be advanced, and facilitate its mobilization. Fat is collected in a closed system, decanted, and transferred into 60-mL syringes. Fat preparation is performed by a 2-team approach to reduce the operative time.

The next step consists of the recruitment of an adipocutaneous flap from the perimammary tissues into the breast. Nonabsorbable threads (reel of Filapeau 2, 250 cm, Péters Surgical, Bobigny, France) are passed transcutaneously through skin stab incisions by means of a 3-mm 3-hole blunt cannula. The first loop, known as the "footprint loop,"[23-25] spans the deep subcutaneous tissues above the fascia in the upper quadrants of the breasts, where its path becomes more superficial in the breast's lower quadrants. The threads are passed twice to reduce the tension on the knot. This loop aims to define and augment the breast footprint as well as to increase the breast projection (Figure 3 and Supplemental Figure 3B,C).



Video. Watch now at http://academic.oup.com/asj/article-lookup/doi/10.1093/asj/sjac044.

The second loop, known as the "IMF loop,"[23-25] spans the superficial subcutaneous tissues along where the IMF will be positioned and superiorly in a suprafascial plane until reaching the midpoint of the interaxillary axis. Here, again, the loops are passed twice. This loop is designed to better define the new position of the IMF more inferiorly (Figure 4 and Supplemental Figure 3D,E).

In cases of areolar herniation or enlargement, mild liposuction is performed at the level of the nipple-areola complex (NAC) to reduce its protrusion. Moreover, utilizing an absorbable barbed suture (number 0 V-Loc 60, Covidien, Mansfield, MA), a third loop can be passed to help correct this deformity. This thread is passed transcutaneously along the areolar circumference, crossing the areola from 6 to 12 o'clock, 12 to 9 o'clock, 9 to 3 o'clock, and 3 to 6 o'clock. The thread is then buried in a deep plane (Figure 5).

Fat can then be grafted into the breast utilizing the PALLL technique,[27-31] especially in the lower quadrants where the defect usually occurs (Figure 6). Through the recruitment of an adipocutaneous advancement flap, the breast matrix is enlarged, and the skin tension is reduced allowing higher volumes of fat to be injected. The different surgical steps are shown in the online Video.

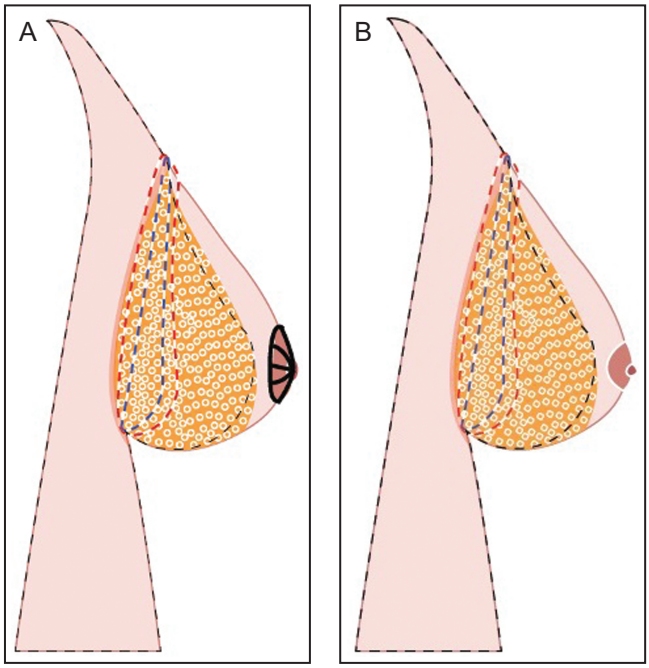


Figure 5. Profile views. Mild liposuction is used to decrease the protrusion of the nipple-areola complex in cases of areolar herniation or hypertrophy. (A, B) A third loop may also be passed with an absorbable barbed suture (number 0 V-Loc 60, Covidien, Mansfield, MA) to assist with rectifying this deformity. This thread is carried transcutaneously around the circle of the areola, crossing it at 6 o'clock, 12 o'clock, 9 o'clock, and 3 o'clock. After that, the thread is buried in a deep plane.

Postoperative Care

The patients left the hospital on the day of the procedure. They were asked to wear a loose sports bra for 8 weeks and to avoid excessive abduction of the shoulder for 4 weeks. A follow-up breast ultrasound was performed 1 year postoperatively.

Measurement of the Perimammary Tissues to Be Recruited

As described in our previous work,[24,25] the volume of the adipocutaneous advancement flap can be measured clinically and radiologically. Clinically, the area of recruited skin is represented by the crescent-shaped flap indicated by the red markings in Figure 2. This area is separated into 3 parts (1 medially, 1 centrally, and 1 laterally), each of which is measured. Radiologically, the thickness of the upper abdomen (below the IMF) and lateral thorax (lateral to the breast) are measured by ultrasound. These data are introduced into a computerized system, AutoCAD (Autodesk, San Rafael, CA), to calculate an average volume.

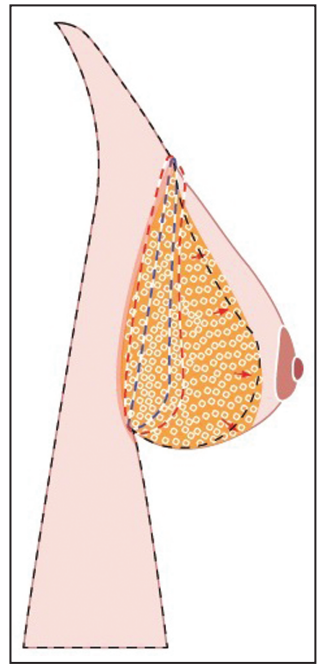


Figure 6. The remaining breast matrix, as well as the advanced adipocutaneous flap from the upper abdomen and lateral thorax, are subsequently injected with fat. Lipofilling is done superficially, above the muscle, in a multidirectional multiplanar fashion. The crescent advanced from the breast environs, the remaining breast volume, and the injected fat make up the ultimate breast volume. Both breasts should have symmetric horizontal and vertical proportions.

RESULTS

Demographic and Preoperative Data

The tuberous breasts of 47 consecutive female patients (78 breasts) were operated on by the PALLL technique. These patients had an age average of 24 years (range, 19-42 years) and a mean BMI of 23 kg/m^2 (range, 18-27 kg/m^2); 9 were former smokers (19%). The average crescent volume was 212 mL (range, 100-325 mL), with higher volumes recruited for advanced deformities. A single session of lipofilling was required for 34 patients (72%) with a mean injected volume of 163 mL (range, 80-220 mL) for the first session, whereas 13 patients (28%) received 2 sessions of lipofilling with an average injected volume of 182 mL (range, 60-200 mL) overall. The average operative time was 67 minutes (range, 42-83 minutes) from incision to wound closure (Table 2). The footprint and IMF loops were used for all cases, whereas the periareolar loop was mostly performed in severe cases with areolar herniation (80% of patients suffering from Grolleau's Type III deformity).

Complications

None of the patients presented major complications, including areolar necrosis, hematomas, seromas, thread

Table 3. Complications

	Deformity type (Grolleau)		
	I	II	III
Infection (%)	0	1 (2)	0
Oil cyst (%)	1 (2)	0	1 (2)
Areolar necrosis	0	0	0
Hematoma	0	0	0
Seroma	0	0	0
Thread extrusion	0	0	0
Pneumothorax	0	0	0
Thromboembolic event	0	0	0
Pain (visual analog scale)	2/10	3.1/10	4.3/10

extrusions, pneumothorax, or thromboembolic events. One diabetic and former smoker patient (2%) suffered from a local breast infection treated by antibiotics. Two patients presented with oil cysts (4%); 1 required an aspiration. Postoperative pain at 48 hours was evaluated on a visual analog scale and showed a mean of 3.2/10 overall. The patients experienced mild discomfort due to the threads, especially limiting the abduction of the shoulder for 3 weeks. The pain was managed by first-line analgesics (Table 3).

Complementary Sessions

Thirteen patients (28%) who presented with severe hypoplasia required a second session of PALLL to add more volume to the breast. None of the patients had revisional surgeries to correct an areolar enlargement or protrusion, or IMF malposition.

Patient Satisfaction

Forty-four patients (94%) answered the survey preoperatively and 6 months postoperatively. Of those patients, 41 (93%) reported being very satisfied and the remaining 7% were satisfied, with improved outcomes for breast scars, sensitivity, clothed appearance, cleavage, size, position, and form. Unclothed appearance was not improved or worsened. General well-being, comfort during intimacy and physical activity, self-esteem, and body image clothed and unclothed were improved. Clinical cases of patients who underwent this procedure are shown in Figures 7 to 9 and Supplemental Figures 1 and 2, available online at www.aestheticsurgeryjournal.com.

DISCUSSION

Initially popularized by Coleman, fat grafting is now a valuable tool in soft tissue augmentation and particularly in breast surgeries. Although fat grafting provides a natural and autologous breast augmentation and yields higher satisfaction rates in patients with tuberous breasts, it requires multiple sessions to achieve the desired result. The presence of fibrous tissue in tuberous breasts makes fat grafting more difficult to perform. Khouri and Del Vecchio emphasized the effect of recipient site preparation on the success of the fat grafting procedure, the number of the fat grafting sessions, and the fat graft retention.[21] They described the use of the BRAVA system (Brava, LLC, Coconut Grove, FL) for this purpose; however, an enlargement of the areola and an aggravation of glandular herniation through the areola is a significant limitation in cases of tuberous breasts. Later, Khouri and Khouri described "reverse abdominoplasty and fat transfer," which recruits an epigastric crescent into the breast and utilizes a purse-string suture to define the fold and "mushroom out" the breast.[21] They applied this technique for breast reconstruction after mastectomy and in tuberous breasts. Delay and Rigotti described percutaneous fasciotomies to create a 3-dimensional (3D) mesh, expand the constricted breast tissue, improve the recipient site capacity, and enhance fat grafting acceptance.[18,32]

As an extension of our scarless techniques in breast reduction and breast reconstruction, we developed a tricomposite tuberous breast reconstruction involving matrix dissociation through extensive tunnelization, tissue recruitment with loops, and autologous fat transfer. We propose here a targeted surgical approach depending on the type of deformity. In our philosophy the term "scarless" means no visible scarring, referring to scars measuring less than 1 cm, as has been shown in our previous published articles.[23-25]

Our technique described here adheres to the principles of PALLL already described in breast reduction, breast reconstruction, autologous breast augmentation after implant exchange, and liposculpture. The keystone of this technique is matrix remodeling, which starts with matrix dissociation through wide and extensive tunnelization and selective lipoaspiration, then combines loops to recruit skin and fat from the breast's surroundings to ensure reshaping of the matrix, and finally adds fat grafting to increase volume and reconstruct the defect.

In the particular case of the tuberous breast, our technique targets the different anomalies associated with this congenital malformation: the constricted lower pole, the highly mispositioned IMF, the wide areola, the gland herniation through the areola, and the breast ptosis (Table 1). When compared to other techniques based on implants or flaps,

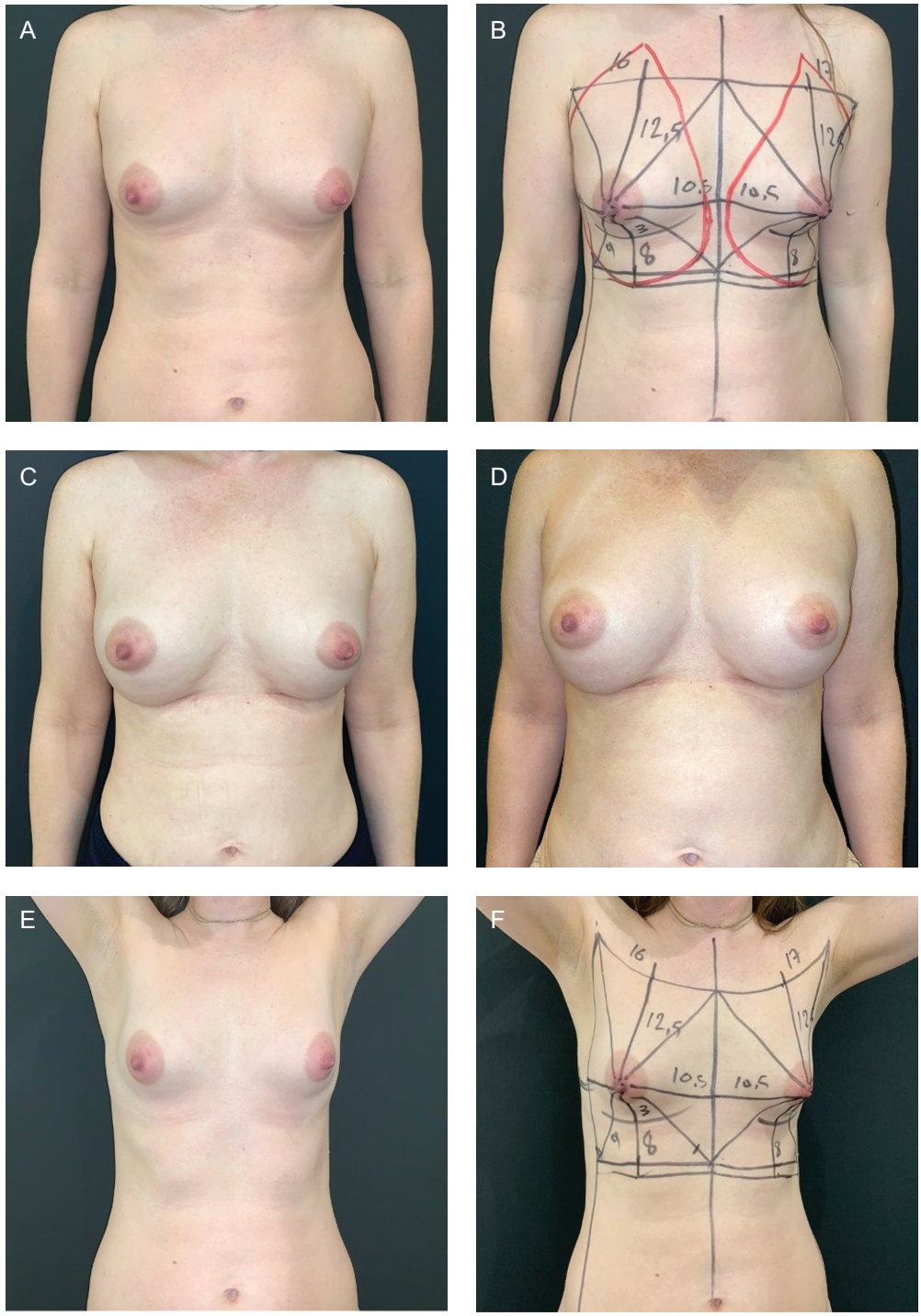


Figure 7. A 22-year-old female patient with bilateral Type II tuberous breasts. She underwent power-assisted liposuction, loops, and lipofilling, with a recruited volume of 150 mL on the right breast and 155 mL on the left breast. The volume of fat injected was 180 mL on the left side and 240 mL on the right side. Frontal view with arms in resting position (A, B, C, D), frontal view with arms elevated (E, F, G, H), three-quarter profile (I, J, K, L) and lateral views with arms in resting position (M, N, O, P). Photographs were taken preoperatively without (A, E, I, M) and with markings (B, F, J, N), and 3 years (C, G, K, O) and 4 years (D, H, L, P) postoperatively.

we recommend this technique for patients with small to moderate breast size seeking autologous tuberous breast correction with minimal scars. Contraindications for this technique are patients who desire augmentation of more than 2 cup sizes, who are lean, and who do not have enough fat to harvest or enough skin laxity in the upper abdomen.

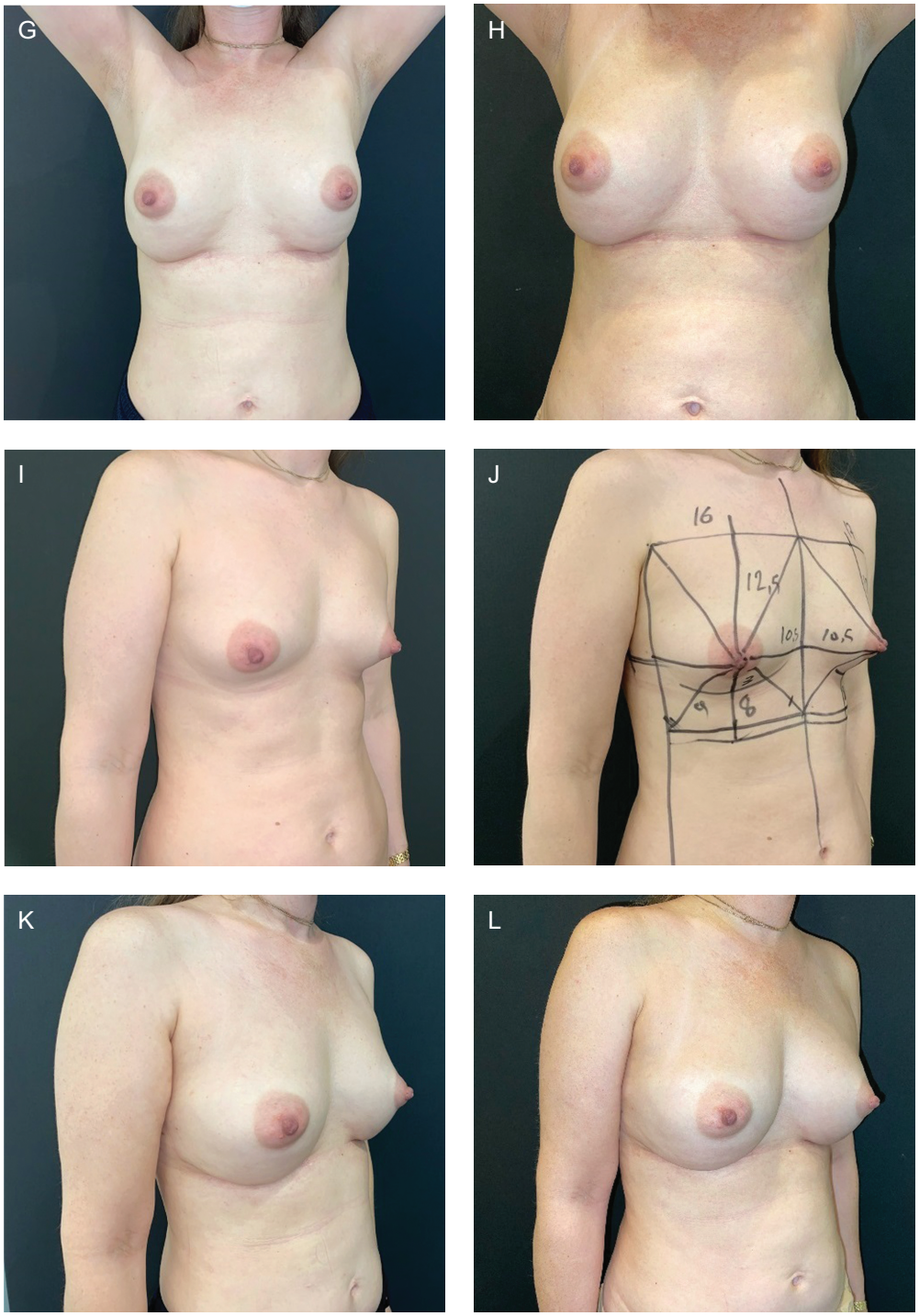


Figure 7. Continued.

As in breast reconstruction, we aim to achieve symmetry of the skin surface, the breast footprint, the IMF position, and the breast volume. Hence, preoperative markings are essential to design the loops, to define the amount of tissue needed to be recruited from the upper abdomen and the lateral thorax, and to indicate where to position the new IMF.

Our concept described here is based first and foremost on matrix dissociation achieved through infiltration, tunnelization, and lipoaspiration performed between the skin and the matrix, to the matrix itself, and between the matrix itself and the underlying muscular fascia. This is the key step to releasing the fibrous bands and the constricting ring that alters the breast base, a major

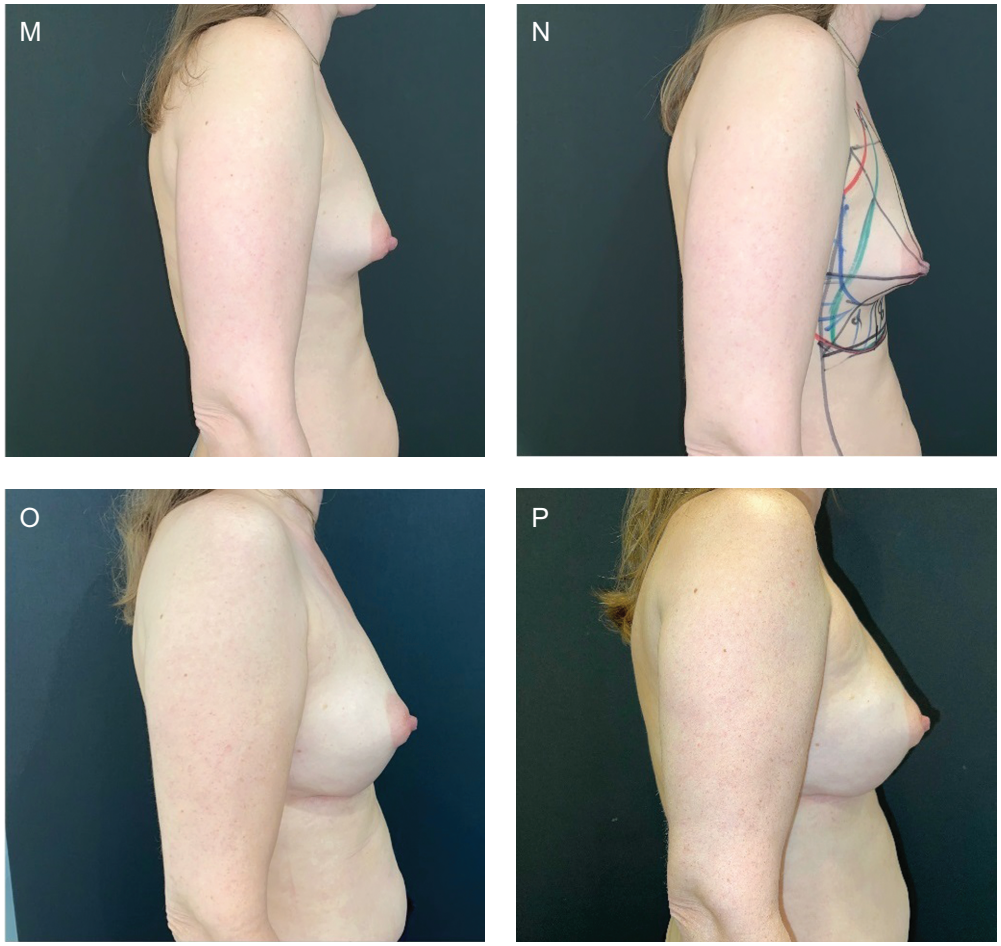


Figure 7. Continued.

component in tuberous breast physiopathology. Moreover, dissociating the breast tissue from the superficial subcutaneous plane and the deep muscular plane will reduce the tensile force, create a gliding effect between the different planes, and allow an easier modeling of tissues. After matrix dissociation, the loops will provide matrix reshaping. Many authors have reported the use of loops in the breast. Khouri and Khouri described a purse-string suture to recruit the epigastric crescent into the breast, define the fold, and "mushroom out" the breast.[21] Hamdi et al described the use of a percutaneous purse-string suture that starts laterally and ends medially over the breast footprint to define the IMF.[33] A similar technique has been described by Visconti and Salgarello, who utilized a dual-anchor barbed cog thread to better define the IMF in breast augmentation.[34] Furthermore, Serdev and Sulamanidze et al have described their technique for scarless breast mastopexy.[35,36]

We have recently published our technique in breast reduction, breast reconstruction, and breast augmentation after implant exchange utilizing liposuction, loops, and lipofilling. The primary objective of the loop is to obtain the same skin surface of the contralateral breast, and therefore, the footprint loop is designed to achieve this aim. It defines the breast footprint, the lateral fold, and the IMF, and it allows an incisionless flap advancement from the upper abdomen and the lateral thorax toward the breast in a centripetal pattern along the breast axis. It also increases the matrix for fat injection, reduces skin tension, and increases breast projection. The footprint loop reconstructs the constricted lower pole by advancing a skin flap from the upper abdomen in a centripetal pattern toward the breast, defining the position of the new IMF. By expanding the lower pole, it elevates, projects, and repositions the NAC.

After achieving the same skin surface, the same footprint, and the same IMF, we treat the herniation of breast tissue in the NAC. After extensive tunnelization releasing the adhering fibers, and superficial lipoaspiration behind the NAC complex, loops are placed around the areola to reduce its size and then in a crisscross fashion forming an internal mesh preventing areolar herniation. The tunnelization we apply in this technique by means of

Figure 8. An 18-year-old female patient with bilateral Type III tuberous breasts. She underwent power-assisted liposuction, loops, and lipofilling, with a recruited volume of 185 mL on the right breast and 150 mL on the left breast. The volume of fat injected was 160 mL on the left side and 220 mL on the right side. Frontal view with arms in resting position (A, B, C), frontal view with arms elevated (D, E, F), three-quarter profile (G, H, I) and lateral views with arms in resting position (J, K, L). Photographs were taken preoperatively without (A, D, G, J) and with markings (B, E, H, K) and 2 years postoperatively (C, F, I, L).

blunt cannulas releases the superficial and deep attachments. We believe it is less traumatic than fasciotomies performed with sharp needles. Tunnelization can be performed alone without creating a periareolar loop if the areola is not enlarged and if the herniation is very mild.

Figure 8. Continued.

A complementary lipoaspiration behind the NAC can be performed to ensure flattening of the areola. This step will reduce the excess volume localized behind the areola. Releasing the fibrotic ring requires extensive tunnelization through the whole breast and in all the planes: the skin, the gland and the deep plane. This principle, called "matrix modeling," which we have applied in other types of breast surgeries, will make the breast looser and the remodeling easier.[23-25]

If NAC ptosis remains, a suspension of the NAC along the breast axis is performed as described in our technique for scarless breast reduction. However, achieving a perfect

Figure 9. A 19-year-old female patient with Type III right tuberous breast. She underwent power-assisted liposuction, loops, and lipofilling, with a recruited volume of 100 mL on the right breast and 160 mL on the left breast. The volume of fat injected was 280 mL on the left side and 100 mL on the right side. Frontal view with arms in resting position (A, B, C), three-quarter profile with arms in resting position (D, E) and elevated (F), and lateral views with arms in resting position (G, H, I). Photographs were taken preoperatively without (A,D,G) and with markings (B, H) and 4 years postoperatively (C, F, I).

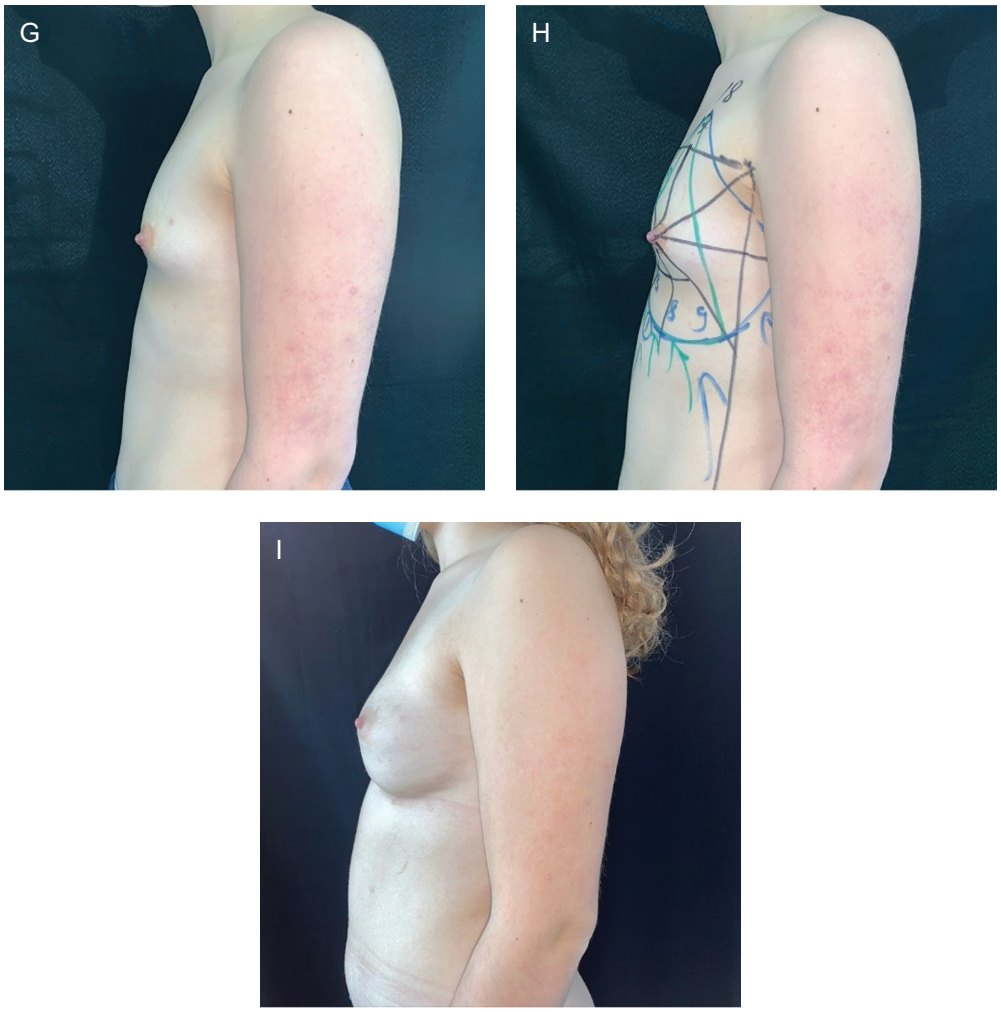


Figure 9. Continued.

result will require incisional and conventional techniques. Despite the imperfection in the result, patients were satisfied given the improvement in the breast shape with minimal scars. With tunnelization, liposuction, and loops, we achieve a reconstruction of the lower pole defect by recruitment of an incisionless advanced skin flap from the upper abdomen into the breast, define the new IMF, treat the herniation of the breast tissue and the widening of the areola, reposition the NAC, and reshape the breast.

The final step is to achieve the same volume. With the added crescent advanced from the upper abdomen and the lateral thorax, the volume to be injected is reduced. The mean volume of the crescent is 212 mL. The fat harvesting and grafting are done utilizing the senior author's PALLL technique to the whole breast with particular attention to the medial and lower quadrants of the breasts. The combination of vibration and tunnelization with the added flap advanced from the breast surroundings improves the recipient site preparation and creates an optimal scaffold for large-volume fat grafting.

Limitations

We acknowledge the study's shortcomings, despite its thoroughness and careful design. The effects of combining internal threads for tunnelization with vibration are based on clinical observation; additional study is still needed to determine the possible advantages and downsides of this approach. Furthermore, our liposuction, looping, and lipofilling breast remodeling technique is continually improving. Finally, because the reduction in skin tension is a therapeutic hypothesis, more research should be done to quantify skin tension before and after loops are added. Other limitations are the lack of a control group or randomization, and that these are the results of only 1 surgeon.

CONCLUSIONS

Tuberous breast correction with PALLL is a minimally invasive tricomposite alternative for remodeling and reshaping deformed breasts following the "matrix

modeling" principle. The use of substantial tunnelization allows for breast remodeling by detaching the breast from its fibrous bands. A vascularized adipocutaneous advancement flap is then recruited utilizing loops from breast surroundings, in combination with fat grafting. The loops allow for the treatment of areolar abnormalities as well as redefining the breast footprint and IMF. The final breast volume is thus composed of its native volume, the volume recruited with loops, and the volume of fat grafting. This procedure is a simple and safe way to treat tuberous breasts at any stage. It has a low complication risk and results in a natural-looking, implant-free breast with minimum scarring and long-term form stability.

Supplemental Material

This article contains supplemental material located online at www.aestheticsurgeryjournal.com.

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REFERENCES

1. Toranto IR. Two stages correction of tuberous breast. *Plast Reconstr Surg*. 1981;67(5):642-646. doi: 10.1097/00006534-198105000-00012
2. Versaci AD, Rozelle AA. Treatment of tuberous breast utilising tissue expansion. *Aesthet Plast Surg*. 1991;15(4):307-312. doi: 10.1007/BF02273878
3. Persichetti P, Berroco M, Casadei RM, et al. Gynecomastia and the complex circumareolar approach in the surgical treatment of skin redundancy. *Plast Reconstr Surg.* 2001; 107(4):948-954.doi:10.1097/00006534-200104010-00007
4. Rees TD, Aston SJ. The tuberous breast. *Clin Plast Surg.* 1976;3(2):339-347.
5. von Heimburg D, Exner K, Kruft S, Lemperle G. The tuberous breast deformity: classification and treatment. *Br J Plast Surg*. 1996;49(6):339-345. doi: 10.1016/s0007-1226(96)90000-4
6. Grolleau JL, Lanfrey E, Lavigne B, et al. Breast base anomalies: treatment strategy for tuberous breasts, minor deformities, and asymmetry. *Plast Reconstr Surg.* 1999; 104(7):2040-2048.doi:10.1097/00006534-199912000-00014
7. Meara JG, Kolker A, Bartlett G, et al. Tuberous breast deformity: principles and practice. *Ann Plast Surg.* 2000;45(6):607-611. doi: 10.1097/00000637-200045060-00006
8. Kolker A, Collins M. Tuberous breast deformity: classification and treatment strategy for improving consistency in aesthetic correction. *Plast Reconstr Surg.* 2015;135(1):73-86. doi: 10.1097/PRS.0000000000000823
9. Costagliola M, Atiyeh B, Rampillon F. Tuberous breast: revised classification and a new hypothesis for its development. *Aesthetic Plast Surg.* 2013;37(5):896-903. doi: 10.1007/s00266-013-0124-2
10. Puckett CL, Concannon MJ. Augmentating the narrow-based breast: the unfurling technique to prevent the double-bubble deformity. *Aesthetic Plast Surg.* 1990;14(1):15-19. doi: 10.1007/BF01578320
11. Ribeiro L, Canzi W, Buss A, Jr, Accorsi A, Jr. Tuberous breast: a new approach. *Plast Reconstr Surg.* 1998;101(1):42-50; discussion 51. doi: 10.1097/00006534-199801000-00008
12. Hoffman S. Two-stage correction of tuberous breasts (Letter). *Plast Reconstr Surg.* 1982;69(1):169.
13. Versaci AD, Rozelle AA. Treatment of tuberous breasts utilizing tissue expansion. *Aesthetic Plast Surg.* 1991;15(4):307-312. doi: 10.1007/BF02273878
14. Scheepers J, Quaba A. Tissue expansion in the treatment of tubular breast deformity. *Br J Plast Surg* 1992;45(7):529-532. doi: 10.1016/0007-1226(92)90148-q
15. Teimourian B, Adham M. Surgical correction of the tuberous breast. *Ann Plast Surg.* 1983;10(3):190-193. doi: 10.1097/00000637-198303000-00003
16. Elliott MP. A musculocutaneous transposition flap mammaplasty for correction of the tuberous breast. *Ann Plast Surg.* 1988;20(2):153-157. doi: 10.1097/00000637-198802000-00013
17. Delay E, Sinna R, Ho Quoc C. Tuberous breast correction by fat grafting. *Aesthet Surg J.* 2013;33(4):522-528. doi: 10.1177/1090820X13480641
18. Ho Quoc C, Sinna R, Gourari A, et al. Percutaneous fasciotomies and fat grafting: indications for breast surgery. *Aesthet Surg J.* 2013;33(7):995-1001. doi: 10.1177/1090820X13501511
19. Khouri R, Schlenz I, Murphy B, Baker T. Nonsurgical breast enlargement using an external soft-tissue expansion system. *Plast Reconstr Surg.* 2000;105(7):2500-2512. doi: 10.1097/00006534-200006000-00032.
20. Khouri R, Del Vecchio D. Breast reconstruction and augmentation using pre-expansion and autologous fat transplantation. *Clin Plast Surg.* 2009;36(2):269-80, viii. doi: 10.1016/j.cps.2008.11.009
21. Khouri RK, Jr, Khouri RK. Current clinical applications of fat grafting. *Plast Reconstr Surg.* 2017;140(3):466e-486e. doi: 10.1097/PRS.0000000000003648
22. Del Vecchio D. Breast reconstruction for breast asymmetry using recipient site pre-expansion and autologous fat grafting. *Ann Plast Surg.* 2009;62(5):523-527. doi: 10.1097/SAP.0b013e3181a23f08
23. Abboud MH, El Hajj HN, Abboud NM. No-scar breast reduction utilizing power-assisted liposuction mammaplasty, loops, and lipofilling. *Aesthet Surg J.* 2021;41(5):550-562. doi: 10.1093/asj/sjaa165
24. Abboud MH, El Haji H, Kapila AK, et al. Scarless composite breast reconstruction utilizing an advancement skin flap,

loops, and lipofilling. *Aesthet Surg J.* 2021;42(1):38-53. doi: 10.1093/asj/sjab049
25. Abboud MH, Kapila AK, Bogaert S, Abboud NM. Composite breast remodeling after implant removal by tissue recruitment and loops fixation with power-assisted liposuction and lipofilling (PALLL). *Aesthet Surg J.* 2021;41(7):770-782. doi: 10.1093/asj/sjaa327
26. Abboud NM, Kapila AK, Abboud S, Yaacoub E, Abboud MH. The combined effect of intravenous and topical tranexamic acid in liposuction: a randomized double-blinded controlled trial. *Aesthet Surg J Open Forum.* 2021;3(1):ojab002. doi: 10.1093/asjof/ojab002
27. Abboud M, Geeroms M, El Hajj H, Abboud N. Improving the female silhouette and gluteal projection: an anatomy-based, safe, and harmonious approach through liposuction, suspension loops, and moderate lipofilling. *Aesthet Surg J.* 2021;41(4):474-489. doi: 10.1093/asj/sjaa157
28. Abboud MH, Dibo SA, Abboud NM. Power-assisted liposuction and lipofilling: techniques and experience in large-volume fat grafting. *Aesthet Surg J.* 2020;40(2):180-190. doi: 10.1093/asj/sjz019
29. Abboud MH, Abboud NM, Dibo SA. Brachioplasty by power-assisted liposuction and fat transfer: a novel approach that obviates skin excision. *Aesthet Surg J.* 2016;36(8):908-917. doi: 10.1093/asj/sjv27
30. Abboud MH, Dibo SA, Abboud NM. Power-assisted gluteal augmentation: a new technique for sculpting, harvesting, and transferring fat. *Aesthet Surg J.* 2015;35(8):987-994. doi: 10.1093/asj/sjv161
31. Abboud MH, Dibo SA. Immediate large-volume grafting of autologous fat to the breast following implant removal. *Aesthet Surg J.* 2015;35(7):819-829. doi: 10.1093/asj/sjv073
32. Khouri RK, Smit JM, Cardoso E, et al. Percutaneous aponeurotomy and lipofilling: a regenerative alternative to flap reconstruction? *Plast Reconstr Surg.* 2013;132(5):1280-1290. doi: 10.1097/PRS.0b013e3182a4c3a9
33. Hamdi M, Anzarut A, Hendrickx B, Ortiz S, Zeltzer A, Kappos EA. Percutaneous purse-string suture: an innovative percutaneous technique for inframammary fold creation and improved breast projection in reconstructive surgery. *Aesthet Surg J.* 2018;38(12):1298-1303. doi: 10.1093/asj/sjx190
34. Visconti G, Salgarello M. Dual-anchor cog threads in fat grafting breast augmentation: a novel scarless method for defining breast footprint and enhancing shape. *Plast Reconstr Surg.* 2019;143(4):1039-1049. doi: 10.1097/PRS.0000000000005431
35. Sulamanidze M, Sulamanidze G, Sulamanidze C. Mastoptosis aesthetic surgery: thread lifting techniques. In: Mugea TT, Shiffman MA, eds. *Aesthetic Surgery of the Breast*. Springer-Verlag; 2015.
36. Serdev N. Serdev sutures lifts in body areas. In: Serdev N, ed. *Miniinvasive Face and Body Lifts—Closed Suture Lifts or Barbed Thread Lifts*. IntechOpen Limited; 2013; 3426–3689.