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ORIGINAL ARTICLE BREAST SURGERY

Tuberous Breast Deformity Correction: 12-year Experience

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Abstract

Background This article shows our 12-year experience in application of the technique of breast parenchyma modification with simultaneous augmentation on the tuberous breast. We undertook the study, and with the results of this study we can say that tuberous breast deformation is a common pathology that is caused not only by a thickening of the superficial fascia but also by breast parenchyma fibrosis. When traditional techniques without parenchyma modification are used during the surgery, it is often that patients come back to treat complications.

Methods A total of 208 patients (414 breasts) with tuberous breast deformation treated from 2005 to 2017 were included. The mean patient age was 31 years (range, 22–53 years). A periareolar approach, vertical and horizontal glandular scoring, dual-plane pocket creation, and anatomic implants were used in all cases.

Results The mean follow-up was 36 months (range, 3–144 months). Deformities of the types I–IV by Von Heimburg were corrected. The global complication rate for all patients in this study was 8.9%—1.4% had capsular contracture, 1.5% had postoperative malposition, 2% had "double bubble" , 2% had rippling, 2% had areola and nipple sensitivity disorder.

Conclusion The authors' experience demonstrates that the described one-stage approach combining mammary gland parenchyma modification (glandular scoring) with dual-plane pocket and anatomic implants provides satisfactory results for treatment of tubular breast deformity with minimal complications and other effects that require repeated treatment.

Level of Evidence IV This journal requires that authors assign a level of evidence to each article. For a full description of these Evidence-Based Medicine ratings, please refer to Table of Contents or the online Instructions to Authors www.springer.com/00266.

Keywords Glandular scoring · Tuberous breast · Herniated areola · Breast asymmetry · Constricted breast · Parenchyma modification technique

Introduction

Tuberous breast deformity leads to a poorer quality of life for the woman and causes psychosocial discomfort as well as within their sexual life. The wide range of presentations, in conjunction with frequent situations of positional asymmetry, poses great challenges to consistency in attempted surgical correction procedures.

Tuberous breast constitutes a difficult congenital breast anomaly that arises from a pathology in the mammary glandular structure and presented at the age of puberty. The characteristics of the tuberous breast deformity include: parenchymal hypoplasia, breast base constriction, inferior breast skin deficiency, superior malposition of the IMF, areolar herniation, and asymmetry [1].

The multiple pathologies involved in tuberous breast deformity have led to many descriptions and systems for

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nomenclature for the deformity; tuberous breast [2, 3], constrictive breast [3], lower pole constriction [2], lower pole hypoplasia [2, 3], areola hernia [4], areolar breast [5], breast with narrow base [2, 3], dome-shaped areola [4], etc.

The classification of tuberous breast deformation was first introduced by Von Heimburg in 1996 and followed later by further specification of the classification in 2000 [3]. He reviewed the preoperative photographs of 40 patients (68 breasts) with varying degrees of mild to severe tuberous breast deformity, and he classified the deformity into four types; however, subsequent classifications were described involving areolar herniation and ptosis [1, 6].

Grolleau later modified the first classification system and assigned only three group types, as no objective or clinical difference could be seen between Von Heimburg types II and III [7]. Afterward, there have been other authors who have tried to extract exacting identifiable features for classification in selecting the most appropriate surgical approach to utilize. Among the approaches, there is the Egle Mutti classification, which describes three fundamental types of tuberous breasts, including a detailed description of a specific corresponding type of glandular flap correction [8].

The etiology of tuberous breast is unclear. There are several theories for its origin. Dr. Glaesmer (1930) suggested a phylogenetic relapse and Pers (1968), postulating that there is a failure of tissue differentiation in a limited zone of the fetal thorax [9]. These theories were effective in explaining deformities consistent with amastia and Poland syndrome. However, more recent theories point to a simpler explanation that highlights the abnormal superficial fascia or in weakness of the periareolar supporting tissues in the tuberous breast.

The aim of this study is to present a single-stage surgical technique to reach a successful stable treatment of tuberous breast deformity. The technique includes parenchyma modification of the mammary gland with simultaneous augmentation including anatomical implants in dual-plane pockets.

Materials and Methods

The authors treated tuberous breast type (I–IV Von Heimburg) by simultaneous parenchyma modification technique and augmentation. This study was conducted on 208 women (414 breasts) from 2005 to 2017 with ages ranging from 22 to 53 year with a mean age of 31 years.

The follow-up period ranged from 3 to 144 months with an average follow-up of 36 months. We evaluated patient satisfaction with the "Quality of Life" scale grade, BREAST-Q. This scale quantifies one's personal feelings about their own body, and how each woman feels about herself with and without clothing. The scale included satisfaction with their breasts, regarding the size, symmetry, breast softness.

All patients had tuberous breast deformity by classification of Von Heimburg from type I to type IV (more often type III–IV). As a rule, there was parenchymal hypoplasia of the lower medial and the lateral quadrants, inferior breast skin deficiency, small breast base constriction, a strong adhesion between skin and gland, constricted lower pole, and superior malposition of the IMF.

With such a situation, it was necessary for us to reach two aims: the relaxation of the constrictive fibrotic base of the gland and also to increase the fullness of the lower pole.

Because of the small breast size, the patients required augmentation and accordingly to thus significantly increase covering the possibilities of the gland to cover the implant.

When there is a tuberous deformity, the parenchyma of the breast has a changed thick fibrotic structure. We utilize small portions of the gland taken from the lower quadrant, along its very edge to the fascia, and the central part of the gland on the border of the upper and lower quadrants, extracted from the glandular mass of the initial histological examination.

During such histological study, we found large concentrations of collagen and elastic fibers not only on the periphery in the area of the constrictive ring of the superficial fascia, but also within the central portion of the glandular structure (Fig. 1).

As normal parenchyma has a smooth elastic consistency, it may be compared with a doughy consistency. At the same time tuberous deformation is similar to stone by consistency. With such parenchyma thickness, the implant will abide isolated from the gland if we do not sever the thick fibrous structure of the gland and we will have the consequential aesthetic complications such as "double-bubble" deformity, rippling, and factors of palpability. Such a comparison is shown on the picture "implant + stone and implant + dough." Due to this, it is clearly seen that without modification of the thick fibrous gland tissue—we cannot always reach satisfactory aesthetic results, as in when the gland covers the implant completely (Fig. 2).

We suggest to solve this complex surgical problem with the method of modification of the whole parenchyma and/or fascia with both horizontal and vertical glandular scoring on the back gland surface using the dual-plane pocket and anatomical implants.

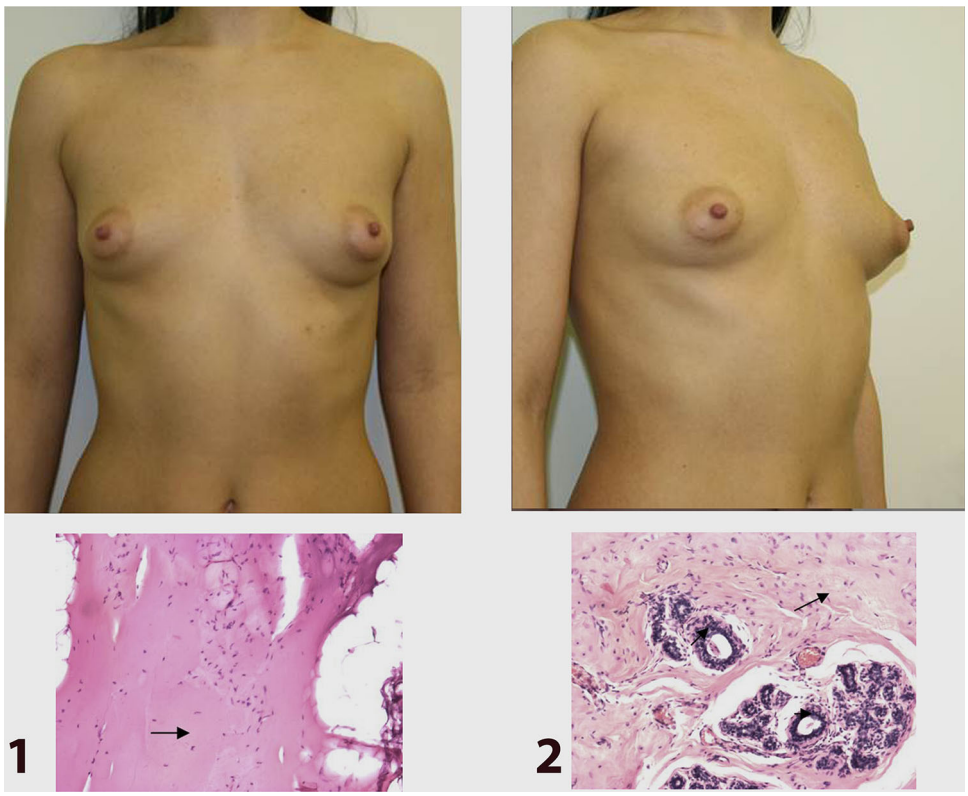

Fig. 1 Hematoxylin-eosin. **1** Periphery: capsule. The preparation of the fibrous ring. Pronounced fibrosis with stroma thickening. **2** The central part: a cystic fibrous formation. The degree of severity of fibrosis is 2 points

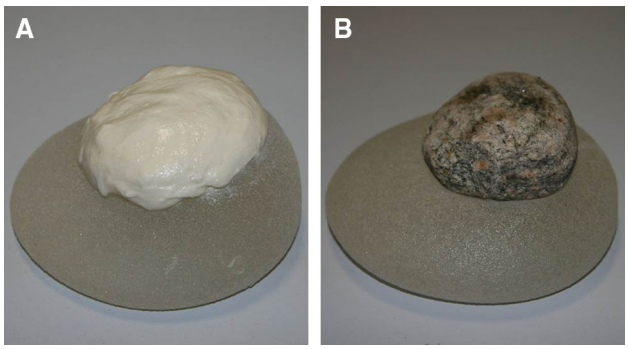

Fig. 2 Comparison of doughy and stony structures with implant: **a** implant and dough, **b** implant and stone

Surgical Technique

This technique is indicated for patients with deficiency of both lower quadrants and all four quadrants, who wish to simultaneously have performed a correction of the tubularity of the breasts along with the augmentation of the breasts. However, with a small degree of applied pathology (deficiency of the lower medial quadrant), such a radical technique is not needed.

Also, with a sufficient amount of gland tissue, when augmentation of the glands is not indicated, one should consider some other techniques. Because the tubular deformity of the gland is corrected by longitudinal and transverse scoring for dissection of the fibrous ring and fibrous parenchyma of the gland, it is strongly advisable in our method to use an implant to create a more natural seeming convex, glandular shape.

Careful visual analysis and confirmation of preoperative markings are performed in a standard, vertical standing position. Markings include middle line, inter breast distance, meridian breast lines, existing and new lowered inframammary fold, the periareolar incision, and lower ventral curvatures (Fig. 3).

The approach uses a periareolar incision performed directly below the nipple (as with some cases of mastopexy, decrease/correction of areola asymmetry). Dissection toward the pocket was performed between glandular tissues and subcutaneous fat after hydro-dissection, along with the detachment of connective tissue (fibers) of the previous inframammary fold to the level of the new inframammary fold (Fig. 4a).

Glandular detachment is then performed to obtain a complete interruption of the retractile fiber connecting the muscular and glandular tissues. The constrictive tuberous parenchyma must be mobilized (separated) by 3/4 of its area from the skin and superficial fat on the anterior surface of the gland and from muscles on the posterior surface of the gland. The level of mobilization is usually within 10–14 h (Fig. 4b). Mobilization is performed using coagulation agents.

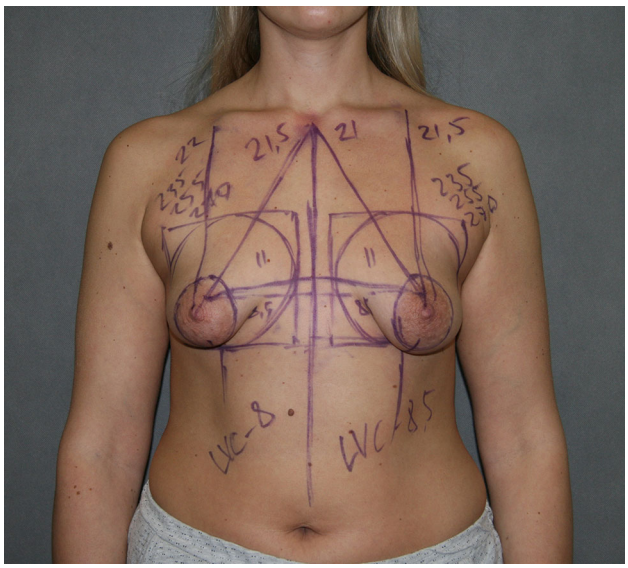

Fig. 3 Preoperative markings for the treatment of tuberous deformity

The dissections are made in a transverse horizontal direction, across the parenchyma until the point at which adequate release is achieved (Fig. 4c).

The pocket was created by employing a Tebbets III. The implant was set within the perimeters of positioning two planes: upper implant pole was set under the muscle, and lower implant pole was set under the modified parenchyma of the gland.

The dual plane is necessary not only to avoid necrosis of the gland itself, besides the nipple-areola complex, resulting from the compression of arterial and venous vessels. This also functionally adds to support additional coverage of the upper implant portions if the skin is thinned (Fig. 4d).

The next step is the modification of the parenchyma of the gland by scoring the posterior surface of the gland (Fig. 5a—before scoring, Fig. 5d—after scoring). Figure 5 shows how much the covering ability of the gland after scoring has increased.

The incisions overlay the entirety of the whole posterior surface of the glandular parenchyma. This proves often adequate in making varying incisions, even as minimal as 1 mm in depth, and thus does not damage ductae (Fig. 5b). The incision depth may be necessarily deeper, as in severe cases, and can reach 1 cm and more.

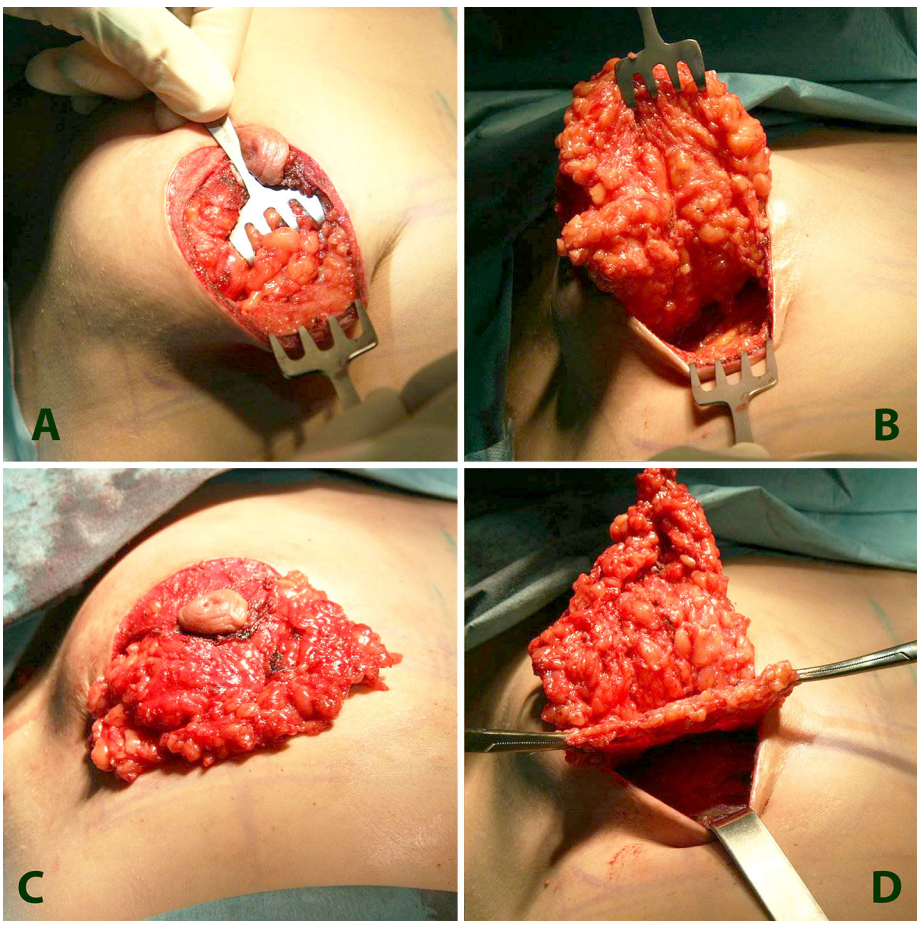

Fig. 4 Glandular detachment: **a** dissection between glandular tissue and subcutaneous fat, **b** borders of mobilization, **c** adequate removal of the glandular mass, **d** dual-plane is employed to prevent glandular necrosis and nipple-areola in and to support additional coverage of the top of the implant

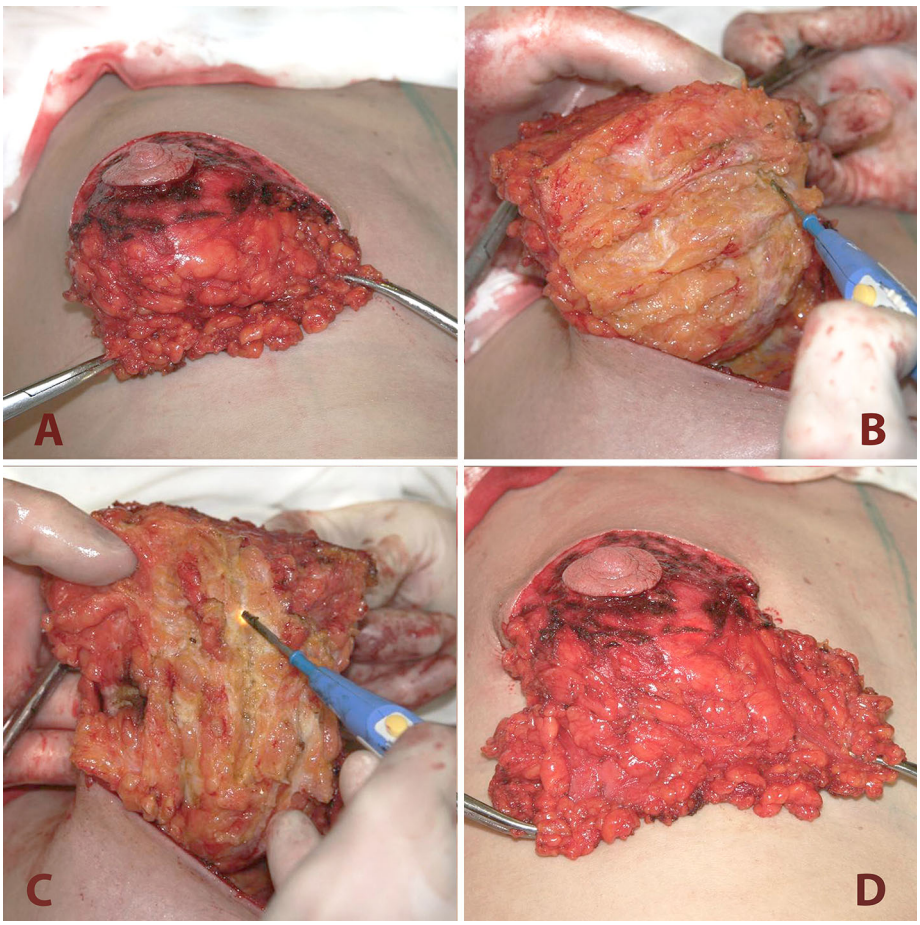

Fig. 5 Parenchyma modification technique: **a** breast before modification, **b** transverse scoring along the posterior surface of the gland, **c** longitudinal scoring, **d** breast after application of the technique of modification of the gland "longitudinal and transverse glandular scoring"

When the transverse incisions are completed, the longitudinal incisions may start in the vertical vector (Fig. 5c). The extraction of material must be sufficient to increase the coverage capacity of the mammary gland parenchyma over the implant.

If obtained in such a manner whereby the tissue lower flap was not sufficient for covering the implant in the lower part of the anatomy, then it was properly sutured and secured along the lower edge in several points, within the caudal or lower direction in the newly formed inframammary fold region using through skin knot sutures.

Schematically, the technique is shown in Fig. 6.

General anatomical implants were surgically installed for the benefit of the patient. This option was chosen due to the technique features, because of the large volume of material remaining in the upper pole—upper 1/3–1/4 of the gland was not modified and also the lowering of inframammary fold in such case in more conservative in comparison with round implants.

A drainage system may be placed in the newly formed cavity, if necessary, for active aspiration. The duration was set at after 1–3 days before removal, as a rule.

After that edges of the wound were sutured together, using knot sutures. Then, if the de-epithelialization was performed during the surgery, then the de-epithelialized skin region was covered with non de-epithelialized edges of the wound that were sutured together with two-layered interdermal suture "Monocryl 4,0".

The non-absorbable suture "Benelli" was used prior to intradermal suture placement during the periareolar mastopexy [10].

In the postoperational period, patients wore compressive linens during a three-week period of restoration. All operated patients were appropriately prescribed standard-strength anti-inflammatory medication and post-surgery anesthetic. Such patients were permitted to bathe as of the 3rd–4th day following the surgery. Routine duties of light work are taken with precaution, being allowed only after the 5th–7th day after surgery.

Light physical exercising (jogging, swimming, etc.) was allowed only after physician verification of the suspect area of recent operation. Such exertions were, upon doctor's confirmation, allowed after at least a 3-week period after the surgery. Exertional exercise, physical training, and

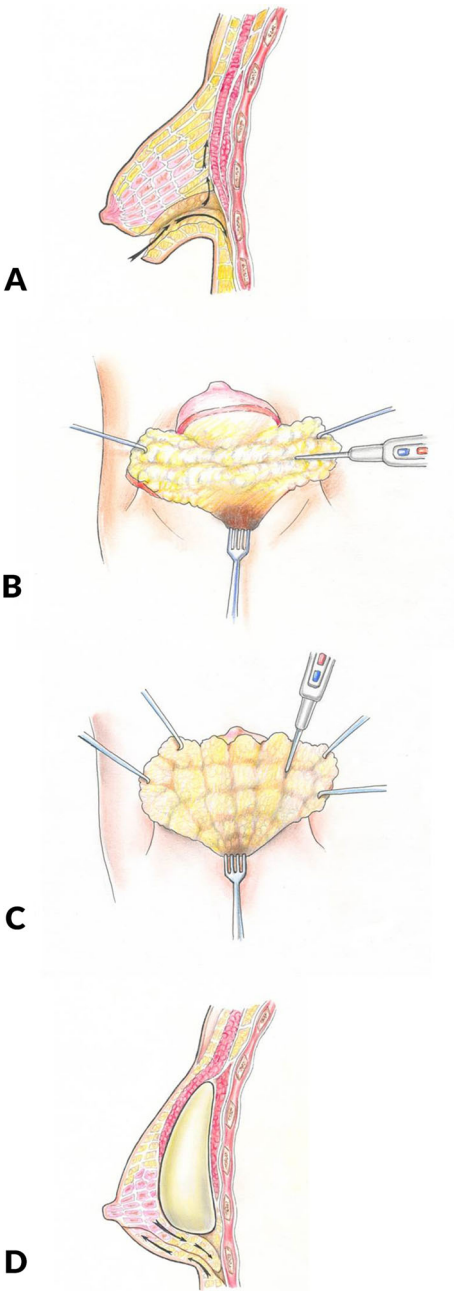

Fig. 6 Illustration of the parenchyma modification technique by "transverse and longitudinal scoring". **a** breast tissue mobilization on the anterior surface of skin and superficial fat, **b** transverse scoring on the posterior gland surface, **c** longitudinal scoring, **d** dual-plane pocket

weight/flexibility reliant labor (especially on shoulder-girdle), is cautiously allowed only after 2 months, subsequently after the surgery.

Results

The global complication rate for all patients involved in this study was 8.9%: 1.4% had Baker grade III capsular contracture, 1.5% had malposition, "double-bubble" deformity with 2%, rippling 2.0%, a disorder of the areola and experiencing nipple sensitivity—2.0%.

"Double-bubble" deformity was observed among 5 of 208 patients (2%) and was connected with a distinguished boundary between undergoing surgical implantation and a parenchyma flap of inadequate size, proving inefficient in layering the implant area. Alternately, there may not be adequate dissection of the fascial surface.

Note: None of the patients requested elimination of the "double-bubble" deformity visible to us, as compared to the initial situation, such deformation did not matter to them. As in the example in Fig. 7, the old IMF points to the arrows in this form, which does not require correction.

Capsular contracture of Level III, by Dr. Baker research, was used upon 3 patients (1.4%) after 6, 8 and 11 months. The correction surgery was performed to repair capsular contracture—capsulotomy with the installation of implantation of another form. Note: There was no resulting relapse of capsular contracture following 1 year following the correctional surgery.

Three patients (1.5%) had implant turnover of both anatomic implants after 3 months, then the patients received round form implants. Four patients (2%) had disorders in areola and nipple sensitivity. All of them had total and complete recovery of areola and nipple sensitivity 1 year after the surgery.

Other complications (infections, hematoma, seroma or necrosis) were not made present within the month observation period.

In all instances, when applying this technique, we micro-managed with a one-step approach. A normal, natural formation of the breasts resulted from the application of our approach for mammary gland modification, with normal size of areola and minimal amount of complications that may otherwise require secondary surgery. Postoperative satisfaction was 93 ± 3 by the BREAST-Q scale.

Outcomes of the operations are shown in Figs. 8, 9 and 10.

The degree of satisfaction was assessed with the BREAST-Q "Quality of Life" assessment scale, taking into account such parameters as: Satisfaction with results, satisfaction with breast, psychosocial, emotional balance, physical and sexual well-being. Postoperative satisfaction was 93 ± 3 on the BREAST-Q scale.

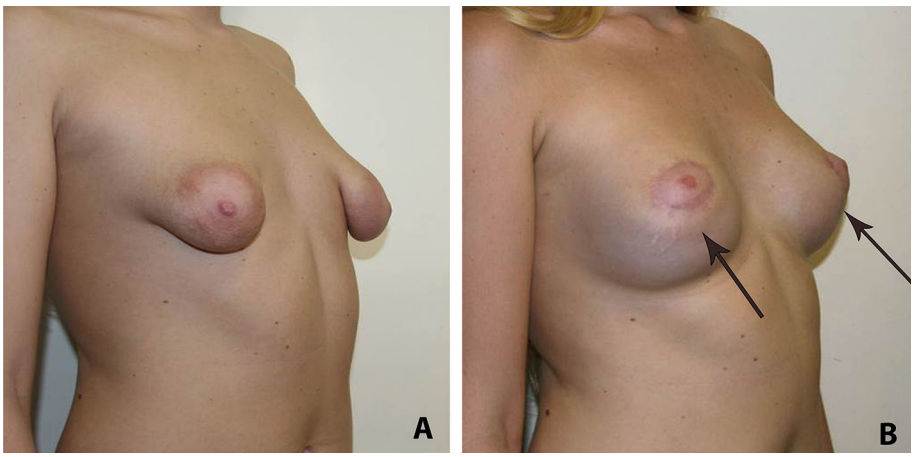

Fig. 7 This 23-year-old woman has the deformity complication "double bubble." The previously employed schematic IMF is illustrated by indicating arrows. The patient reported satisfaction with the results. When asked for surgical follow-up in correcting this deformation, the woman declined such offer

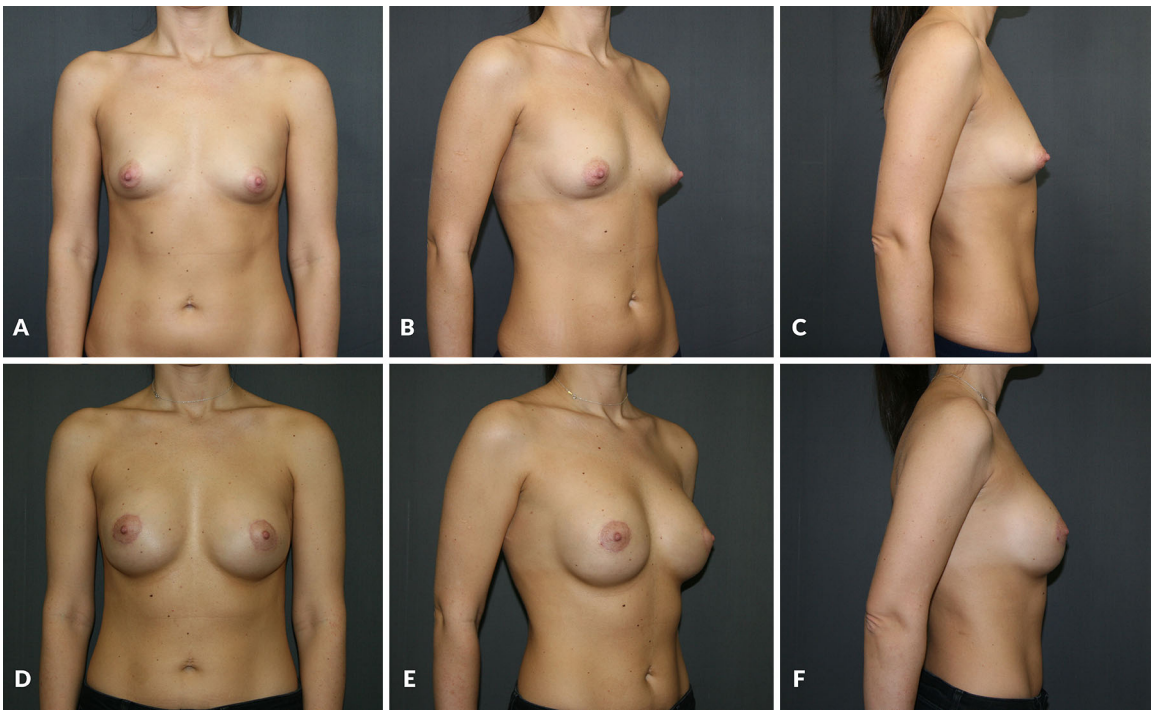

Fig. 8 Case 1. A 32-year-old woman was treated in a single-stage technique of "transverse and longitudinal glandular scoring" in combination with dual-plane pocket and anatomical implants (255 g) for tuberous breast correction. Preoperative (a–c) and 18-month postoperative (d–f) views

Discussion

Many authors have attempted to describe, classify and correct tuberous breast deformity using different techniques and thus obtaining different results. In such a way, it is not always possible to reach satisfactory and predictable scientific results after surgical treatment. We performed histological research on mammary gland tissues of such a pathology, obtained a better understanding of the nature of this deformity, and formulated our surgical approach to address issues of concern regarding a female patient's breasts, of otherwise normal anatomy, and applied the described methodology with combination of dual-plane and anatomical implants during the last more than 12 years with good aesthetic results.

Most surgeons agree that an implant cannot completely solve this problem alone, as there can be difficulties when encountering a "double fold". If you do not pay attention to the problem of modified fibrous thickness of parenchyma of the gland, then the results often will be far from satisfactory to both patient and attending surgeons upon final analysis.

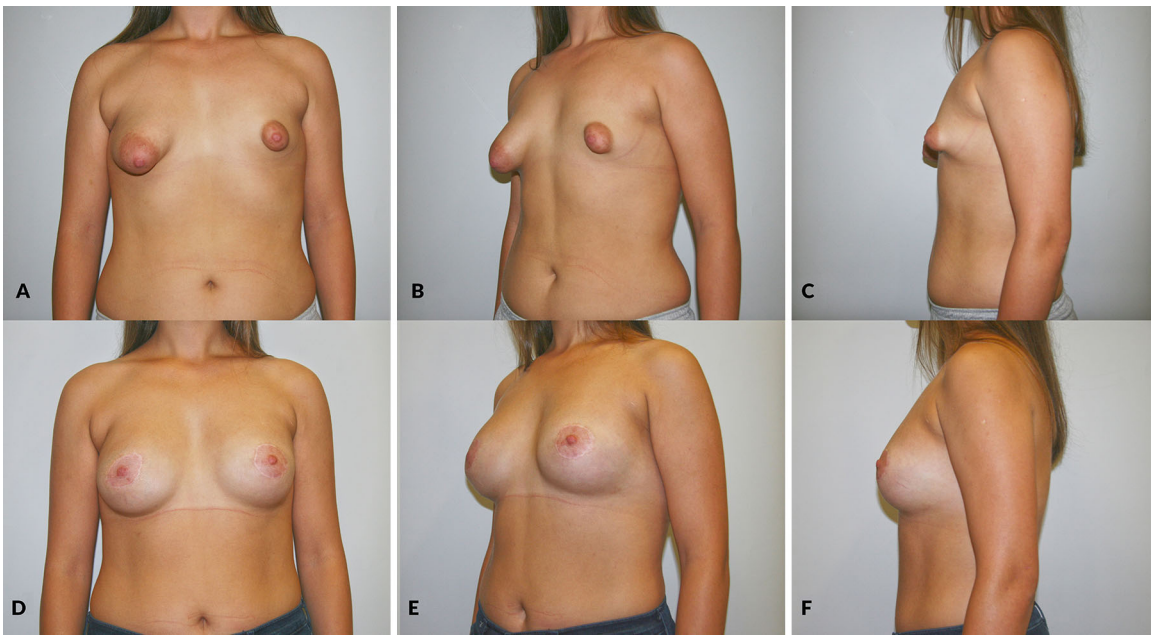

Fig. 9 Case 2. A 28-year-old woman was treated in a single-stage technique of "transverse and longitudinal glandular scoring" in combination with dual-plane pocket and anatomic implants (295 g) for tuberous breast correction. Preoperative (**a**–**c**) and 12-month postoperative (**d**–**f**) views

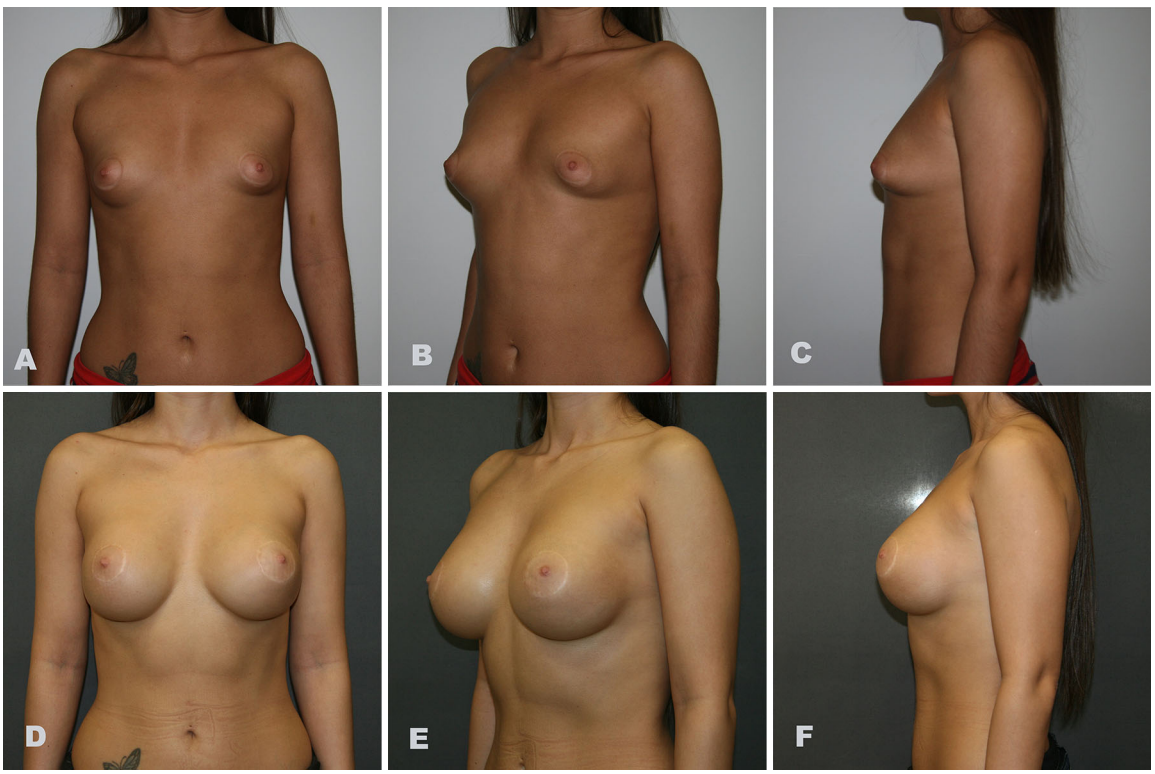

Fig. 10 Case 3. A 22-year-old woman was treated in a single-stage technique of "transverse and longitudinal glandular scoring" in combination with dual-plane pocket and anatomic implants (335 g) for tuberous breast correction. Preoperative (**a**–**c**) and 36-month postoperative (**d**–**f**) views

In Fig. 2 we demonstrated "implant + dough" and "implant + stone" cases in which it is clearly seen why such results occur.

Currently, there are some regularly practiced methods for the correction of tuberous breast deformation. Rees and Aston [11] were the first to adequately research and offer

suggestions for radial dissections upon the posterior gland surface to widen the base of the concerned structure. However, it may be noted that their published and since used technique did not influence the squeezing ring.

The two stages of correction, using expander dermotension, were described by *Dr. Toranto*: "the first stage is augmented mammoplasty, with the second stage being correction of NAC projections and ptosis under local anesthesia" [12].

Furthermore, this technique was modified and applied by other authors. But we consider that the single-stage approach is more appropriate with stable results immediately following the actual operation.

Z-plasty by *Dr. Maillard* is the improved technique of reduction mammoplasty that has the advantage of lasting satisfaction, resulting from minimal scar tissue [13]. This technique consists of periareolar de-epithelialisation with replacement of the areola-nipple complex, a partial subcutaneous mastectomy at the base of the lactation cone, and Z-plasty to block two skin triangles that are left after some excessive skin removal in the region of the inframammary fold. Z-plasty adds flesh vertically to the lower pole and this leads to an improved resulting form while notably decreasing tension around the areola. However, this technique can be applied only in the case of sufficient amounts of glandular tissue, which will prove not to always be the case.

Constricted lower pole treatment was described by *Dinner* and *Dowden.* They described the skin role in relation to constriction of the lower pole and suggested the execution of an incision of the whole thickness through the skin, fat and the gland to release it [14]. Then follows the careful transposition of skin and under skin flap. In turn, *Dr. Elliot* was the first to apply muscle-skin flap material to comparably treat the deformation [15]. He described a serratus musculocutaneous transposition flap to correct infra-areolar skin deficiency on 2 patients with severe tuberous breast deformity. The disadvantages of these two techniques are intact gland parenchyma and intact superficial fascia, wide vertical and inframammary incisions. Inevitably, there was unsatisfactory aesthetic results because of evident scarring.

The surgery technique by *Dr. Puckett* concludes in modification of the lower pole of the gland [16]. His suggestion is to dissect the parenchyma in a distinctly horizontal direction and then turn inwards and outwards. However, it is difficult to perform such incisions with equal symmetry on both sides.

Dr. E. Mutti suggests forming distinct types of gland flaps for each deformation type (central lower flap with surface lower crus, retro-areolar glandular flap, small under skin flap, etc.) that combines with dissection of the constrictive fascial ring [8]. For severe hypoplasty breasts—to use implants. However, it is impossible to completely solve tuberous breast concerns only with glandular flaps formation. The high IMF and the relatively short distance between nipple-IMF will not allow a surgeon to acquire aesthetically pleasant results in the relationship of breast proportions without the liquidation of the previous inframammary groove and formation of the new lower IMF. A big T-shaped scar is also a distinct disadvantage of such an approach, mainly due to the lack of skin on the horizontal axis and needful implant contouring.

Dr. Atiyeh et al. described an innovative single-stage method of longitudinal dissection of the gland tissue (perinipple round-bloc technique), where the intra-areolar region was de-epithelialized and was then combined with a retro-glandular implant set-up [17]. However, it must be cautioned that not every tubular breast has a widen areola. Consequently, the method is not considered universal in all patient instances.

Dr Grolleau et al. proposed a classification for breast base anomalies including tuberous breasts. They proposed a procedure in which to treat the minor forms of the deformity, using a mammoplasty with a superior pedicle and a lower lateral dermoglandular flap to fill-in the deficient lower medial quadrant [2]. However, this technique can be used only with minor tuberous breast deformity (example: Type I as outlined by Dr. Von Heimburg).

Dr. Hodkinson was able to advance the acclaimed "Sampaio Goes Technique," using Prolene-mesh regarding alleviation of tuberous breast deformity [18]. Consequently, the breast form is supplied consistently with non-resolving thin mesh that avoids contouring of glandular flaps. When skin tone of the breast is lowered and also when the parenchyma of the gland is not sufficient the mesh will support the form of an aesthetically pleasant breast augmentation.

Starting with *Ribeiro* the surgical approach for tuberous breast correction came to fascial constriction dissection. He dissected the squeezing ring on the horizontal axis for two planes using the periareolar approach, then forming the flap from the lower gland part to decrease the projection of hypoplastic breast [19], as the implants were not used. This technique was recommended by authors also for use with patients who were not in need of breast augmentation.

The *Mandrekas* and *Zambacos* technique suggests traversing the squeezing ring on the 6-h half-axis with 2-column formation in the lower gland portion of the anatomy, and they were afterward easily iteratively approximated by absorbent sutures or folded one upon another as a double-breasted jacket [20].

The implant is used to add volume in inferior part. In the case of covering tissues lacking in a vertical direction, there is always the double-bubble complication. That is why it is necessary to perform such a surgical approach

only in the case of only lower pole constriction of the gland.

Some recent papers describe the fat-grafting application for tuberous breast correction [21, 22]. We consider fat-grafting only as an addition to the routine surgery as it is necessary for a surgical method to release parenchyma narrowing. Using lipofilling with patients having distinctive severe deformation may result in near-impossible access in reaching satisfactory aesthetic results without parenchyma modification of the gland and/or constrictive ring dissection and decreasing of NAC.

Due to the diversity of tuberous deformity formations of the mammary glands, none of these techniques allows one to adequately reach equally good aesthetic results in all cases, especially in consideration of single-stage tuberous correction and augmentation mammoplasty. Because of this, the methods that do not directly affect the integrity of the modified thick fibrous parenchyma of the gland and superficial fascia, may be judged to have varied disadvantages. These drawbacks may lead to secondary surgery because of the aesthetic appearance and functionality of the region of operation, with final results added with complications to consider.

Owing to the histological research that we conducted, we may well conclude that tubularity forms are inherent not only because of the increased density of superficial fascia (fascial constriction) but also because of the presence of malformation (fibrosis) of the parenchyma of the mammary gland. And, establishing this as regarded fact, we have developed our own unique single-stage approach to correct tuberous pathology using preglandular hydro-dissection, dual-plane by Tebbets III, and mobilization of 2/3 or 3/4 of the gland parenchyma. Further, its modification may be achieved via usage of vertical and horizontal scoring, abetted by inclusion of an anatomical form implant. Such an approach allows the surgical practitioner to achieve an aspect of optimal results in achieving a more natural appearance for the patient, with full operability, besides predictable and stable results in attaining attractive breast form with proportions (45/55) [23] and with minimal complications such as "double-bubble" deformity, rippling, palpability, etc.

The "transverse and longitudinal glandular scoring" technique advanced in the G. Patrick Maxwell practice, must be noted. It has been crucial during the correction of asymmetry of mammary glands [24]. G. Patrick Maxwell has suggested prefascial dissection through the gland parenchyma (transglandular approach) to the new inframammary fold, gland mobilization, and then superseded by careful vertical scoring on the parenchyma, after that—transverse scoring. Maxwell uses retro-glandular or retropectoral placement of implants and two-stage correction with expander utilization to stretch the tissues and their consequent substitution of implants of differing sizes (because this technique is described regarding the correction of breast asymmetry).

We used adaptational means of applying the G. Patrick Maxwell concept of "transverse and longitudinal glandular scoring" in our work. It was augmented and transformed into a single-stage approach, with the addition of added new parameters: preglandular hydro-dissection, dual-plane pocket by Tebbets III, and also employing anatomic implants.

The advantages of our approach of tuberous deformity correction are hardly visible and short in most cases minimal scarring as outcomes of the surgical procedure. The approach is limited only in the periareolar approach, with the single-stage correction determining predictable and stable outcomes. In most cases, a portion of the lactoductus maintains sufficient integrity and, consequently, a mother's breast feeding is possible.

Conclusion

The authors suggest the single-stage approach to correct tuberous breast deformation based on the parenchyma modification technique of "transverse and longitudinal glandular scoring" in combination with dual-plane pockets and anatomic implants with satisfactory results which are predictable, after effects that are uniformly stable.

For the last 12 years, patients undergoing treatment with this technique have been endowed with aesthetically attractive postoperational results. Complications have been rare and exceedingly minimal.

Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflict of interest.

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