Tuberous Breast: A Wide Spectrum of Features of the Same Disorder—13-Year Experience-Based Classification and Reconstructive Algorithm

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Background: A multitude of variants of tuberous breast exist, and a reconstructive algorithm could help in assessment of all features that affect the breast and planning the most appropriate surgical correction strategy. Although several efficient techniques have been described in the literature, the authors propose their experience to help standardize a diagnostic and therapeutic approach. The aim of this article is to assess the pathologic hallmarks of each type of tuberous breast and to propose a one-step reconstructive algorithm tailored to the patient characteristics based on the use of three different adipo-glandular flaps.
Methods: From September of 2006 to December of 2019, 118 patients were treated for tuberous breast in a one-step procedure using tailored local flaps according to the preoperatively assessed clinical variant. Minimum follow-up was 12 months. All the procedures were performed under local anesthesia.
Results: A total of 220 tuberous breasts (98 hypoplastic and 122 normoplastic) were treated. Mean patient age was 20.2 years. Mean follow-up was 36.5 months. Six minor complications (capsular contracture and nipple-areola complex hypesthesia) but no major complications were reported. In 9% of cases, minor secondary procedures, including lipofilling, scar revisions, and breast implant substitution, were performed.
Conclusion: The proposed algorithm, including a comprehensive classification, preoperative planning, and surgical approach derived from the authors' experience, presents a tailored surgical approach for each type of tuberous breast. *(Plast. Reconstr. Surg.* 153: 1231, 2024.)
CLINICAL QUESTION/LEVEL OF EVIDENCE: Therapeutic, IV.

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THERAPEUTIC

Tuberous breast is a congenital variation appearing during puberty, unilaterally or bilaterally, with a wide spectrum of anatomic presentation. Tuberous breast is widely variable, showing different clinical appearances, but wide intermammary space, breast base constriction, cranialization of the inframammary fold (IMF), and areola disorders are always present as common hallmarks.[1] Tuberous breast may also appear in men with gynecomastia.[2] Asymmetry may also be observed.[3]

This wide range of clinical findings inherent in the same condition poses a great challenge to consistency in nomenclature classification and surgical correction. Several names have been proposed, each coined to underline the most significant clinical items, including tuberous breast, tubular breast, and constricted breast. Epidemiologic data show a wide discrepancy in the literature because of the difficulty in recognizing minor forms of tuberous breasts, which may be confused with normal anatomic breast variations, or because patients may be hindered from seeking medical consultation because of embarrassment.[4]

The accepted etiopathogenic theory points toward an embryologic origin of tuberous breast. Mandrekas[5] suggested a thickening of collagenous fibers of superficialis fascia, organized in a fibrous

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ring that obstructs the radial development of the inferior mammary pole. The congenital absence of the superficialis fascia behind the areola creates a gap through which the parenchyma herniates.

The simple introduction of a prosthesis does not allow a satisfactory outcome in volume correction of tuberous breast hypoplasia because the fibrous constriction at the mammary base does not allow the parenchyma, confined above the native sulcus, to slide down to cover the distal edge of the outer surface of the breast implant. The difference in thickness of the tissue overlying the breast implant will create a coverage discontinuity above and below the native sulcus, producing a double bubble. Several surgical techniques have been described in the literature to address tuberous breasts, performed in one or multiple surgical steps.[6]

The aim of this article is to focus on the unique pathologic hallmarks of each type of tuberous breast and to propose a one-step reconstructive algorithm tailored to the breast characteristics, using the concept of volume displacement, according to the different types of tuberous breasts.

CLASSIFICATION SCHEME

The following measures were included in the classification scheme reported in the algorithm: volume, quality, consistency of the breast tissue, and anatomic location (Fig. 1).[7] Based on the volume, tuberous breasts were classified as hypoplastic or normoplastic. Based on the tissue consistency, hypoplastic breasts could be distinguished as soft or solid. Soft hypoplastic tuberous breast, attached to the thorax by a constricted mammary base, represents the most severe form of tuberous breast. Its skin cover, consisting almost entirely of a wide areola, is thin and pinched easily in folds because of the insufficiency of suspending ligaments. Solid hypoplastic tuberous breasts have a wider mammary base, a smaller areola, and a thicker skin cover firmly connected to the parenchyma through strong connections by Cooper ligaments. The inferior mammary pole is generally flat or concave, whereas the IMF is absent. Normoplastic tuberous breasts have a greater volume and are classified into three types. In type 1, the medial inferior quadrant is missing; in type 2, both the medial and lateral inferior quadrants are missing. In type 2, the constriction at the mammary base displaces almost all the parenchyma upward in the superior pole, which appears full with a convex profile. The distance between the inferior border of the areola and the IMF is very short. Because of this, the nipple-areola complex (NAC) points downward, inverting the ratio between upper and lower length profile. Therefore, a pseudoptotic aspect is observed, because the parenchyma is

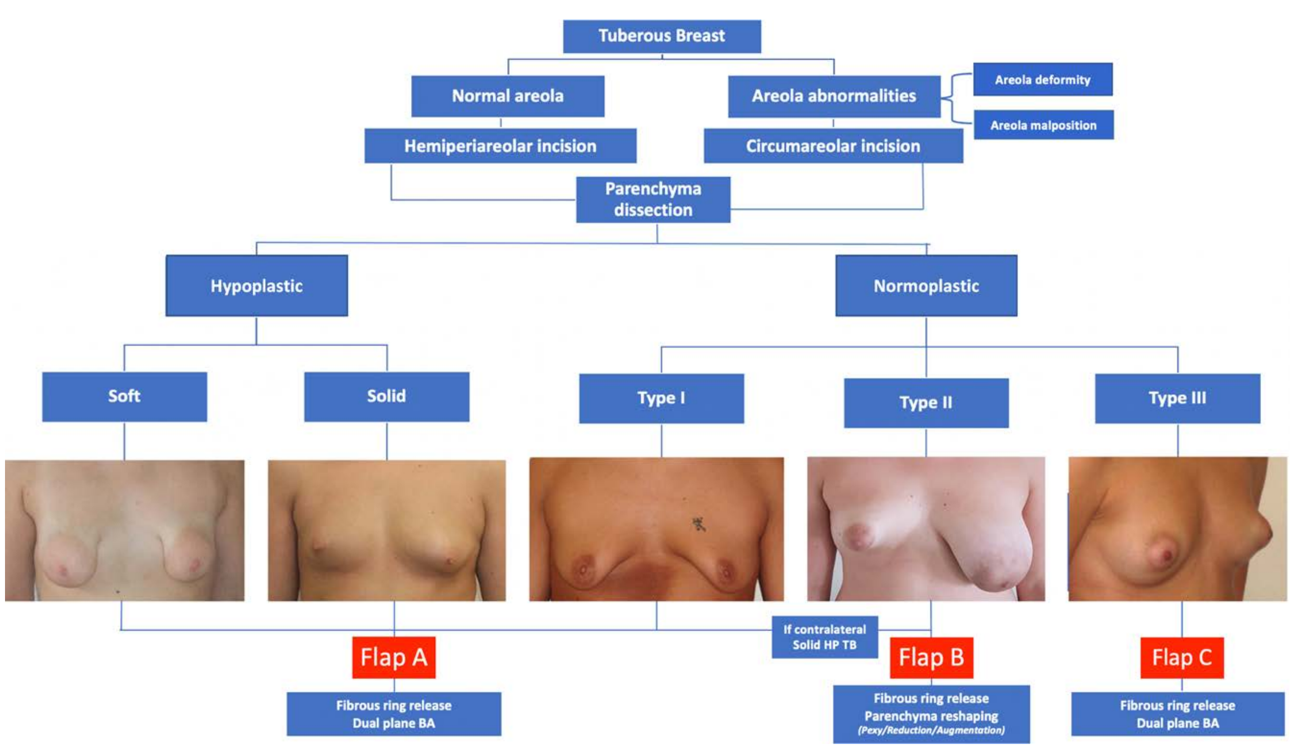

Fig. 1. Classification scheme and reconstructive algorithm.

mostly located above the IMF, and only the NAC points downward. Asymmetries are also present in type 2 because they are frequently associated with a solid hypoplastic tuberous breast on the contralateral side. Type 3 normoplastic tuberous breast is a minor form, not always easily recognizable, characterized by a persistent or intermittent glandular herniation inside the areola that appears as an independent second breast overlying a normal mammary plate.[8]

PREOPERATIVE PLANNING

According to the tuberous breast type, all patients are marked preoperatively, including existing submammary fold, new sulcus, vertical plumb-midline, horizontal line passing through the neosulcus, breast implant pocket contour, shape, and areola position.

The position of the new sulcus is the milestone of surgical planning. This depends on the amount of glandular tissue available to be harvested as flap, assessed according to the distance between the apex of the tuberous breast cone and the sulcus previo. This distance informs about the amount of tissue that can be transposed downward to increase the thickness of the skin envelope between the sulcus previo and the new IMF, to ensure an even cover of the prosthesis, avoiding double bubble, when a volume augmentation is required. In the absence of breast augmentation, as in normoplastic type 2 tuberous breast, the use of adipo-glandular flaps is also suggested to recontour the breast cone, restoring a satisfactory ratio between the upper and lower pole.[9]

SURGICAL TECHNIQUE

A periareolar incision surgical access is first approached in all cases. Dissection progresses perpendicularly through the parenchyma. Once the pectoralis fascia is reached, dissection proceeds to the premarked new IMF. During this dissection, the fibrous ring narrowing the lower pole must be released through radial scoring. Once the parenchyma is divided into two portions, three different flaps are proposed.

Flap A

The aim of flap A is to enlarge the vertical dimension of the mammary base, lowering the sulcus previo. With its vascularization based on a superficial caudal vascular network, flap A is harvested by splitting the lower pole of the separated parenchyma. Once harvested, the flap is rotated downward 180 degrees as a finger glove to reach with its proximal edge the neosulcus, where it is fixed. To optimize the coverage of the lower part of the implant, the cranial edge of the flap can be shaped with many scored incisions, thus improving its distribution onto the distal edge of the implant. [**See Video 1 (online)**, which demonstrates the surgical technique after the periareolar surgical incision; dissection progresses perpendicularly through the parenchyma.]

A more oblique orientation of the major axis of flap A may be helpful to reach the more distant part of the missing quadrant in normoplastic type 1 tuberous breast.

Flap B

Because the parenchyma is almost all displaced upward in normoplastic type 2 tuberous breasts, the convex profile of the upper pole must be corrected. Flap B is harvested from the extraparenchyma of the deep surface of the upper pole, flattening the upper pole convexity at the same time. (**See Figure, Supplemental Digital Content 1**, which shows flap B harvesting from the deep surface of the upper pole, ***http://links.lww.com/PRS/G660***.) The aim of flap B is craniocaudal transposition of breast tissue to enrich the lower quadrant, improve its projection, and increase the convexity of its profile, restoring a normal length ratio between the superior and inferior pole.

Flap C

Flap C is harvested by splitting the extraparenchyma behind the areola craniocaudally, basing its vascularization on a superficial distal pedicle. Flap C aims to produce a telescopic realignment of the prominent areola. The more prominent the areola, the thicker the flap.[10] Transferring the extraparenchyma craniocaudally, the difference in thickness between the lower edge of the areola and the upper part of the lower pole can be recontoured, and its drawing-back resolves tuberous breast efficiently. [**See Video 2 (online)**, which demonstrates flap C harvested by splitting the extraparenchyma behind the areola craniocaudally. Once harvested, the flap is rotated downward to recontour the difference in thickness between the lower edge of the areola and the upper part of the lower pole.]

Assessment of the Implant Pocket

A breast implant is considered based on the need for volume increment. Aligning to the fibers, a subpectoralis pocket is created by electrocautery dissection. No blunt dissection occurs. Meticulous

Fig. 2. Compressive medical dressing applied at the end of the procedure.

hemostasis is strictly performed. All the implants are placed in a double plane to cover the upper part of the prosthesis with the muscle, leaving free the bottom part of the prosthesis to move the harvested flaps forward to maximize lower pole projection. (**See Figure, Supplemental Digital Content 2**, which shows dual plane location of the breast implant to increase the lower pole projection, ***http://links.lww.com/PRS/G661***. **See Figure, Supplemental Digital Content 3**, which shows the preoperative appearance of a patient with bilateral soft tuberous breasts and the intraoperative appearance of the right breast after correction with flap A plus prosthesis, ***http://links.lww.com/PRS/G662***.) Drainage is always applied.

Areola Remodeling

When a circumareolar incision is required to transpose or reduce the NAC, a 3/0 Gore-Tex interlock suture ensures the stability of the areola diameter, preventing its enlargement.[11,12]

Medical Dressing

A custom-made push-down bra will be maintained for at least 1 week to assist in maintaining the surgical result. Once removed, a compressive bra is suggested for at least 1 month (Fig. 2).

Algorithm

The algorithm is reported in Figure 1.

PATIENTS AND METHODS

A total of 118 patients have been treated for tuberous breasts from September of 2006 to December of 2019. Collected data included tuberous breast classification, surgical procedure, outcome, and complications. Inclusion criteria were presence of unilateral or bilateral tuberous breast, age older than 16 years, absence of comorbidities, and no history of previous breast surgery. Minimum follow-up was 12 months. For all patients, preoperative and postoperative photographs were collected under the same standard conditions. In the authors' practice, clinical examination and photographic documentation are routinely carried out for all patients at 1, 3, 6, and 12 months.

All the procedures were performed under local anesthesia with deep sedation during infiltration, which is reduced for the rest of the operation to ensure a sufficient degree of comfort. All patients were under strict control of vital measures (eg, blood pressure, O_2 saturation, heart activities) by an anesthesiologist during the procedure. All procedures were performed with infiltration of 100 to 150 mL of saline solution, 20 mL of 2% xylocaine, 20 mL of 2% carbocaine, 20 mL of 10% naropine, and 1 mg of adrenalin to aid hemostasis and long-lasting anesthesia.[13] Drains were placed, to be removed when output was less than 30 cc over 24 hours.

The study was carried out according to the principles of the Declaration of Helsinki, informed consent was obtained, and permission to use clinical data and photographs was obtained from all participants.

RESULTS

A total of 118 patients were included in the study; 102 had bilateral tuberous breasts, for a total of 220 breasts. The patients' mean age was 20.2 years, ranging between 16 and 31 years. Follow-up ranged between 12 and 108 months, with an average of 36.5 months.

A total of 98 hypoplastic tuberous breasts were reported: 35 soft and 63 solid. Among the 122 normoplastic tuberous breasts, 69 were type 1, 32 type 2, and 21 type 3. Among the 32 normoplastic type 2 tuberous breasts, 11 were on the left side, associated with solid hypoplastic tuberous breasts on the contralateral side.

Periareolar surgical access was approached in all cases. A total of 140 were located at the inferior border of the areola. Among the 80 circumareolar approaches, 20 vertical incisions were added: 18 in normoplastic type 2 and two in soft tuberous breasts. Except for two bilateral cases, smooth, round, soft gel breast implants were used, ranging from 140 to 245 cm.[3] Although dual-plane placement of the prosthesis represents the authors' first choice, in the presence of satisfactory upper-pole pinch test results and per patient request, four subglandular anatomic implants were placed.

The average time of the surgical procedure was 105 minutes, ranging between 80 and 135 minutes. Drains were removed according to fluid amount between the first and the fourth day, with an average of 2 days.

Secondary procedures were performed as follows: 11 lipofilling to recontour the lower pole, seven scar revisions, and two breast implant substitutions because of rupture.

Among the 118 treated patients, six (5.08%) experienced minor complications: two bilateral cases (1.69%) of Baker II capsular contraction occurred, as well as three bilateral cases (2.54%) and one unilateral case (0.84%) of NAC hypesthesia, which resolved spontaneously between the third and sixth months after surgery. Among the 220 operated breasts, three bilateral cases and one unilateral case of NAC hypesthesia and one bilateral capsular contracture occurred in patients who underwent flap A for the correction of two cases of bilateral type 1 tuberous breasts, one case of bilateral soft hypoplastic tuberous breasts, and one case of unilateral and one case of bilateral solid hypoplastic tuberous breasts, respectively. In a patient with a type 3 tuberous breast, flap C resulted in a bilateral capsular contracture. No complications were reported in patients with flap B.

No major complications, such as necrosis, delayed wound healing, hematoma requiring revision in the surgical theatre, or infection, were reported.

For patient and surgical data, **see Table, Supplemental Digital Content 4**, ***http://links.lww.com/PRS/G663***.

DISCUSSION

Rather than simply increasing volume, the goal of tuberous breast surgery aims at correcting the tuberous breast by constructing a proportionate and harmonious breast cone. The simple introduction of a prosthesis for the correction of tuberous breast hypoplasia is often a harbinger of failure, because the constriction of the breast base prevents homogeneous distribution of the parenchyma onto the entire outer surface of the implant.[14] The constricted parenchyma, enclosed above the native sulcus, misses the lower part of the prosthesis, resulting in thinner coverage and producing a double bubble.[15] To regulate the thickness of the implant coverage, the mammary base must be widened, except in normoplastic type 2 or 3 tuberous breasts. Because fibrous ring release could be insufficient to widen the gland, once the position of the neosulcus has been defined, the thickness of the tissue cover below the native sulcus must be increased. For this purpose, adipo-glandular flaps work efficiently.[16,17] Although preoperative planning of neosulcus position requires careful attention by the surgeon, the distance between the native sulcus and the apex of the mammary cone gives information about the amount of the parenchyma available for flap harvesting, whereas tissue consistency informs about mobility. Once the new IMF has been marked, the vertical height of the implant can be identified.[18]

Because of their consistency, solid hypoplastic tuberous breasts tend to retain the memory of their presurgical shape, limiting flap transposition. This detail is correlated to the selection of the most appropriate height of the prosthesis to be implanted, influencing the entity of breast volume augmentation.

Moving down the parenchyma, the logic of flap A is to fulfill the lower part of the breast implant pocket between the sulcus previo and the new IMF. Once adipo-glandular flaps have been dissected completely, they may be shaped with many score incisions proximally, improving the distribution when transferred downward into the neosulcus. (**See Figure, Supplemental Digital Content 5**, which shows scoring of the proximal edge of flap A to optimize the evenness of the glandular coverage of the implant onto the new IMF, ***http://links.lww.com/PRS/G664***.) Because normoplastic type 1 tuberous breasts are missing the inferior medial part of the breast, a more oblique orientation of the major axis of flap A may be helpful to reach the more distant part of the missing breast to be reconstructed.

Inverting the ratio between the length of the superior/inferior pole profile, the brief distance between the NAC and the IMF of normoplastic type 2 tuberous breasts points the areola downward. Because almost all the parenchyma is constricted in the upper pole and placed above the IMF, a ptotic breast appearance is usually simulated because of the inverted ratio between the profiles of the upper and lower pole. To create a proportionate contour of the mammary cone, a simple mastopexy will not be sufficient, and creation of a normal ratio should be considered by transferring the extra parenchyma confined in the upper pole to the lower quadrants. By this logic, flap B works efficiently.

The logic of flap C is to produce a telescopic drawing back of the areola, realigning its prominent aspect.[19] The removed extra parenchyma behind the areola provides an increment of thickness below the distal edge of the areola, recontouring the profile of the upper part of the lower pole, where usually a residual depression could remain to distort the profile of the mammary cone.

Even if autologous fat grafting could represent a useful tool, because of the unpredictable results of the procedure, multiple surgical steps could be required; moreover, a suitable fat donor site is essential for both quantity and quality, and this condition is not always present. Considering these aspects, lipofilling is a suitable method for soft-tissue increment or breast-contour refining, but the risk of oil cysts should be kept in mind. On the other hand, adipo-glandular flaps provide vascularized tissue, allowing tissue transfer from the extraparenchyma to the lacking quadrants in a one-step procedure. Because local flaps do not permit real soft-tissue volume increment, as in fat grafting, but only volume displacement, they ensure a predictable and reliable vital tissue support attributable to the vascular network, reducing the risk of fat necrosis and therefore the loss of tissue.

Anatomic implants allow more natural results, but prosthesis rotation may occur over time, except for polyurethane foam–coated breast implants. Anaplastic large-cell lymphoma has been related to the use of textured prosthesis. Smooth round implants avoid rotation problems and are less related to anaplastic large-cell lymphoma incidence, although a less natural aspect of the upper pole can occur.[20,21] According to the Tebbets dual-plane pocket technique, submuscular placement of the upper edge of the round prosthesis allows more natural results.[22] In the presence of a soft silicone gel round breast implant, muscular resistance onto the cranial part of the device displaces the gel downward, in the lower part of the prosthesis, producing a more classic anatomic shape and therefore more acceptable results.[23] The difference between anatomic versus round implants is particularly evident in the presence of large breast prostheses, the use of which could be difficult in tuberous breast correction.[24] The submuscular location of the implant reduces the incidence of capsular contraction and guarantees more valid coverage of the implant rather than the gland, which may atrophy because of the presence of the breast implant itself and the natural aging process.[25] For these reasons, anatomic implants could be a suitable solution in case of subglandular positioning of the device in the presence of valid pinch test results, which are rarely observed in hypoplastic tuberous breasts. To obtain more stable and long-lasting results, in the presence of asymmetry, volume is usually addressed through a reduction of the larger breast rather than using different implants.[26,27]

Compared with the several techniques proposed in the literature for tuberous breast correction, one of the authors' key objectives is to highlight the importance of areolar surgical access to avoid scarring displacement that may occur with the IMF approach. Even in simple breast augmentation, planning the exact position of IMF surgical access presents a challenge to even the most skilled surgeon. In the presence of tuberous breast, where sulcus modification represents a mandatory step, inframammary surgical access requires an exact preoperative plan of the neosulcus. Even if the inframammary scar position can be optimized by Scarpa fascia anchoring, scarring could be difficult to contain in a bra, especially during upper arm movement. With scarring displacement kept in mind, areola access represents a valid approach to maximize the final result, with a barely visible scar. An areolar surgical approach allows good visibility of the surgical field during flap harvest and fibrous ring release; allows NAC translocation in a more suitable position; and allows telescopic realignment of the areola, including its reshaping.

Flap fixation, performed through transcutaneous stitches, should remain in place for at least 3 weeks to ensure stability. Medical dressing is a mandatory step: at the end of the surgical procedure, a bra, tailored with adhesive garments, contributes to maintain the forward projection of the lower pole for the first week. The use of a breast compression belt, applied to the upper pole, and minimal physical activity are strongly suggested for the first month.

Clinical cases are shown in the Supplemental Digital Content. (**See Figure, Supplemental Digital Content 6**, which shows preoperative and postoperative frontal views of the soft hypoplastic tuberous breast, ***http://links.lww.com/PRS/G665***. **See Figure, Supplemental Digital Content 7**, which shows preoperative and postoperative frontal views of the solid hypoplastic tuberous breast, ***http://links.lww.com/PRS/G666***. **See Figure, Supplemental Digital Content 8**, which shows preoperative and postoperative frontal views of the type 1 normoplastic tuberous breast, ***http://links.lww.com/PRS/G667***. **See**

Figure, Supplemental Digital Content 9, which shows preoperative and postoperative frontal views of the type 2 normoplastic tuberous breast showing high grade of asymmetry, ***http://links.lww.com/PRS/G668***. **See Figure, Supplemental Digital Content 10**, which shows preoperative and postoperative lateral views of the type 3 normoplastic tuberous breast, ***http://links.lww.com/PRS/G669***.)

CONCLUSIONS

Tuberous breast correction requires careful assessment because of the complexity of its pathologic hallmarks, after which preoperative planning can be performed and a surgical strategy developed. The proposed algorithm, including a comprehensive classification, preoperative planning, and surgical approach derived from the authors' experience, could help elucidate the most appropriate surgical approach for each type of tuberous breast.

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DISCLOSURE

The authors have no commercial associations or financial interest to declare in relation to the content of this article. No external funding supported this study.

PATIENT CONSENT

Patients provided written informed consent for the use of their images.

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