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ORIGINAL ARTICLE BREAST SURGERY

Stenotic Breast Malformation and Its Reconstructive Surgical Correction: A New Concept From Minor Deformity to Tuberous Breast

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Abstract

Background Several classification systems have been reported to define the spectrum of tuberous breast deformity, and a range of surgical techniques has been described. In this paper, we proposed a new classification including tuberous breast and minor deformity based on stenosis type, glandular trophism and ptosis adapting surgical planning to different breast types.

Methods A total of 246 patients meeting our definition for stenotic breasts asking for surgery were analyzed in this study. We considered eight different types of stenotic breasts analyzing anatomical presentations, and we then proposed eight key-point maneuvers, finalized to the correction of different breast deformities and their possible association according to the stenotic breast type. Results have been evaluated by a group of three surgeons and by patients. In addition, we evaluated the complication incidence in terms of re-intervention rate.

Results Following our classification eight different groups were distinguished. For each one we reported the prevalence and the surgical procedure adopted. Results evaluated by the surgeon group reported a mean aesthetic outcome of 8.2 (range 5–10), whereas patients reported a mean value of 7.9 (range 6–10). During a follow-up period with a mean of 16 months we observed a 4.9% re-intervention rate.

Conclusions We believe this new classification to be very complete in evaluating breast shape, including most of the breast evaluable features. Our results confirmed the suitability of the approach for appropriate preoperative planning, thus improving the global surgical outcome.

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Keywords Stenotic · Breast · Classification · Surgery

Introduction

Tuberous breasts are widely described in the literature, and several surgical strategies have been proposed [1]. Tuberous deformity develops during puberty development. It usually involves both breasts with a high rate of asymmetry.

The main hypothesis suggests that an abnormal thickening of the fascia corporis leads to a condition that might alter glandular development [2]. In 2011, we performed a study showing significant differences in quantity and disposition of collagen fibers in patients with tuberous breasts when compared to normal breasts. In tuberous breasts these features are altered, and collagen fibers are occasionally assembled in bundles determining the typical glandular toughness, ligament and fascial thickening and general fibrosis [3]. Different clinical presentations can be discerned. Several classification systems have been proposed

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to define the spectrum of tuberous breast deformity, and a range of surgical techniques have been reported to correct breast shape and volume in this context.

Considering the wide spectrum of deformities and that many patients show a mild degree of malformation, as we recently observed [4], many breast clinical presentations are not included in the previous classification systems emphasizing the need for a new comprehensive one. A standardized nomenclature for tuberous breast deformity has not been published, and different authors still refer to this condition using many terms including tubular breasts, constricted breasts, doughnut breasts, nipple breasts, breasts with narrow bases and dome nipples. Consequently, in the present paper we propose a new classification based on the following parameters: type of stenosis, glandular trophism and ptosis. Following our new classification system we are able to include most breast anatomical features from simple hypoplastic breasts to tuberous breasts including most of the previous terms: the stenotic breast. We adapted the surgical planning to different breast types classified in line with this method and analyze the outcomes obtained.

Materials and Methods

Stenotic Breast Classification

We consider the anatomical feature of breast stenosis as the most relevant aspect to be assessed. We identified two groups: vertical stenotic gland and vertical–horizontal stenotic gland. Two additional parameters were analyzed: glandular parenchymal trophism (hypoplastic defined as insufficient glandular tissue or not hypoplastic) and ptosis (considered as areolar positioning under the inframammary fold). Eight different groups were obtained, as reported in Table 1.

In addition to these parameters, we highlighted others to be evaluated in the planning process: areolar asymmetry, glandular asymmetry, breast volume. Because a hypoplastic inferior pole of the pectoralis major muscle has often been observed in patients presenting with glandular stenosis, pectoralis muscle shape and trophism was also employed as an additional parameter.

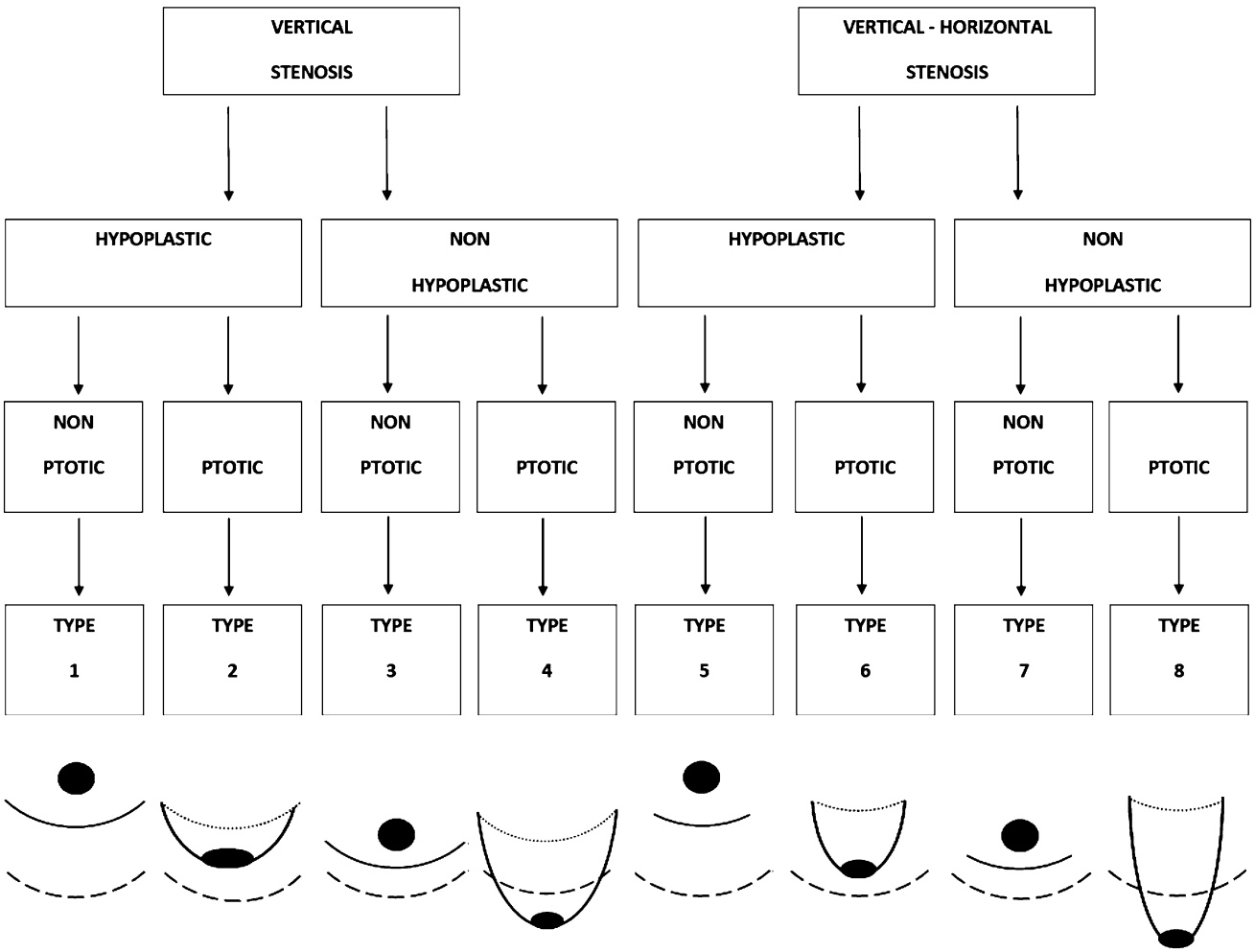
Reconstructive Surgical Procedure

For each anomaly, we propose a specific surgical procedure to achieve an appropriate correction.

In all treated cases, we perform surgery bilaterally. Firstly, a skin incision on the inferior areolar border is made. Such surgical access is the one of choice for the authors because the whole gland is easily visible thus allowing a wider vision of the operative field. Moreover by employing a periareolar access, a periareolar mastopexy after breast implant or breast reshaping can be easily performed, if needed. We schematize as follows what we consider as the key-point maneuvers to be employed in stenotic breast correction (Table 2). Depending on the type of stenotic breast they can be combined if needed.

1. 360° *Glandular detachment* A 360° glandular detachment is performed to obtain a complete interruption of the retractile fibers connecting the muscular and glandular tissues. This maneuver is of great importance to correct the glandular constriction and to obtain a glandular redistribution reshaping it equally in the four poles; every single connecting fiber between the gland and muscle should be cut. When vertical stenosis has to be corrected, lowering of the inframammary fold is performed. When a combined vertical–horizontal stenosis is present we also obtain breast base enlargement by combining both of the above-mentioned techniques. Thus, allowing parenchymal reshaping and redistribution to the four mammary poles (inferior, lateral, medial and even upper pole in a certain number of cases). We take particular care in the dissection in the supero-lateral quadrants so as not to damage nerve branches leading to reduced breast or nipple areola sensitivity.
2. *Radial scoring* It helps in expanding stenotic tissues and in releasing the resulting retraction forces when associated to glandular detachment. When a satisfying glandular redistribution is obtained solely by the use of 360° glandular detachment, as previously described, radial scoring is not needed.
3. *Breast implant* Breast prostheses can improve breast volume and reconstruct the mammary cone when absent. Partial sub-muscular coverage of breast implants is usually employed. On the other hand when the pectoralis major costal insertion is excessively cranial or when the pectoralis muscle is assessed as hypotrophic, not providing adequate implant covering, the prostheses are inserted in the subglandular plane. All breast prostheses used were textured implants.
4. *Glandular resection* When an unnatural glandular herniation is present at the lower pole, a glandular resection is performed in this mammary region.
5. *Glandular flaps* When enough glandular tissue is present the lower pole can be filled by the use of one or more glandular flaps based on a superior, medial or lateral pedicle. The lateral-inferior, inferior and medial inferior breast poles can thus be reconstructed leading to complete implant coverage and to a round breast shape.

Table 1 Stenotic breast classification: dotted semicircular line represents the ideal inframammary fold and ideal breast base: in vertical stenosis we observe an upper position of the real inframammary fold with different grade of trophism and ptosis; in patient with both vertical and horizontal stenosis we observe both an upper position of the real inframammary fold and a constricted breast base with different grades of trophism and ptosis



Ptosis is defined as areolar positioning under the inframammary fold (punctuated line)

6. *Periareolar mastopexy* Corrects asymmetries between the nipple areola complexes in terms of position and diameter. An excessive and unpleasant increase in the distance between the new inframammary fold and the areolar border can be derived by a lowered inframammary fold and by the detachment of the gland from the fascial layer. This can be avoided by performing a periareolar mastopexy resecting a certain amount of skin also in the lower pole. Finally, by the resection of the periareolar tissue, the unexpandable skin pad can be removed. In these cases, the blood supply derives from the internal mammary perforator vessels.
7. *Inverted T mastopexy* Only severely ptotic breasts with no constricted base can be lifted by the use of this technique, because horizontal stenosis would not allow a skin resection at the inferior pole. On the other hand, inverted T mastopexy can be employed in vertical–horizontal stenosis if a balanced redistribution of the mammary gland is achieved by the use of the 360° glandular detachment. In these cases, the blood supply derives from the internal mammary perforator vessels.
8. *Lipofilling* We consider fat grafts to have a similar action in correcting both scar tissue and stenotic fibrotic tissue. Both improved tissues release and lower pole filling are obtained by the employment of needle-based autologous fat grafting [5]. In particular, deformities due to persistence of the previous inframammary fold shape can be corrected by fat needle

Table 2 Relationship between stenotic breast type (according to our classification) and reconstructive surgical procedure

Stenotic breast classification type	Characteristics	Mandatory procedures	Optional procedures
Type 1	Vertical stenosis	360° Glandular detachment	Radial scoring
	Hypoplastic	Breast implant	
	Non-ptotic	Lipofilling	
Type 2	Vertical stenosis	360° Glandular detachment	Radial scoring
	Hypoplastic	Breast implant	
	Ptotic	Periareolar mastopexy	
		Lipofilling	
Type 3	Vertical stenosis	360° Glandular detachment	Radial scoring
	Non-hypoplastic	Lipofilling	Breast implant
	Non-ptotic		Glandular flaps
Type 4	Vertical stenosis	360° Glandular detachment	Radial scoring
	Non-hypoplastic	Periareolar mastopexy	Breast Implant
	Ptotic	Lipofilling	Glandular flaps
			Inverted T mastopexy
Type 5	Vertical–horizontal stenosis	360° Glandular detachment	Radial scoring
	Hypoplastic	Breast implant	Periareolar mastopexy
	Non-ptotic	Lipofilling	Discoid glandular resection
Type 6	Vertical–horizontal Stenosis	360° Glandular detachment	Radial scoring
	Hypoplastic	Breast implant	Discoid glandular resection
	Ptotic	Periareolar mastopexy	
		Lipofilling	
Type 7	Vertical–horizontal stenosis	360° Glandular detachment	Radial scoring
	Non-hypoplastic	Lipofilling	Breast implant
	Non-ptotic		Discoid glandular resection
			Glandular flaps
			Periareolar mastopexy
Type 8	Vertical–horizontal stenosis	360° Glandular detachment	Radial scoring
	Non-hypoplastic	Periareolar mastopexy	Breast implant
	Ptotic	Lipofilling	Discoid glandular resection
			Glandular flaps
			Inverted T mastopexy

injection. It can also be used in the upper pole to improve the breast profile.

In Table 2 we report the relationship between each stenotic breast type following our classification and reconstructive surgical procedures.

We considered 246 patients asking for aesthetic mammaplasty with a mean age of 34 years (range 18–44) meeting our definition of stenotic breasts treated with surgery in our institute from 2010 to 2015.

We performed surgery in all cases, depending on the stenotic breast type diagnosis. Aesthetic assessment was performed using preoperative and postoperative digital photographs with frontal, lateral and bilateral oblique views for each patient. Follow-up photographs were taken at a follow-up visit after completion of the treatment. A questionnaire was used to assess each patient's satisfaction and graded according to a eleven point Likert scale from 0, extremely poor outcome, to 10 extremely satisfactory outcome [6, 7]. The results of physician satisfaction were obtained by three independent board-certified plastic surgeons who did not participate in the medical care of the patients. According to the photographs taken preoperatively and postoperatively, the results were also graded with the same scale. Categories for patient self-evaluation and physician assessment included breast cone shape, inframammary fold position and symmetry, breast volume symmetry and scarring.

In addition, we collected complication rates in terms of re-intervention rates.

Results

Considering all 246 patients with stenotic breasts we find 58 with Type 1, 41 with Type 2, 22 with Type 3, 9 with Type 4, 41 with Type 5, 19 with Type 6, 52 with Type 7, and 4 with Type 8. An example of each stenotic breast type is reported as follows (being more difficult, we report three examples for Type 8 Stenotic Breast).

Type 1 (58 Patients)

Characteristics: Vertical Stenosis, Hypoplastic, Non-Ptosis

Procedures 360° glandular detachment, breast implant, lipofilling (Fig. 1).

Type 2 (41 Patients)

Characteristics: Vertical Stenosis, Hypoplastic, Ptosis

Procedures 360° glandular detachment, breast implant, periareolar mastopexy, lipofilling (Fig. 2).

Type 3 (22 Patients)

Characteristics: Vertical Stenosis, Not Hypoplastic, Non-Ptosis

Procedures 360° glandular detachment, breast implant, lipofilling (Fig. 3).

Type 4 (9 Patients)

Characteristics: Vertical Stenosis, Not Hypoplastic, Ptosis

Procedures 360° glandular detachment, breast implant, periareolar mastopexy, lipofilling (Fig. 4).

Type 5 (41 Patients)

Characteristics: Horizontal–Vertical Stenosis, Hypoplastic, Non-Ptosis

Procedures 360° glandular detachment, breast implant, discoid glandular resection, periareolar mastopexy, lipofilling.

Figure 5a From Klinger M, Caviggioli F, Giannasi S, Bandi V, Banzatti B, Veronesi A, Barbera F, Maione L, Catania B, Vinci V, Lisa A, Cornegliani G, Giaccone M, Siliprandi M, Klinger F. The prevalence of tuberous/constricted breast deformity in population and in breast augmentation and reduction mammaplasty patients. Aesthetic Plast Surg. 2016 Aug;40(4):492–496. Reprinted with permission of Springer.

Type 6 (19 Patients)

Characteristics: Horizontal–Vertical Stenosis, Hypoplastic, Ptosis

Procedures 360° glandular detachment, breast implant, periareolar mastopexy, lipofilling (Fig. 6).

Type 7 (52 Patients)

Characteristics: Horizontal–Vertical Stenosis, Not Hypoplastic, Non-Ptosis

Procedures 360° glandular detachment, radial scoring, breast implant, periareolar mastopexy, lipofilling.

Figure 7a From Klinger M, Caviggioli F, Giannasi S, Bandi V, Banzatti B, Veronesi A, Barbera F, Maione L, Catania B, Vinci V, Lisa A, Cornegliani G, Giaccone M, Siliprandi M, Klinger F. The prevalence of tuberous/constricted breast deformity in population and in breast augmentation and reduction mammaplasty patients. Aesthetic

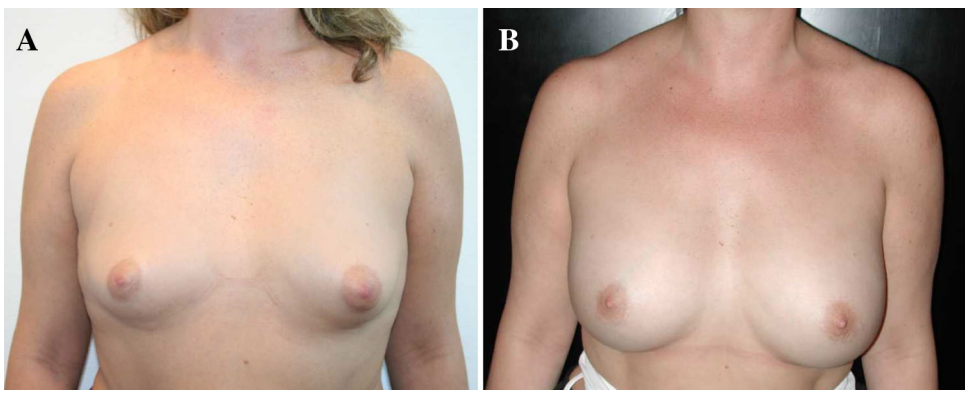


Fig. 1 **a–b** Pre-postoperative view type 1 stenotic breast

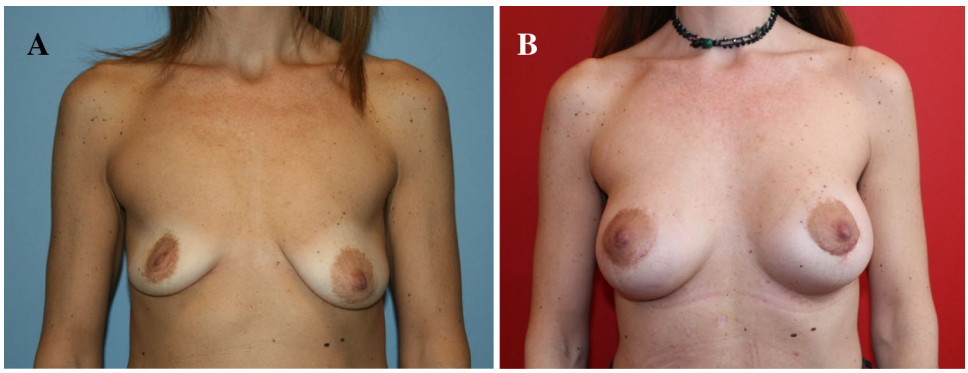


Fig. 2 **a–b** Pre-postoperative view type 2 stenotic breast

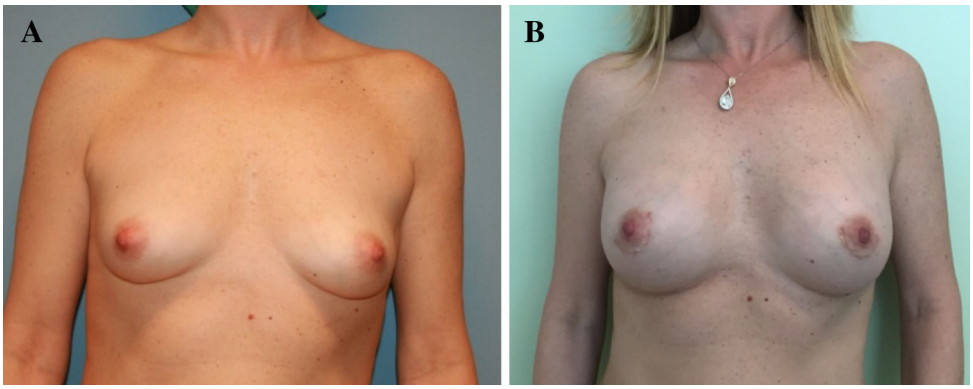


Fig. 3 **a–b** Pre-postoperative view type 3 stenotic breast

Plast Surg. 2016 Aug; 40(4):492–496. Reprinted with permission of Springer.

Type 8 (4 Patients)

Characteristics: Horizontal–Vertical Stenosis, Not Hypoplastic, Ptosis

Procedures 360° glandular detachment, periareolar mastopexy, lipofilling (Fig. 8).

Procedures 360° glandular detachment, breast implant, glandular flaps, inverted T mastopexy, lipofilling.

Results evaluated by the surgeon group reported a mean aesthetical outcome of 8.2 (range 5–10), whereas patients reported a mean value of 7.9 (range 6–10). During a follow-up period with a mean of 16 months (range 12–28) we observed a 4.9% re-intervention rate (12 procedures). There was no report of reduced nipple or local sensitivity for nerve disruption. In one case, we substituted the implants because the patient asked for a bigger breast size; in two cases, we performed capsulotomy for implant repositioning; in six cases, we performed periareolar scar revision; in three patients, we performed lipofilling to correct lower pole retraction.

Discussion

In 1979 Rees and Aston first described tuberous breast deformity as a condition of small breasts characterized by a reduction in both vertical and horizontal diameters with glandular herniation behind a huge nipple areolar complex [8]. Concepts such as tubular breast [9], nipple areolar complex herniation [10], constricted breast [11], lower pole hypoplasia [12] and snoopy deformity [13] refer to the different aspects of this particular condition. DeLuca-Pytell [14] reported an 88.8% incidence in patients requiring a mammaplasty due to breast asymmetry. The etiopathogenesis of tuberous breast by Grolleau [2] is described as an alteration of the superficialis fascia that blocks normal breast glandular growth.

From the first description of Rees and Aston many authors proposed different classifications. In 1996, Von Heimburg classified the condition into four categories based on glandular hypoplasia and skin deficiency in the lower pole [15]. In 1999, Grolleau classified breast base hypoplasia in his three classes [16]. Eventually in 2000 Meara completed and summarized previous classifications [17]. Recently the authors assessed the prevalence of tuberous breasts considering the general population and

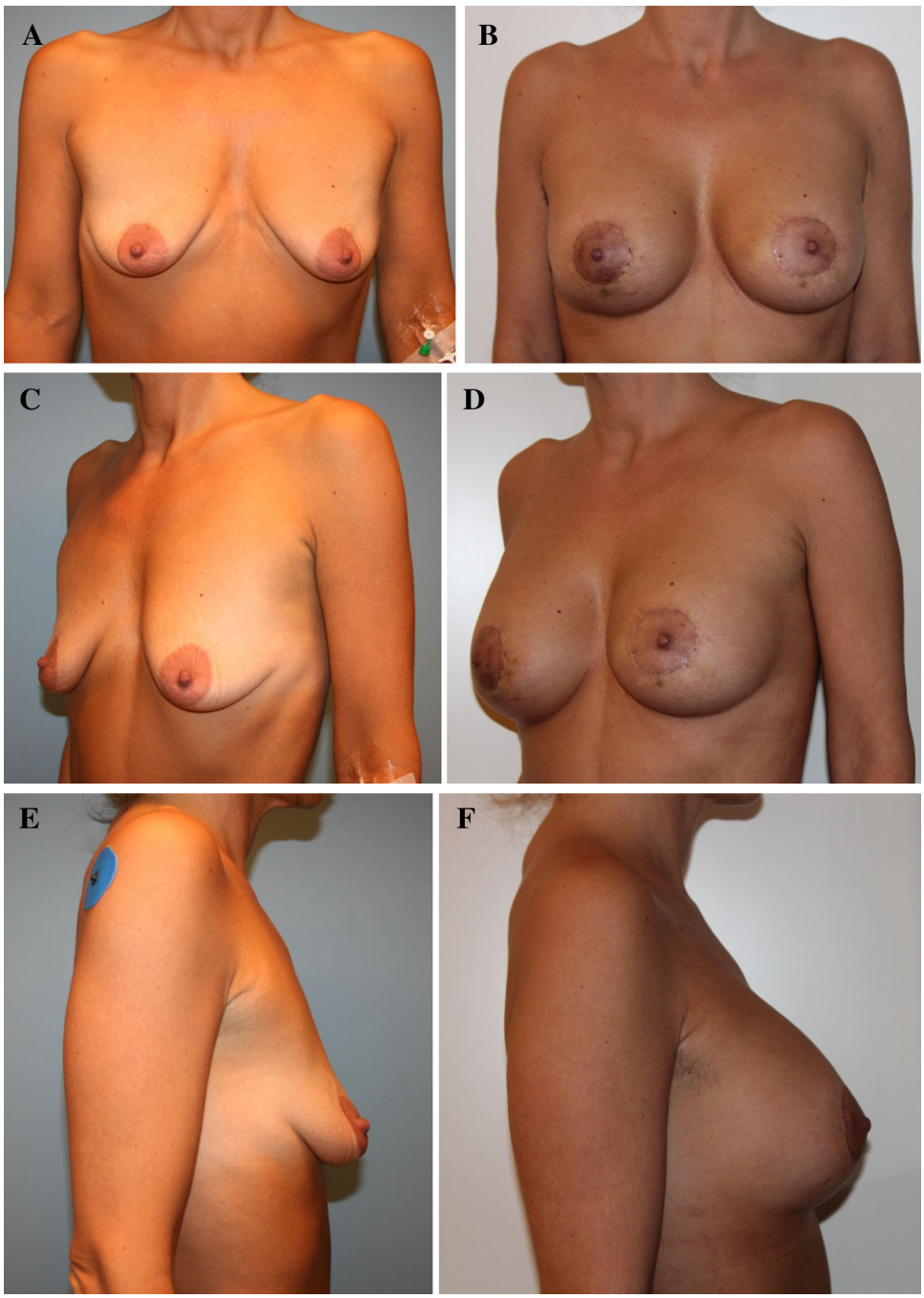


Fig. 4 **a–f** Pre-postoperative view type 4 stenotic breast

patients undergoing breast reduction or augmentation, interestingly finding a higher prevalence than expected [4].

Different conditions as well as different surgical procedures have been described for tuberous breast correction: The periareolar approach to improve its diameter and position, different glandular incisions to obtain appropriate expansion and release [15–17], glandular flaps for breast cone reconstruction [18, 19], fat grafting procedure [20] and breast implant positioning were all demonstrated to be efficacious in different conditions [21].

Recently, we read with interest a study from Kolker and Collins describing their surgical approach related to different breast anomalies and we decided to explain our philosophy in approaching this condition [22]. In this paper, we propose a new terminology for breast anomalies introducing the concept of stenotic breast. Different presentations, from a minor deformity to tuberous breasts, are included in this definition, thus widening the variety of features assessed. We obtained eight different classes, and for each one we focused on particular aspects of each.

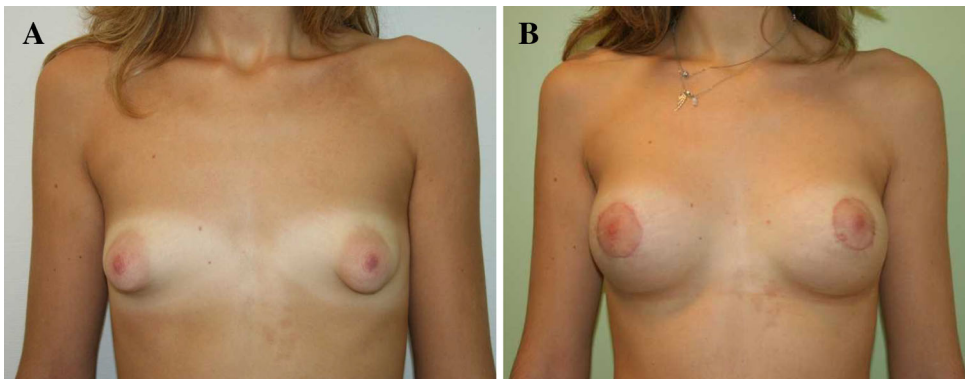


Fig. 5 **a–b** Pre-postoperative view type 5 stenotic breast

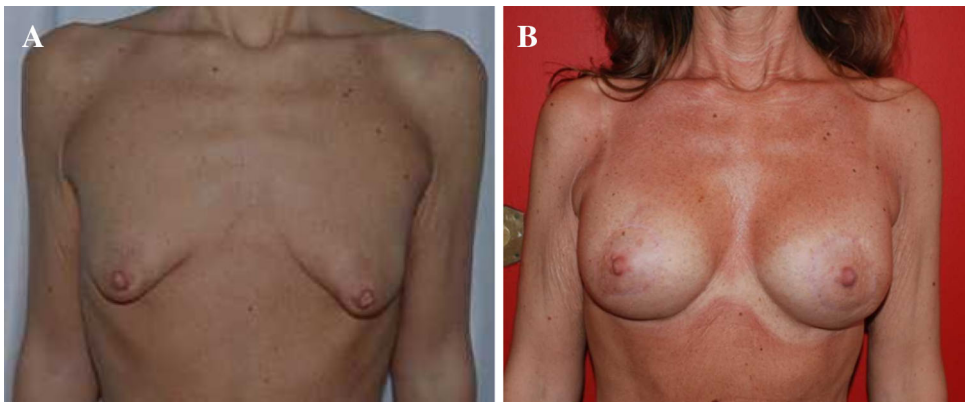


Fig. 6 **a–b** Pre-postoperative view type 6 stenotic breast

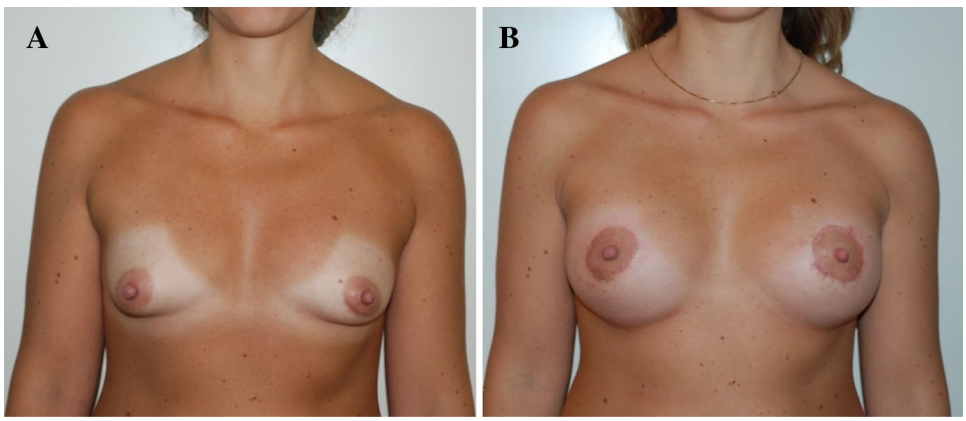


Fig. 7 **a–b** Pre-postoperative view type 7 stenotic breast

We want the reader to consider that each patient may have additional and more specific alterations which may not be described in the classification: Many different presentations are possible, and classifying every singular one is hardly possible. On the other hand, we noticed that in all cases a certain degree of either vertical stenosis or vertical–horizontal stenosis, but not horizontal stenosis alone, is present.

We suggest using our classification as a main guideline when first approaching a patient. We found that a complete detachment of the gland from the muscular plane could often be achieved solely by removing all retracted fibers thus making radial scoring [22] a useless maneuver in most cases. Moreover, we noted that glandular deformation was sometimes associated with hypoplasia of the lower portion of the pectoralis muscle so that retropectoral implant placement could not be performed. On the contrary, when a neurotrophic pectoralis is assessed, the breast implant is usually positioned partially sub-muscularly thus allowing for reconstruction of the breast cone and improving volume if necessary.

We noticed that centripetal retraction was exerted not only by fibrotic tissue but also by cutaneous periareolar tissue in particular in lower poles. Breast stenosis thus

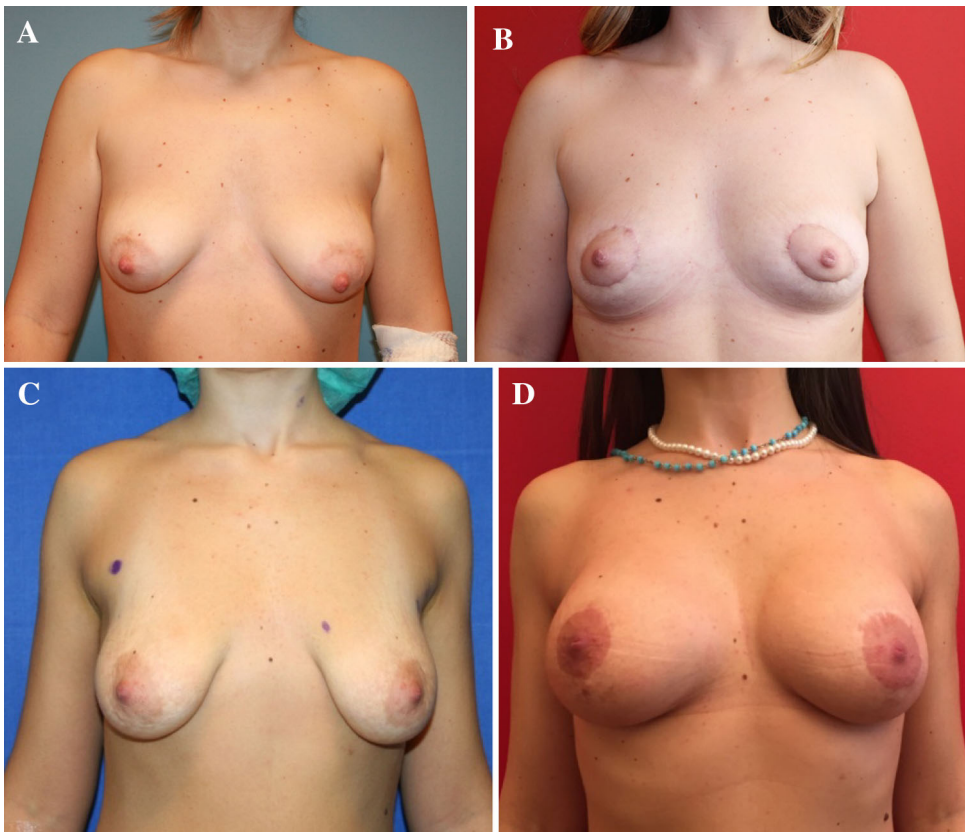


Fig. 8 **a–b** Pre-postoperative view type 8 stenotic breast. **c–d** Pre-postoperative view type 8 stenotic breast

results from the combined action of both parenchymal constriction and periareolar tissue retraction. We believe needle fat grafting to be effective in the correction of fibrotic retraction, similarly to what we observed in scar tissue remodeling [23, 24]. In fact, in most cases, needle fat grafting allowed us to correct both glandular retraction and cutaneous periareolar tissue retraction. On the other hand, when greater skin pad circular tension forces were assessed, a periareolar skin excision was mandatory. Glandular flaps can be setup when inferior breast poles are lacking or when the breast is flat in its lower portion, thus obtaining a rounder and more pleasant breast shape.

Dealing with the inverted T mastopexy, we believe it to be contraindicated in vertical–horizontal stenotic breasts, because the removal of skin from the inferior pole would lead to an increase in breast distortion. Contrarily when the 360° glandular detachment leads to a satisfactory redistribution of glandular tissues and to horizontal stenosis correction, inverted T mastopexy can be employed.

Moving from our experience with periareolar breast surgery in the oncological field [25], we employed this technique in most cases of stenotic breast correction. Rarely, a surgical periareolar scar revision is required some months after surgery. In these cases, patients are correctly informed at the time of the first preoperative visit.

We would like to underline how, in our mind, the present state of art in breast plastic surgery leaves a great margin for artistry based on studies and engineering, imagining a round breast shape at the beginning of the surgical act and then managing how to reach it. Our results confirmed the suitability of the approach described for appropriate preoperative planning, thus improving the global surgical outcome. The high values for patient satisfaction and the low re-intervention rate additionally support the efficacy of our approach.

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Compliance with Ethical Standards

Human and Animal Rights All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards.

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