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HOW I DO IT

Oncoplastic mammaplasty with geometric compensation: Evolution of the technique, outcomes and follow-up in a multicentre retrospective cohort

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Abstract

Background and Objectives: To report on the outcomes and evolution of an oncoplastic mammaplasty referred to as geometric compensation mammaplasty.

Methods: Seventy-three patients with malignant tumours were operated on and followed up in five centres in two countries. Preoperative markings were performed using a Wise pattern. The resection of affected skin was geometrically compensated using another area of preserved skin.

Results: Mean pathological tumour size was 30.42 ± 21.98 mm. Twenty tumours (30.77%) were locally advanced and 15 (20.55%) were multicentric. Twenty-two patients (34.38%) were submitted to neoadjuvant chemotherapy. Cosmetic results were considered good or excellent in 59 cases (80.82%). Margins were positive in two cases (2.74%). Complications were partial wound dehiscence (n = 11; 15.07%), fat necrosis (n = 9; 12.33%), skin necrosis (n = 5; 6.85%), seromas (n = 5; 6.85%), enlarged scars (n = 7; 9.59%) and infection (n = 2; 2.74%). There were three cases of local recurrence (4.29%), two of bone metastasis (2.86%) and three of metachronous contralateral breast cancer (4.35%). No deaths were recorded within a mean follow-up of 35.33 ± 28.21 months.

Conclusions: The technique allowed breast conservation in situations requiring a large resection of skin in difficult positions, with a high rate of free margins, correction of ptosis, satisfactory symmetry and few complications.

KEYWORDS

breast cancer, conservative surgery, mammoplasty, mastopexy, oncoplastic surgery

1 | INTRODUCTION

Breast-conserving surgery (BCS) has proved to be a safe treatment option, with the safety of the procedure being comparable to mastectomy in many situations.[1,2] Oncoplastic breast reconstruction, or partial breast reconstruction, enables breast preservation in difficult cases.[3,4] Furthermore, oncoplastic surgery is associated with better cosmetic results and fewer complications compared to mastectomy with total breast reconstruction.[5–7]

In spite of the many oncoplastic techniques currently available, mastectomies are still common worldwide, particularly in developing countries where locally advanced breast cancer is often detected in women diagnosed at a late stage.[5,8,9]

In 2014, a new technique for partial breast reconstruction referred to as geometric compensation mammaplasty (GCM) was proposed. GCM is particularly useful in cases in which skin resection is required in areas not included in the usual mammaplasty drawings, such as the upper quadrants or within the lateral or medial pillars of the breast in mammaplasty.[10]

Many surgeons in Brazil and in other countries have already adopted GCM. Now, some years after the first report on GCM, with more experience and longer follow-up, it is time to review the evolution of this technique, the oncologic outcomes and cosmetic results.

2 | PATIENTS AND METHODS

Seventy-three patients were retrospectively included in the study between March 2007 and October 2019. All patients signed an informed consent form. Nineteen patients (26.03%) came from the Federal University of Goiás, 18 (24.66%) from Chile, 14 (19.18%) from the Santa Casa de Misericordia de São Paulo, 12 (16.44%) from the private office of one of the authors in Goiania, and 10 (13.70%) from the Araújo Jorge Hospital in Goiania. In all cases, the ratio between breast and tumour size was unfavourable or the tumours were situated close to the skin, outside the usual areas of skin resection in mammaplasty. All patients wished to have breast ptosis corrected. If it were not for the geometric compensation technique, a total mastectomy immediately followed by breast reconstruction would have been performed for most of these patients. The same breast surgeons, who were fully trained in oncologic and reconstructive breast surgery, performed both oncologic and reconstructive surgical procedures.

In all cases, after a pathological diagnosis of breast cancer was made, an immunohistochemical panel, routine preoperative examinations, mammograms and breast ultrasounds were performed. There was no data available on the number of patients submitted to magnetic resonance imaging (MRI); however, this number is believed to be small, both because MRI is not currently provided within the public healthcare system and because in some cases it was not considered necessary. To determine HER2 status, fluorescence in situ hybridisation (FISH) or a similar test was used for those tumours with a borderline immunohistochemical result.

Informed consent has been obtained and procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation.

3 | PREOPERATIVE MARKINGS AND TECHNIQUE DESCRIPTION

3.1 | Classic geometric compensation

Preoperative marking is described in detail in an earlier paper on GCM published by this same research group.[10] Initially, the Wise inverted-T pattern technique was used. Great care was taken to avoid tension in the suture.

Depending on the location of the tumour and on the distance between point A and the nipple-areola complex (NAC), a superior, superomedial, superolateral or inferior pedicle was marked. The NAC was included in the resection whenever it appeared clinically involved. The tumour area, as well as the adjacent skin, was marked for resection in such a way so as to ensure a macroscopic free margin. On the contralateral breast, mammaplasty was planned with the objective of achieving symmetry, usually based on the same pedicle.

The originality of this technique lies in trying to geometrically compensate the resected skin using the same amount of skin taken from another area. There are some variations in the way this surgical technique is performed depending on the size or localisation of the tumour and according to the evolution of the technique over time.

The most commonly used and classic approach consists of transposing the measurements from one of the triangles in the lower quadrants, usually resected in conventional mammaplasty, up towards the area of the tumour, changing an inverted-T scar into a Z-shaped scar (Figures 1 and 2).

3.2 | Embryonic planning of the technique

Initially, in some cases, instead of transposing the entire lower triangle, only part of the triangle was transposed, resulting in two split triangles (Figures 3 and 4). This strategy was later abandoned, since the resulting parallel scars could hypothetically reduce the vascularisation of the pillar, occasionally leading to fat and skin necrosis. In addition, in that initial embryonic planning, the margins were closer and indeed, the only two

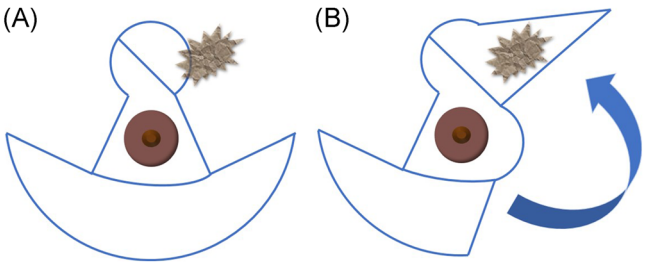

FIGURE 1 A, Graphic depiction of a conventional inverted-T or Wise-pattern mammaplasty. B, In the planning of the classic geometric compensation technique, the lower skin and glandular tissues are preserved to compensate tumour resection, resulting in a Z-shaped scar, instead of an inverted-T scar [Color figure can be viewed at wileyonlinelibrary.com]

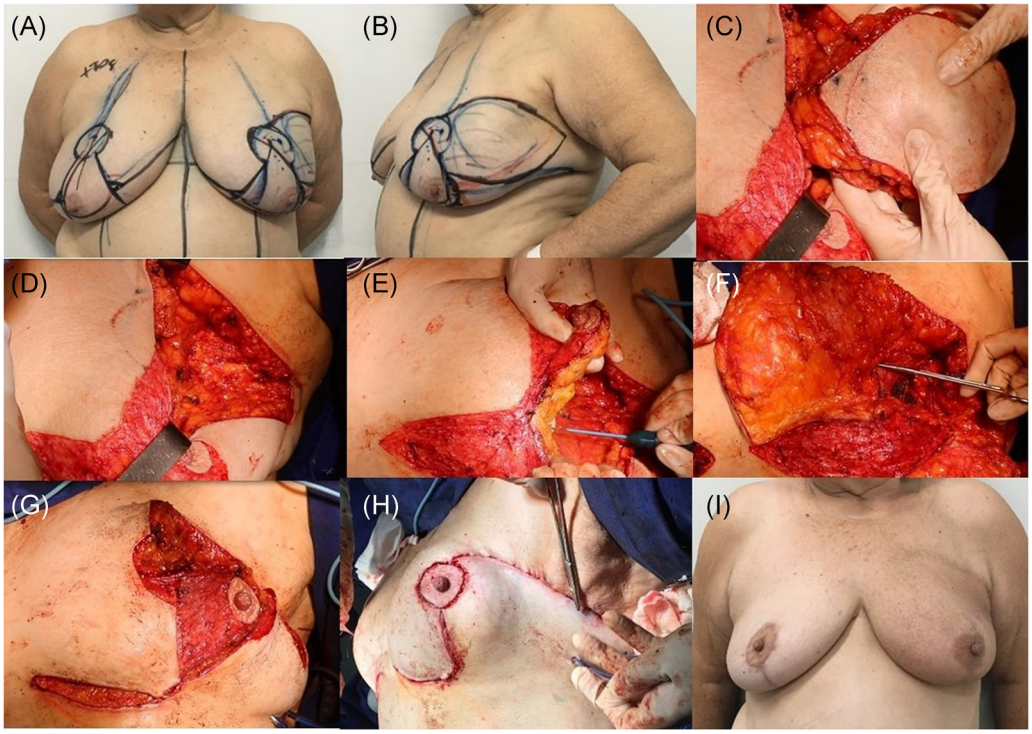

FIGURE 2 Example of classic geometric compensation, resulting in a Z-shaped scar. An obese woman with a 9-cm, grade 2, luminal B-like, invasive ductal carcinoma within the upper lateral quadrant (ULQ) of the left breast, with adjacent skin retraction. She failed to respond to neoadjuvant chemotherapy. A, B, Preoperative frontal and oblique views of the surgical planning. C, Large quadrantectomy in the ULQ of the left breast (480 g). D, Aspect of the defect resulting from the quadrantectomy. E, Preparation of a superomedial pedicle for the areola. F, Confection of an inferomedial non-epithelialised pedicle to maintain volume and projection of the remaining breast mound. G and H, Mounting and closing of the left breast. I, Frontal view 6 months after radiotherapy [Color figure can be viewed at wileyonlinelibrary.com]

cases of positive margins in this series occurred with this type of design (Figures 3 and 4).

3.3 | Avoiding NAC deviation

In some cases, over time, the radial scar may retract the NAC. To avoid NAC deviation, a small modification was added to the initial technique in recent years. On the tumour side, the areola is now marked 2 cm offset to the opposite side of the radiated scar. Moreover, the referential vertical line that represents the junction point of both pillars is then deviated 1 cm to the same side as the final NAC (Figure 5).

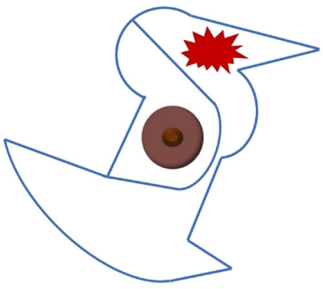

FIGURE 3 Early geometric compensation planning, with partial transposition of the lower triangle to the area of the tumour. In this situation, the sum of the two divided triangles must correspond to the total size of the conventional lower triangle. This technique was practically abandoned, since the resulting margins were narrower, pillars were less vascularises, and there was a hypothetically greater risk of fat necrosis compared to the standard technique [Color figure can be viewed at wileyonlinelibrary.com]

3.4 | Inverted geometric compensation

In cases in which the tumour has infiltrated the pillars of the mammaplasty or when the vascularisation of the remaining skin would be impaired as a consequence of the extensive removal of glands, an idea was put forward to change the technique to render the scar less visible. Instead of transposing the entire lower triangle to the tumour site, only the affected part of the pillar was resected, leaving free margins and preserving a similar corresponding area of skin and glandular tissue within the lower triangle. It follows the same logic as the geometric compensation technique, albeit inverted, although the basic principle was similar: the same amount of glandular tissue and skin was preserved on both sides, even if the scars are asymmetric (Figure 6). This technique allowed the same results as those achieved with classic geometric compensation; however, the scars are less evident (Figure 7).

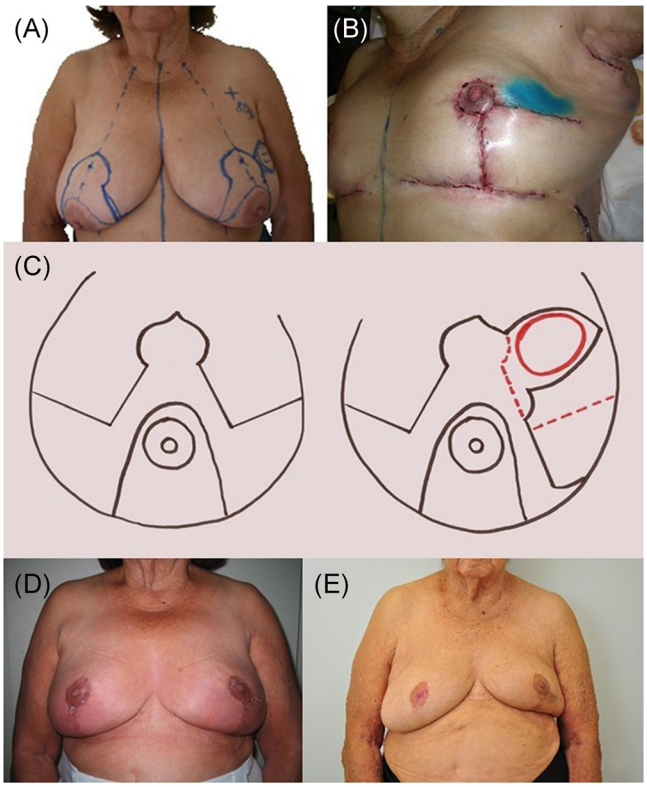

FIGURE 4 Example of embryonic planning of the geometric compensation technique. A, Markings. B, Intraoperative view of the resulting scar. C, Schematic view of the drawings. D, Follow-up 40 days after surgery. E, Follow-up 12 years after surgery. Volumetric retraction occurred in the left breast following radiotherapy and there was lateral hardening due to fat necrosis. Note the lesion in the areola of the right breast, which was recently diagnosed as Paget's disease [Color figure can be viewed at wileyonlinelibrary.com]

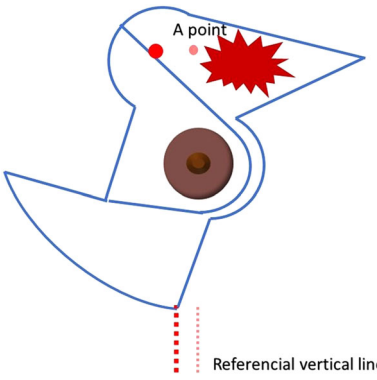

FIGURE 5 To avoid later deviation of the nipple-areola complex (NAC) towards the radiated scar, the referential vertical line must be repositioned 1 cm offset, and the "A point" 2 cm offset. If the radiated scar is lateral, then the NAC must be repositioned medially. If the radiated scar is located slightly upwards, the NAC should be repositioned proportionally downwards, and so on [Color figure can be viewed at wileyonlinelibrary.com]

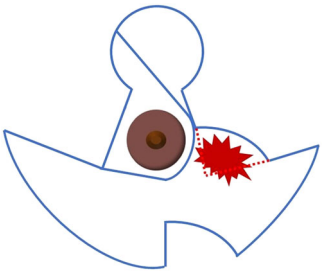

FIGURE 6 In the inverted geometric compensation technique, the exact shape of the defect within the pillar is geometrically preserved in the lower triangle [Color figure can be viewed at wileyonlinelibrary.com]

3.5 | Double geometric compensation

In two cases of very large tumours (up to 14 cm), the lower triangles, both medial and lateral, had to be transposed to the area of resected skin (Figures 8 and 9). In both cases, the NAC was affected and had to be removed. As described in other cases of vertical mammaplasty, care should be taken to avoid drawing the pillars to the infra-mammary crease so as to prevent the vertical scar from appearing below the boundaries of the breast. It is advisable to leave the pillars 2 cm above the inframammary crease. As a result, a "T" scar is obtained.

3.6 | Combined geometric compensation

In some very large tumours, the lower triangle may be smaller than the resulting defect. In two such cases, geometric compensation mammaplasty had to be performed in conjunction with a plug flap, a technique in which a skin island within the inferior pedicle is preserved and moved to the upper pole to compensate for the lack of tissue[11] (Figures 10 and 11).

3.7 | Cosmetic evaluation

The surgeons assessed the cosmetic results using photographic documentation taken two to 6 months after radiotherapy. The cosmetic outcomes were classified according to the Harris scale into excellent (treated breast nearly identical to untreated breast), good (treated breast slightly different from untreated breast), fair (treated breast clearly different from untreated breast but not seriously distorted) or poor (treated breast seriously distorted).[12] The cosmetic results were also classified using BCCT.core. Because this software program uses the position of the NAC as one of the parameters for symmetry, a visual subjective localisation was estimated in cases in which the NAC was removed and reconstruction was not performed.[13]

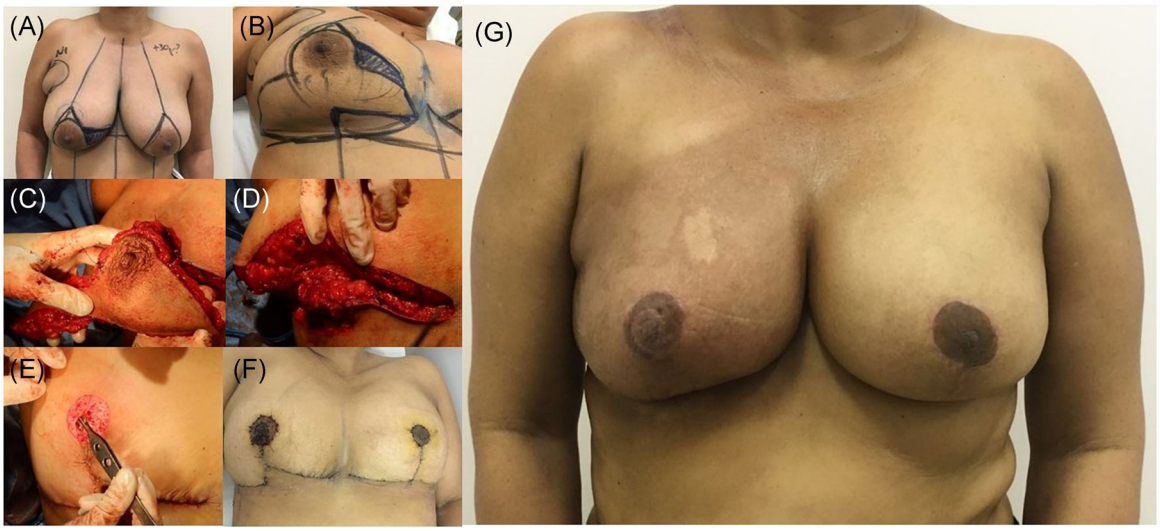

FIGURE 7 An example of an inverted geometric compensation mammaplasty. Woman with a 5-cm tumour involving part of the central quadrant and the lower medial quadrant. There was a partial clinical response to neoadjuvant chemotherapy, with the persistence of a palpable thickening of the glandular tissue and skin. A, Frontal view of the preoperative markings. B, Detail of the drawing showing that the part of pillar to be removed was geometrically preserved in the lower triangle. C, Intraoperative view of the resected area. D, Intraoperative view of the defect after tumour resection. E, The nipple-areola complex was immediately reconstructed using contralateral nipple and areola grafts. F, Intraoperative view of the closed breast mound. G, Frontal view 3 months after radiotherapy. Symmetry was good, and the scars were less apparent than would be expected with classic geometric compensation [Color figure can be viewed at wileyonlinelibrary.com]

Breast ptosis was graded from 0 to 3 in accordance with the classification system defined by Regnault and Bostwick. In this system, grade 0 is when the nipple and most of the mammary gland are above the inframammary crease; grade 1 when the nipple is at the level of the crease; grade 2 when the nipple is below the crease but above the lower outline of the breast; and grade 3 when the nipple is below the inframammary crease and below the lower outline of the breast.[14]

4 | RESULTS

The mean age of the patients was 53.50 ± 11.74 years (±SD). Fifty-four patients (74%) were Caucasian. Eight (10.96%) had a first-degree family history of breast cancer. Twenty (30.30%) were

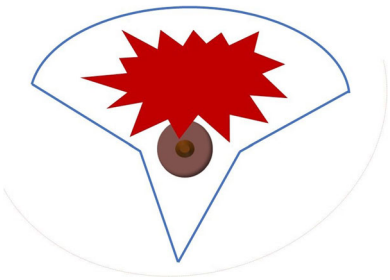

FIGURE 8 Double geometric compensation. For very large tumours it may be necessary to transpose both inferior triangles, resulting in a T-shaped scar [Color figure can be viewed at wileyonlinelibrary.com]

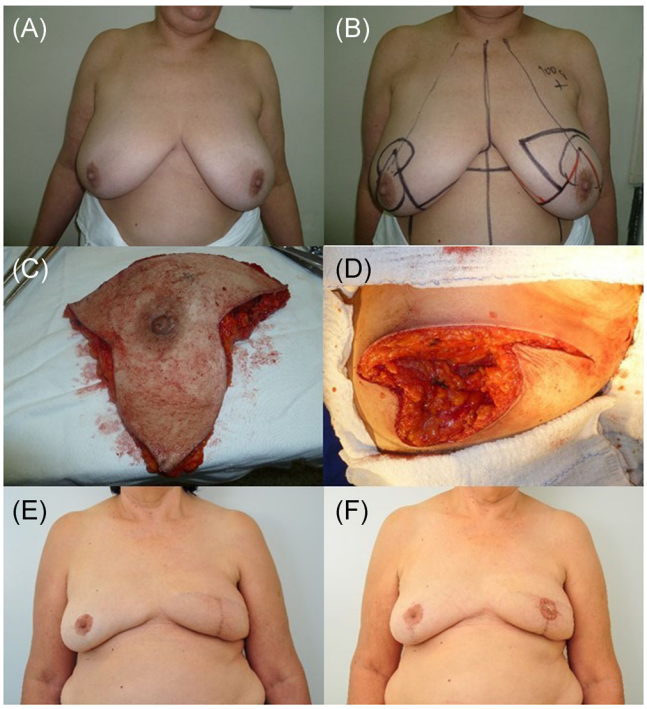

FIGURE 9 Example of double geometric compensation. An 8-cm central tumour that failed to respond to neoadjuvant chemotherapy. A, Frontal view. B, Preoperative drawings, with both of the lower triangles transferred to the tumour area. C, Aspect of the surgical T-shaped specimen. D, Defect left by quadrantectomy. E, Result 6 months after radiotherapy. F, Result 6 months after reconstruction of the left nipple-areola complex with a CV flap and micropigmentation [Color figure can be viewed at wileyonlinelibrary.com]

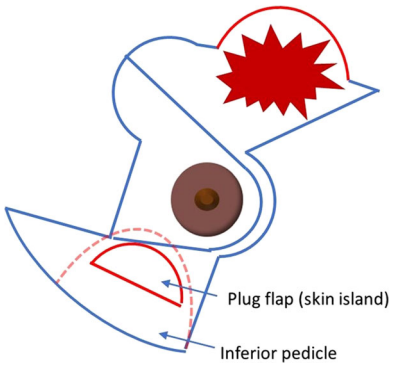

FIGURE 10 A breast island flap (also referred to as a "plug flap") may be required to complement reconstruction when the lower triangle is not large enough to compensate for the defect caused by the oncologic resection [Color figure can be viewed at wileyonlinelibrary.com]

hypertensive, five (7.58%) had diabetes mellitus, seven (13.46%) were former smokers and two (3.28%) were current smokers. Thirty-three patients (58.93%) were overweight and twelve (21.43%) were obese. Mean body mass index was 28.37 ± 4.26 kg/m^2.

Initial clinical tumour size was 38.86 (±21.98) mm. Twenty of the tumours (30.77%) were larger than 5 cm (T3 or T4). Mean pathological tumour size was 30.42 ± 21.98 mm (range 0-140 mm). Fifteen of the tumours (20.55%) were multicentric.

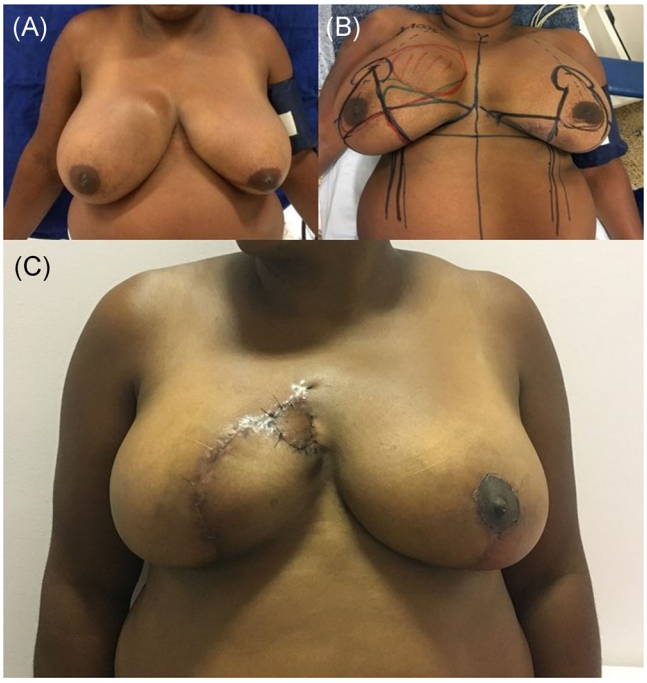

FIGURE 11 Resection of a 16-cm tumour involving the upper-inner and central quadrants of the right breast that failed to respond to neoadjuvant chemotherapy. The defect caused by the resection was larger than could be compensated by the lower triangles. In this case, an additional plug flap was used. A, Preoperative frontal view. The tumour is visible as a bulge in the upper-inner quadrant. B, Preoperative drawings. C, Result 2 months after surgery, before radiotherapy. The breast skin island observed in the extreme upper-inner quadrant, originating from the plug flap, is kept vascularises by means of an inferior pedicle [Color figure can be viewed at wileyonlinelibrary.com]

Sentinel lymph node biopsy (SLNB) was performed in 41 patients (62%) and axillary dissection was performed in 24 (36%), either because of initially clinically positive nodes or immediately following a positive SLNB result.

Invasive ductal carcinoma was the most common type of malignant tumour, accounting for 57 cases (82.61%), followed by 3 cases of invasive lobular carcinoma (4.35%), 2 mucinous carcinomas (2.90%), 2 ductal carcinomas in situ (2.90%) and 2 malignant phyllodes tumours (2.90%). Forty-eight tumours (75%) were evaluated as grade 2, ten (15.63%) as grade 3 and six (9.38%) as grade 1. According to the St. Gallen classification,[15] 30 (50.85%) were luminal A-like tumours, 19 (32.20%) were luminal B-like tumours, 6 (10.17%) were luminal B/HER tumours and 4 (6.78%) were triple-negative tumours.

Twenty-two patients (34.38%) were submitted to neoadjuvant chemotherapy, with the pathologic complete response being achieved in two cases (9.09%). The clinical oncologists recommended adjuvant chemotherapy, endocrine therapy and trastuzumab in accordance with the local protocols. All cancer patients underwent adjuvant radiotherapy following evaluation by the radiation oncologist. In addition, an electron boost was generally given, targeted to the metallic clips in the tumour bed.

Thirty-two tumours (43.84%) were located in the upper outer quadrant, ten (13.70%) in the upper inner quadrant, nine (12.33%) in the lower inner quadrant, eight (10.96%) at the intersection of the outer quadrants, seven (9.59) in the lower outer quadrant, two (2.74%) in the central portion of the breast and one (1.37%) at the intersection of the inner quadrants. In four cases (5.48%), multiple quadrants were involved.

A superior pedicle was chosen for the areola in 22 (30.14%) cases, a superomedial pedicle in 20 cases (27.40%), an inferior pedicle in 17 (23.29%) cases and a superolateral pedicle in one case (1.37%), depending on the best available source of vascularisation (Figure 2).

The NAC was resected in 13 cases (17.81%), either because it appeared to be affected by the tumour or because a clear margin might have compromised its vascular viability. Immediate NAC reconstruction was performed in three cases (23.08%), while later reconstruction took place in two cases (15.38%).

Margins were positive in two cases (2.74%) and treated by re-excision. One of the three patients in whom breast cancer recurred was submitted to a latissimus dorsi flap for total breast reconstruction, while the other two were submitted to simple mastectomy. The geometric compensation technique allowed one-stage partial breast reconstruction in 64 cases (87.67%).

Small areas of wound dehiscence occurred in 11 cases (15.07%). There were areas of palpable fat necrosis following radiotherapy in nine cases (12.33%); five cases (6.85%) in which there was a small amount of skin necrosis; and five seromas (6.85%) that required percutaneous aspiration. Hypertrophic scars developed in three

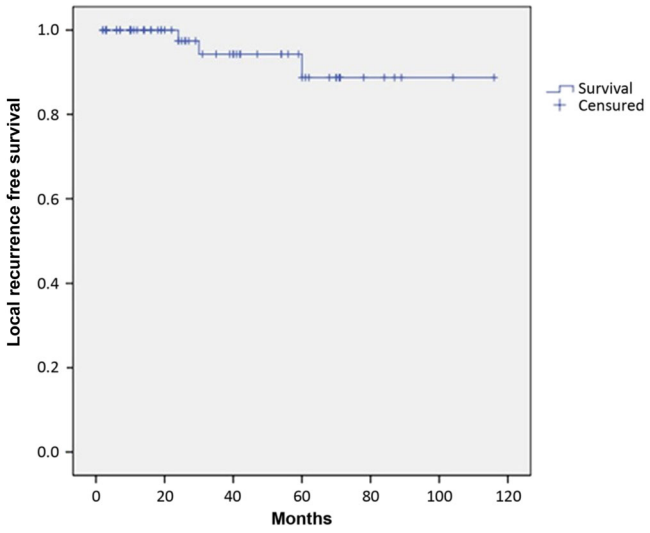

FIGURE 12 Local recurrence-free survival was 88.75% at 60 months [Color figure can be viewed at wileyonlinelibrary.com]

patients and enlarged scars in seven (9.59%). Infections requiring antibiotics occurred in two cases (2.74%). There were no cases of haematoma and blood transfusion was not required in any of the cases.

Breast ptosis was present in all cases before surgery. Based on the Regnault and Bostwick classification,[16] 38 cases (53.52%) were considered grade 2, 25 (35.21%) grade 3 and 8 (11.27%) grade 1. Ptosis was corrected in all cases. The cosmetic result according to the Harris scale was considered excellent in 22 cases (32.35%), good in 37 (54.41%), fair in 8 (11.76%) and poor in 1 (1.47%) case.[12] According to BCCT.core, the cosmetic results were rated excellent in 10 cases (14.93%), good in 43 (64.18%), fair in 12 (17.91%) and poor in 2 (2.99%) cases.

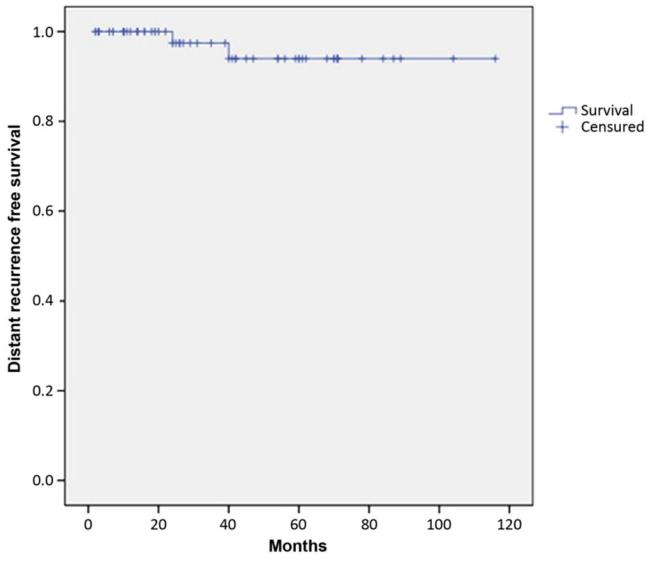

FIGURE 13 Distant recurrence-free survival was 93.96% at 60 months [Color figure can be viewed at wileyonlinelibrary.com]

There were three (4.29%) cases of local recurrence, two (2.86%) patients with bone metastasis, and three (4.35%) who developed contralateral breast cancer (Figures 12 and 13). No deaths were observed within a mean follow-up period of 35.33 ± 28.21 months.

5 | DISCUSSION

Although randomised data on the oncologic safety of BCS are available for tumours of up to 5 cm, some relative contraindications regarding breast preservation have been questioned. However, BCS appears to be safe in other circumstances as long as free margins are obtained and radiotherapy is available.[17–19] Over 30% of the present cases consisted of locally advanced breast cancer and over 20% of multicentric/multifocal disease. GCM allowed resection of tumours up to 14 cm. Another advantage was that the technique allowed tumours in all quadrants of the breast to be resected. Moreover, it permitted the use of a variety of areolar pedicles, according to the needs of each individual case.

A meta-analysis showed that oncoplastic breast surgery was significantly associated with lower rates of positive margins (12%) and fewer re-excisions (3-6%) compared to conventional lumpectomies or quadrantectomies (21% and 15%, respectively).[4,7,20] Since it was possible for large parts of the breast, including the overlying skin, to be resected, GCM resulted in affected margins in less than 3% of cases. Although intraoperative frozen section assessment of the margins is popular in Brazil, it was used in less than 40% of the cases, at the surgeon's discretion. This is due to the low rates of positive margins associated with this type of technique, despite the proportionally high number of cases of locally advanced breast cancer or multicentric disease.

Oncoplastic breast surgery, or partial breast reconstruction, is generally preferable to mastectomy and total breast reconstruction.[7] Oncoplastic surgery is cost-effective. Moreover, it is associated with lower complication rates, better symmetry, better quality of life and better satisfaction, particularly in cases in which radiotherapy was necessary.[20,21] The complication rates with GCM were low, comparable to the rates found with other conventional techniques of oncoplastic mammaplasty.[7,20] Despite major differences in the follow-up of cases, the oncologic outcome appears to be comparable to results reported from other series of oncoplastic surgeries.[7]

Symmetry was good or excellent in most cases, whether evaluated objectively or subjectively. Unfortunately, the quality of life questionnaires was not used to evaluate patients' reports. However, information collected through patient testimonials showed a high level of satisfaction with the results and only 12% of the patients requested additional surgeries to improve symmetry or reconstruct the NAC.

Over time, some variations were made to the technique. Some resulted from the need for larger resections (double GCM and combined GCM), while others were added to prevent nipple retraction or to reduce the risk of fat necrosis or the visibility of scars. All these variations have been discussed in full in the Patients and Methods section.

The GCM technique is not often used because of the resulting asymmetric and more evident scars. Because GCM represents only a small proportion of oncoplastic surgeries, data were collected in different breast units in different countries. Although the asymmetric positioning of the scars may sometimes be an issue for surgeons, asymmetry is justifiable when due to tumour involvement or proximity to the skin. Recently, the possibility of sparing the overlying skin has begun to be investigated for certain specific cases, and this will be presented as an alternative variation to the technique as soon as enough experience has been accumulated.

GCM has been developed as a possible alternative to total mastectomy, allowing resection of large tumours with skin resection in challenging localisations. The cosmetic results, profile of complications and oncologic outcome appear comparable to other oncoplastic mammoplasty techniques.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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