

Breast Implant and Fat Grafting With Radial Scoring for Tuberous Breast Deformity With Lower Pole Constriction: A Retrospective Cohort Study

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Background: Diverse surgical techniques can be used to correct tuberous breast deformity (TBD). This study aimed to analyze lower pole expansion using breast implants and fat grafting with radial scoring for TBD correction.

Methods: This retrospective study included patients who underwent TBD surgery between 2018 and 2022. All patients in whom a breast implant was used were included. Two groups were considered according to the use of fat grafting. Patients and surgeons assessed aesthetic outcomes at follow-up using the Aesthetic Items Scale.

Results: Sixty-two patients (median age of 30 y) were included in the study. Fat grafting was performed in 42 (67.7%) patients, and the volume of fat used was 65 (35–120) mL. No significant differences existed in radial scoring use (16 [80.0%] versus 35 [83.3%]) between the groups. In the fat grafting group, the Aesthetic Items Scale improved in shape, volume, symmetry, and total score. No patients reported altered sensitivity, and only 1 (1.6%) required revision surgery.

Conclusions: Combining diverse surgical techniques (implants, fat grafting, radial scoring) was associated with good aesthetic outcomes in TBD correction. This approach may be considered a feasible surgical approach for TBD. (*Plast Reconstr Surg Glob Open* 2025;13:e7045; doi: [10.1097/GOX.00000000000007045](https://doi.org/10.1097/GOX.00000000000007045); Published online 22 August 2025.)

INTRODUCTION

Tuberous breast deformity (TBD) is a congenital anomaly that presents with varying degrees of severity, including lower pole constriction, inferior breast skin deficiency, superiorly displaced inframammary fold, parenchymal hypoplasia, breast asymmetry, and areolar herniation.¹ It causes significant discomfort to affected patients and challenges surgeons due to its varied nature, necessitating management by expert surgeons. Precise assessment and careful surgical procedure selection are crucial for optimal outcomes.

However, TBD prevalence in the general population remains unclear. Several studies have investigated the prevalence of TBD in specific populations. DeLuca-Pytell et al² found that 88.8% of patients presenting with breast asymmetry had TBD. Klinger et al³ found that the prevalence of TBD in patients undergoing breast reduction and augmentation was approximately 50%. These results suggest that its prevalence is extremely high in specific populations. Recognizing and correctly classifying this condition is necessary to implement an appropriate surgical approach and achieve optimal aesthetic results.

Depending on the predominant abnormality, diverse surgical techniques can be combined to address TBD. One such technique is fat grafting. Fat grafting was first described as a single technique (without breast implants) for treating TBD.⁴ However, we have recently described the use of fat grafting as an adjuvant for lower pole expansion.⁵ Combining fat grafting and lower pole expansion to address parenchymal deficiency provides surgeons

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Anonymized data will be made available upon request, subject to approval by our institutional review board.

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with a new understanding of TBD's structural limitations and facilitates corrective surgery. Lower pole expansion, aimed at stretching inadequately sized lower quadrants, can also be achieved through mechanical methods (tissue expanders, breast implants with/without radial scoring) or by adding tissue (fat grafting or local flaps).

We hypothesized that lower pole constrictions behave similarly to scar tissue retraction and respond to mechanical expansion and fat grafting. This study aimed to describe the procedure and the aesthetic results of lower pole expansion using fat grafting in combination with other surgical techniques for the TBD correction.

MATERIALS AND METHODS

Study Design

This is a retrospective study that included patients undergoing surgical correction of TBD at Hospital Quironsalud Barcelona (Spain) from January 2018 to December 2022. The local ethics committee approved the study, and the requirement for informed consent was waived because of the retrospective nature of the study. Informed consent was obtained from the patients shown in the figures. To ensure the rigor and transparency of our research, we adhered to the Strengthening the Reporting of Observational Studies in Epidemiology guidelines for reporting observational studies.⁶

Patients Included

All patients undergoing TBD correction during the study period were included. We excluded those patients in whom breast implants were used.

Variables Recorded

Demographic and clinical data were collected from electronic patient records. These variables included sex, age at the time of surgery, preoperative bra cup size, and presence of areolar herniation. We classified these using the von Heimburg,⁷ Grolleau et al,⁸ and Costagliola et al⁹ criteria. We also recorded variables related to the surgical procedure, such as the use of breast implants, implant shape (round or anatomical), height and volume, implant pocket, type of skin incision, and the need for mastopexy, fat grafting, radial incisions, or local flaps. Finally, the follow-up time, aesthetic results, lower pole expansion, and need for secondary revision surgery were also documented.

Surgical Technique

The patients were evaluated in an upright position to delineate critical anatomical landmarks. The inframammary fold, axillary and medial lines, and superior mammary border were marked to define the dissection limits. Periareolar markings were also made. The inframammary fold was repositioned in cases where the distance from the original inframammary fold to the areolar border, under maximum manual cranial traction, was less than 5 cm. Further, the original fold was preserved when this distance was 5 cm or greater.

Takeaways

Question: How does combining breast implants, fat grafting, and radial scoring improve the correction of tuberous breast deformity, especially for lower pole constriction?

Findings: In this retrospective study of 62 patients, combining breast implants, fat grafting, and radial scoring was feasible and may be associated with good aesthetic outcomes in tuberous breast correction.

Meaning: The combined use of breast implants, fat grafting, and radial scoring may be a feasible approach to potentially enhance outcomes in tuberous breast deformity correction.

The flanks were identified as optimal donor sites for fat grafting owing to their ample fat reserves and accessibility. This procedure was designed to minimize bleeding and facilitate fat extraction by inducing local vasoconstriction (using adrenaline at a concentration of 1:200,000). After allowing 20 minutes for adrenaline to exert its vasoconstrictive effects, the fat was liposuctioned using a sterile closed collection system. The collected fat was then decanted into 10-mL overlock syringes for subsequent use.

The periareolar approach was selected for cases presenting with clinically significant areolar herniation or where areolar reduction or symmetrization was indicated (ie, all cases in the present cohort). Dissection progressed perpendicularly through the gland directly to the prepectoral fascia. Prefascial dissection was then performed inferior to the limits of the marked inframammary fold line. Subsequently, the prosthetic pocket was dissected in the cranial and medial directions, lifting the inferior border of the pectoralis major (in dual-plane cases) and the subglandular border (in prepectoral implant cases). Hemostasis was achieved after establishing the prosthetic pocket. Implant size selection was guided by intraoperative evaluation to achieve optimal aesthetic outcomes. The implant sizer was tractioned cranially to feel the constricted gland ring firmly and increase lower pole tension.

Additionally, radial incisions were made within the gland using electrocautery until the complete liberation of the constricted tissue was confirmed. The procedure was concluded by evaluating the lower pole expansion and symmetry while the patient was in a semiseated position. Temporary closure was performed using staples to assess lower pole descent accurately. Areas with lower pole deficiency were marked for subsequent enhancement using fat grafting, thereby ensuring a harmonious and aesthetically pleasing breast contour.

Fat grafting was performed in the supine position with the sizer in place and provisional periareolar closure. The fat grafts were infiltrated and placed according to the markings, with a radial distribution from the nipple-areolar complex and a transversal pattern above the theoretical inframammary fold, particularly in the inner lower quadrant.¹⁰

After the placement of the fat grafts, the implant sizer was removed, and exhaustive washing and hemostasis checks were performed. The dissection planes were

then drained using closed suction drains in all cases. Subsequently, a definitive implant was placed according to choice using a sizer and closed in layers. An interlocking purse-string suture with a nonabsorbable suture material coapts the concentric incision lines and reduces the areolar surface area and projection. Running intradermal absorbable monofilament sutures were used for complete closure. (See Video [online], which demonstrates the operative technique for correcting TBD.)

Qualitative Evaluation of the Aesthetic Result

The evaluation of the aesthetic result was performed using the Aesthetic Items Scale (AIS)^{11,12} by 2 plastic surgeons who did not take part in the surgery and, therefore, were not aware of the surgical technique used in the evaluated patient. Briefly, standardized photographs of the breast area were taken, spanning from shoulder level to the level of the umbilicus. The breasts were evaluated in terms of volume, shape, symmetry, scars, and nipple-areolar complex. A 5-point Likert scale was used to score each of these items. The scale ranged from “very dissatisfied,” “dissatisfied,” “neutral,” “satisfied,” to “very satisfied” (from 1 to 5, respectively). The total aesthetic score was defined as the summed score of the 5 items (ranging from 5 to 25).

Statistical Analysis

Continuous variables were expressed as mean (SD) or median (interquartile range), whereas categorical variables were presented as frequencies (percentages). Two different groups were described based on the use of fat grafting.

Table 1. Baseline Characteristics of the Study Population

Variable	Without Fat Grafting (n = 20)	With Fat Grafting (n = 42)
Age (y), median (p25–p75)	30 (26–34)	30 (26–32)
Time of follow-up (y), median (p25–p75)	2.6 (2.4–7)	2.6 (2.5–2.8)
Areolar herniation, n (%)		
None	12 (60)	24 (57.1)
Intermittent	8 (40.0)	11 (26.1)
Permanent	2 (20.0)	5 (11.9)
Von Heimbürg classification, n (%)		
Type I	1 (5.0)	8 (19.0)
Type II	13 (65.0)	25 (59.5)
Type III	6 (30.0)	9 (21.5)
Grolleau classification, n (%)		
Type I	11 (55.0)	22 (52.4)
Type II	9 (45.0)	19 (45.2)
Type III	0	1 (2.4)
Costagliola classification, n (%)		
Type I	9 (45.0)	21 (50.0)
Type II	11 (55.0)	20 (47.6)
Type III	0	1 (2.4)

RESULTS

General Characteristics

Thirty patients with a median age of 30 (22–33) years at the time of surgery were included in the study. The patients' preoperative bra sizes ranged from A to C, with 23 (37.1%) patients having A cups, 21 (33.9%) patients having B cups, and 18 (29.0%) patients having C cups. No differences in the median time of follow-up or the type of areolar herniation were observed between groups (Table 1).

Table 2. Surgical Technique Characteristics and Outcomes

Variable	Without Fat Grafting (n = 20)	With Fat Grafting (n = 42)
Type of incision, n (%)		
Periareolar	6 (30.0)	15 (35.7)
Inframammary fold	10 (50.0)	20 (47.6)
Anchor	4 (20.0)	7 (16.7)
Use of breast implant, n (%)	20 (100)	42 (100)
Position of the breast implant, n (%)		
Prepectoral	12 (60.0)	22 (52.4)
Retropectoral	8 (40.0)	20 (47.6)
Breast implant shape, n (%)		
Anatomical	2 (20.0)	8 (19.0)
Round	18 (80.0)	34 (81.0)
Breast implant placement, n (%)		
Prepectoral	9 (45.0)	19 (45.2)
Retropectoral	11 (55.0)	23 (54.8)
Breast volume, mL		
Right breast, median (p25–p75)	280 (260–300)	295 (240–330)
Left breast, median (p25–p75)	280 (260–300)	280 (240–330)
Mastopexy, n (%)	11 (55.0)	22 (52.4)
Radial scoring, n (%)	16 (80.0)	35 (83.3)
Alteration of the cutaneous sensibility, n (%)	0 (0)	0 (0)
Need for reintervention, n (%)	0 (0)	1 (2.4)
Total fat used (mL), median (p25–p75)	NA	65 (35–120)
Increase of distance between the nipple and the inframammary fold after surgery (cm), median (p25–p75)	2.2 (2.0–2.5)	2.7 (2.5–2.9)
AIS, median (p25–p75)		
Volume	4 (3–5)	5 (5–5)
Shape	4 (3–5)	5 (5–5)
Symmetry	4 (3–5)	5 (4–5)
Scars	4 (4–5)	5 (4–5)
Nipple-areolar complex	4 (4–5)	5 (4–5)
Total	21 (20–23)	24 (23–25)

AIS ranges from 1 to 5 (“very dissatisfied” corresponds to 1, “dissatisfied” to 2, “neutral” to 3, “satisfied” to 4, and “very satisfied” to 5) for each variable. The total score ranged from 5 to 25, with higher scores indicating better performance.

NA, not applicable.

Surgical Procedures

Fat grafting was used in 42 (67.7%) patients, whereas it was not used in 20 (22.3%) patients. Table 2 depicts the characteristics of surgical treatment according to the group. No differences were observed in the placement of breast implants (prepectoral or retropectoral). Round implants were used more frequently in both groups, with no significant intergroup differences. In all cases, a moderate profile and cohesive silicone gel was used. Furthermore, the rate of radial scoring was similar in both groups. The median fat volume used for grafting was 65 mL (range: 35–120 mL). No clinically evident complications related to fat grafting were observed during the follow-up period (ie, necrosis, cysts, or calcifications). The distance between the nipple and the inframammary fold was higher in the fat grafting group (2.7 [2.5–2.9] versus 2.2 [2.0–2.5] cm).

Aesthetic Result

The use of fat grafting was associated with good aesthetic results (Table 2). Higher scores were observed in 3 of the 5 items of the AIS: volume, shape, and symmetry. Conversely, no differences were reported in scars and nipple-areolar complex. Finally, the total score was also higher in the fat grafting group. Illustrative cases demonstrating the

spectrum of patient presentations and surgical outcomes are presented in Figures 1–3.

DISCUSSION

In this study, we present the first and largest cohort of patients in whom fat grafting was used in combination with breast implants and radial scoring for TBD correction. The use of fat grafting was associated with good aesthetic results. Notably, this was associated with a significant increase in the distance between the nipple and inframammary fold postsurgery. With these results, we proposed a new algorithm combining different surgical techniques according to patients' characteristics, facilitating the decision-making process and individualization of the surgical treatment to enhance aesthetic results and patient satisfaction (Fig. 4).

TBD is highly individualized. Although valuable and well-conceptualized algorithms exist,¹ it is up to the surgeon's judgment to plan a surgical strategy for each breast and patient. Understanding the mechanics underlying the morphological changes observed in patients with TBD will help guide treatment strategies and simplify the selection process. Insufficient lower pole expansion is a common preoperative complaint in patients with TBD.

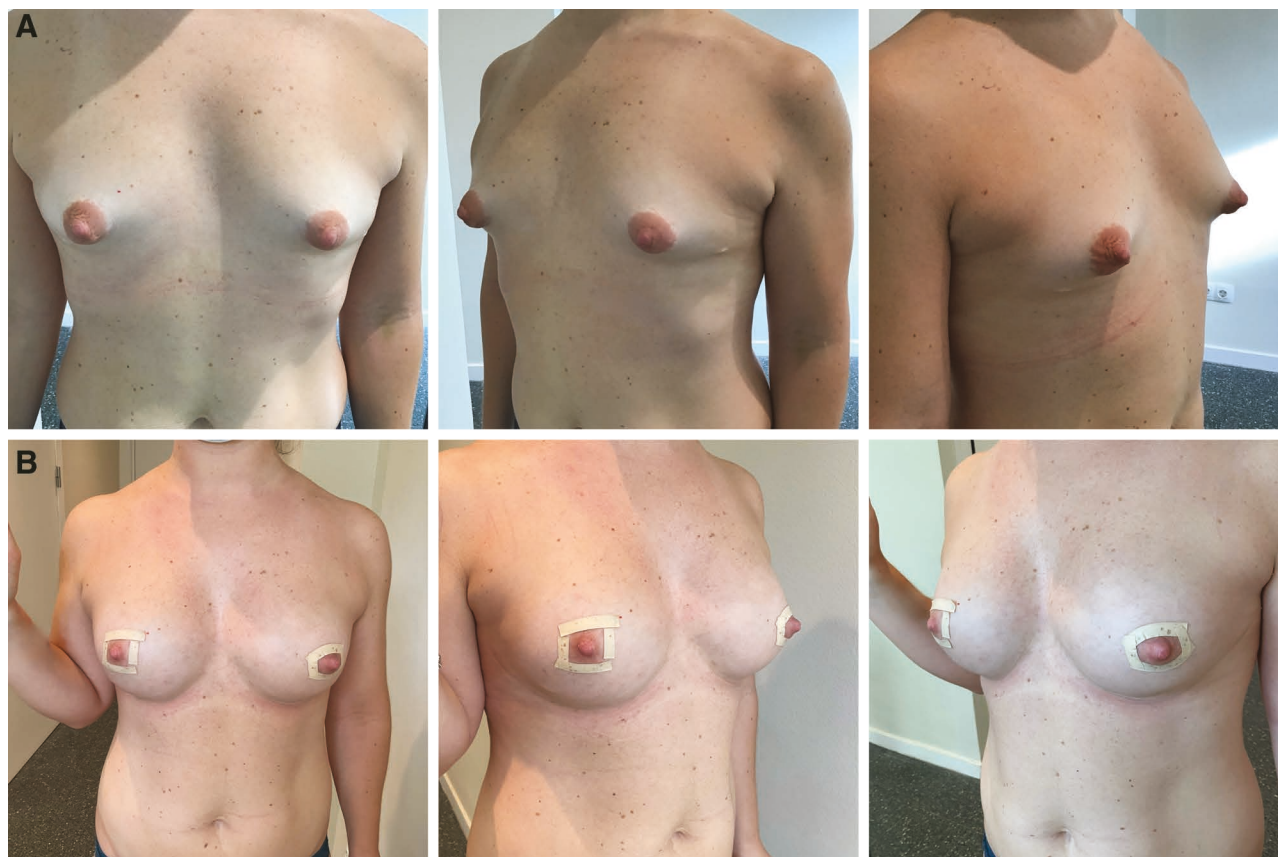


Fig. 1. Tuberos breast correction. A, Preoperative views of a 36-year-old patient with type I TBD. B, Postoperative views at 10 months after correction with circumareolar scar, radial scoring, fat grafting (70 mL), and prepectoral placement of Sebbin semimoderate profile LS 74 245 implants in both breasts.

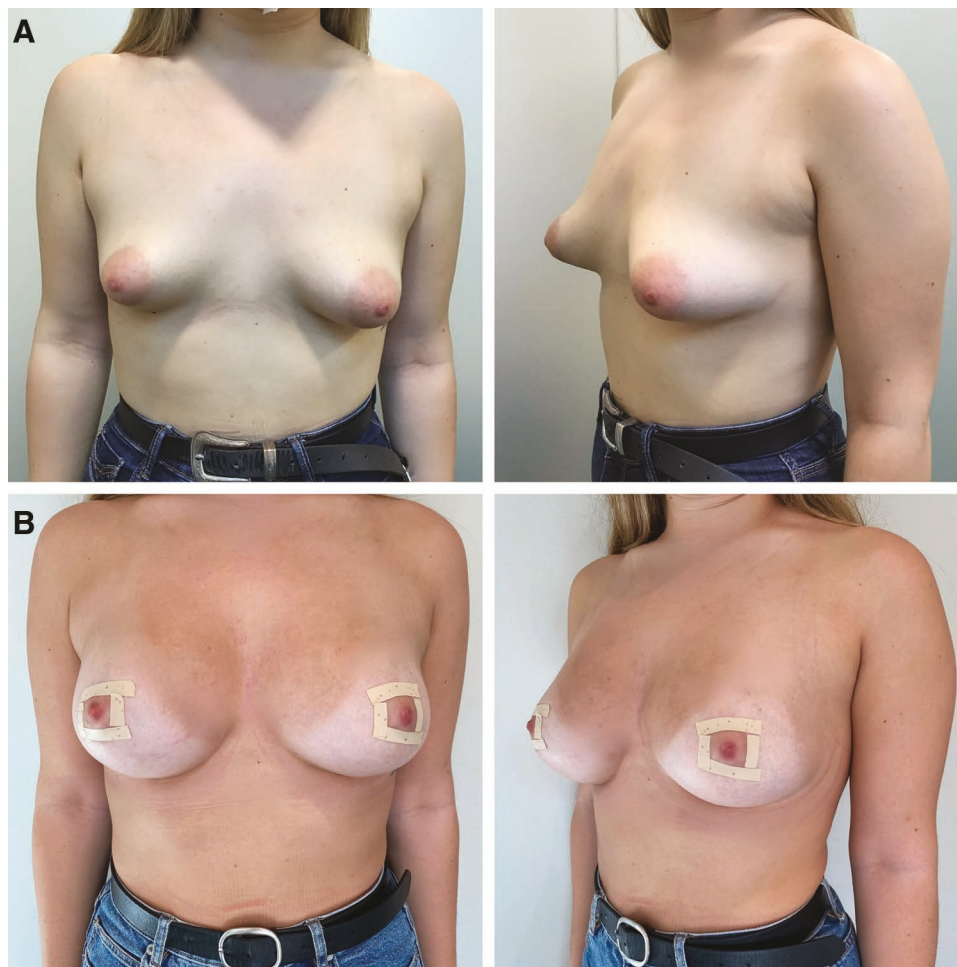


Fig. 2. Tuberous breast correction. A, Preoperative views of a 28-year-old patient with type II and III TBD in the right and left breast, respectively. B, Postoperative views at 10 months after correction with circumareolar scar, radial scoring, fat grafting (100 mL) with left mastopexy, and prepectoral placement of Sebbin semimoderate profile LS 74 245 implants in both breasts.

Functionally, the lower pole of a tuberous breast, particularly the lower medial quadrant, behaves like a constricted scar. Therefore, the current surgical strategies are similar to those used for contracted scars. Radial or other scoring techniques of the glandular and subcutaneous tissue are similar to scar release. However, fat grafting can also improve scarring by creating an intermediate layer that prevents or reduces retraction to deep planes and improves pliability.¹³ This may be partially mediated by the modulatory effects of adipose-derived stem cells and cell growth and differentiation mediator molecules, such as vascular endothelial growth factor.¹⁴

The effects of fat grafting may not be evident intraoperatively or during the early postoperative period. Fat graft retention may be influenced by several factors, such as inflammatory status or patient age.¹⁵ However, it improves long-term outcomes by facilitating natural ptosis of the breast and lower pole expansion with no recurrence of constriction, which is particularly relevant in TBD correction. A significant difference in the postoperative increase in the distance between the nipple and inframammary fold was observed. This result, along with improvements

in volume and shape as measured by the AIS, suggests that the use of fat grafting in combination with other surgical techniques in the overall management of TBD may improve aesthetic-related outcomes.

Expected areolar herniation remains a contentious subject. Klinger et al⁸ aimed to study the prevalence of TBD in patients with augmentation and reduction mammoplasty, finding parenchymal areolar herniation in 53.1% of cases as the most common finding. The distribution of intermittent and permanent herniations may be related to severity. The distinction between nonherniated and herniated mammary glands through the nipple–areolar complex has crucial technical significance at the surgical stage. Improperly addressing this can compromise the final aesthetic result.

Patient satisfaction and aesthetic enhancement in TBD cases are generally favorable, largely attributable to the marked improvement in breast morphology and symmetry postintervention. Using a patient-specific, problem-oriented approach is essential for plastic surgeons to assist in the therapeutic decision-making process and improve

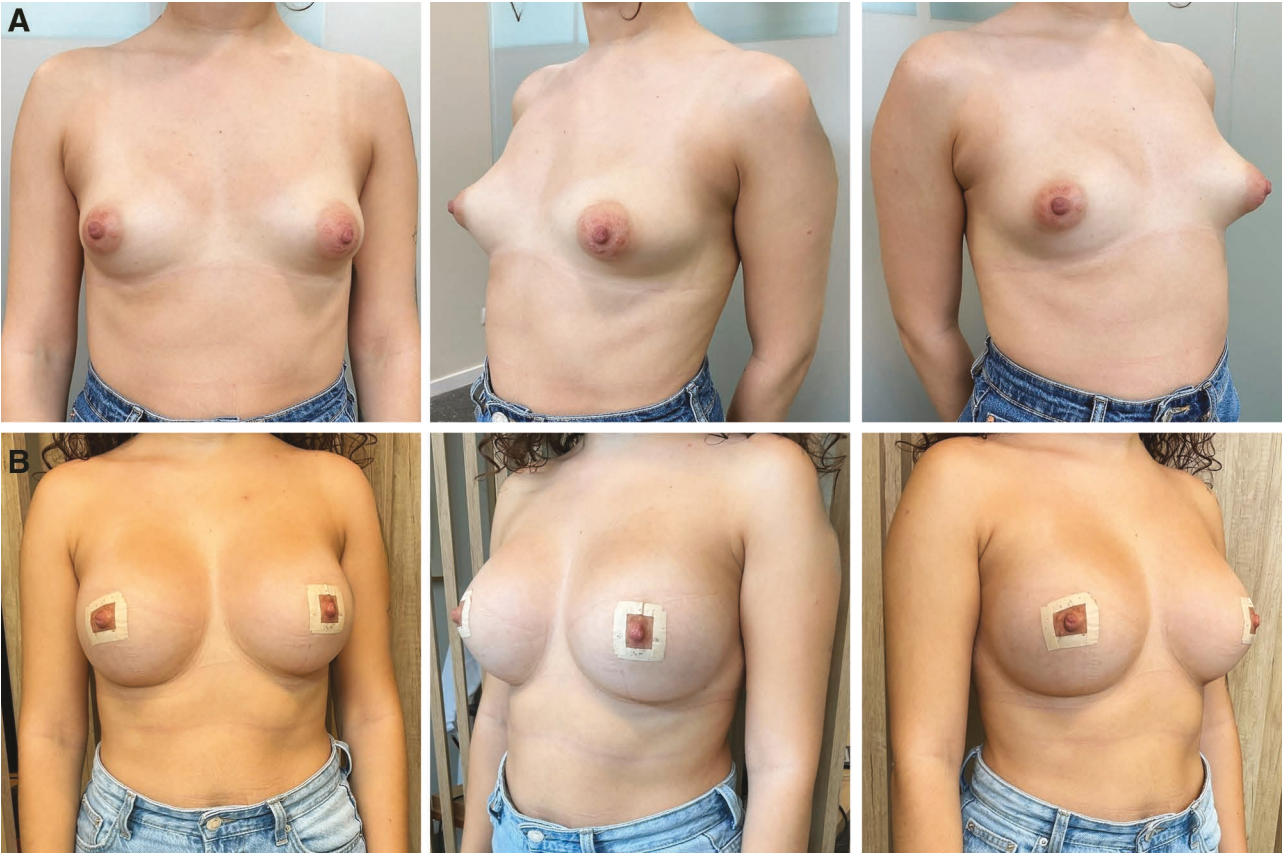


Fig. 3. Tuberous breast correction. A, Preoperative views of a 27-year-old patient with type III and IV TBD in the right and left breast, respectively. B, Postoperative views at 6 months after correction with circumareolar scar, radial scoring, fat grafting (120 mL) in both breasts, and prepectoral placement of Sebbin semimoderate profile LS 70 330 implants in both breasts.

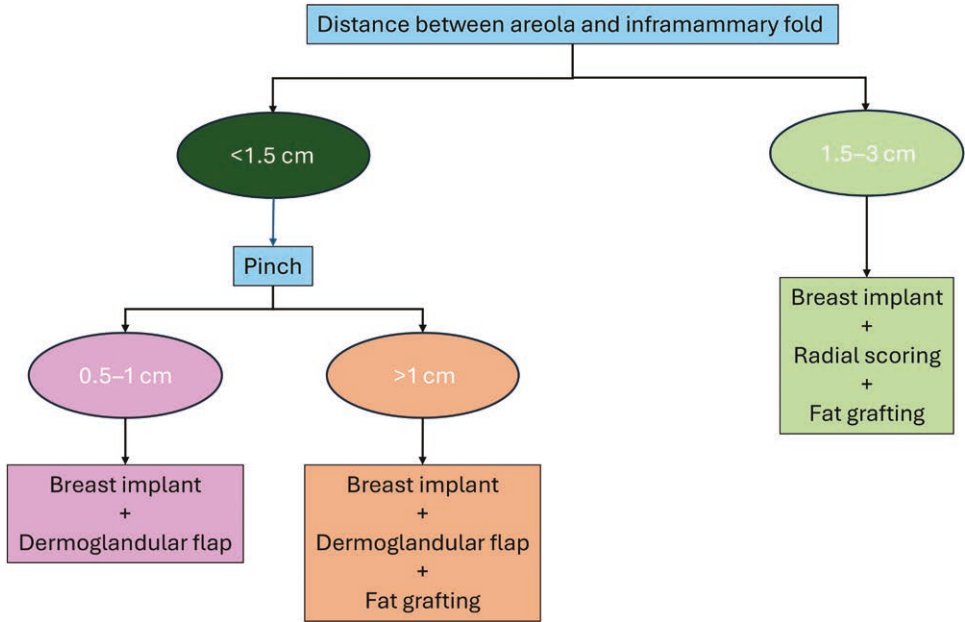


Fig. 4. Proposed algorithm to personalize the surgical approach of the tuberous breast disease.

outcomes. In our cohort, improved aesthetic results were reported with fat grafting.

Our study had some limitations. First, this is a retrospective single-center observational study. However, the aesthetic results obtained are relevant and have led us to describe an algorithm for treating TBD that needs to be prospectively assessed. Second, the AIS scale was described in patients with breast reconstruction after mastectomy. The results of the AIS scale may be highly subjective, and 5 different plastic surgeons were used for this assessment. Moreover, the patients may perceive the aesthetic results differently from the surgeons. Thus, the aesthetic results reported need further validation. Third, this is a descriptive study, and no formal statistical analysis was performed. Although the groups seemed balanced in terms of main clinical variables and those related to the surgical procedure, multiple variables may still influence the outcome. Fourth, the role of mastopexy in perceived outcomes was not assessed. However, no difference in the rate of mastopexy use between groups was observed. Fifth, no specific assessment of potential complications was performed using imaging techniques during the follow-up period. This is due to the fact that it is a nonrandomized retrospective study, and none of these techniques are routinely used as a screening test in patients with no clinical signs of potential complications. In addition, the follow-up period was relatively short, and therefore, the occurrence of long-term complications related to fat grafting use cannot be excluded. Considering all these limitations, further research with a prospective randomized controlled trial, including a larger sample size and using tools for standardized patient-centered outcomes, would be beneficial to validate and extend our findings.

In conclusion, a better understanding of TBD pathophysiology is crucial for refining surgical treatment strategies. Our study suggests that combining fat grafting with breast implants and radial scoring is a feasible surgical approach that achieves good aesthetic outcomes in TBD correction.

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DISCLOSURE

The authors have no financial interest to declare in relation to the content of this article.

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REFERENCES

1. Rees TD, Aston SJ. The tuberous breast. *Clin Plast Surg*. 1976;3:339–347.
2. DeLuca-Pytell DM, Piazza RC, Holding JC, et al. The incidence of tuberous breast deformity in asymmetric and symmetric mammoplasty patients. *Plast Reconstr Surg*. 2005;116:1894–1899; discussion 1900.
3. Klinger M, Caviggioli F, Giannasi S, et al. The prevalence of tuberous/constricted breast deformity in population and in breast augmentation and reduction mammoplasty patients. *Aesthetic Plast Surg*. 2016;40:492–496.
4. Brault N, Stivala A, Guillier D, et al. Correction of tuberous breast deformity: a retrospective study comparing lipofilling versus breast implant augmentation. *J Plast Reconstr Aesthet Surg*. 2017;70:585–595.
5. Ruiz-Castilla M, Dos Santos B. Inferior pole expansion with lipofilling for tuberous breast surgery. *Clin Surg*. 2021;6:3287.
6. von Elm E, Altman DG, Egger M, et al; STROBE Initiative. The Strengthening of Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. *J Clin Epidemiol*. 2008;61:344–349.
7. von Heimburg D. Refined version of the tuberous breast classification. *Plast Reconstr Surg*. 2000;105:2269–2270.
8. Grolleau JL, Lanfrey E, Lavigne B, et al. Breast base anomalies: treatment strategy for tuberous breasts, minor deformities, and asymmetry. *Plast Reconstr Surg*. 1999;104:2040–2048.
9. Costagliola M, Atiyeh B, Rampillon F. Tuberous breast: revised classification and a new hypothesis for its development. *Aesthetic Plast Surg*. 2013;37:896–903.
10. Kolker AR, Collins MS. Tuberous breast deformity: classification and treatment strategy for improving consistency in aesthetic correction. *Plast Reconstr Surg*. 2015;135:73–86.
11. Visser NJ, Damen THC, Timman R, et al. Surgical results, aesthetic outcome, and patient satisfaction after microsurgical autologous breast reconstruction following failed implant reconstruction. *Plast Reconstr Surg*. 2010;126:26–36.
12. Dikmans REG, Nene LEH, Bouman MB, et al. The Aesthetic Items Scale: a tool for the evaluation of aesthetic outcome after breast reconstruction. *Plast Reconstr Surg Glob Open*. 2017;5:e1254.
13. Negenborn VL, Groen JW, Smit JM, et al. The use of autologous fat grafting for treatment of scar tissue and scar-related conditions: a systematic review. *Plast Reconstr Surg*. 2016;137:31e–43e.
14. Yu F, Witman N, Yan D, et al. Human adipose-derived stem cells enriched with VEGF-modified mRNA promote angiogenesis and long-term graft survival in a fat graft transplantation model. *Stem Cell Res Ther*. 2020;11:490.
15. Trotzier C, Sequeira I, Auxenfans C, et al. Fat graft retention: adipose tissue, adipose-derived stem cells, and aging. *Plast Reconstr Surg*. 2023;151:420e–431e.