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Burow's triangle advancement flap: a reliable tool on oncoplastic breast-conserving surgery

Jaime Letzkus[1,2,3]*, Maria José Del Río[1,2], Carlos Rencoret[3], Alejandro Belmar[1], Galina Ivanova[1,2], Daniela Hidalgo[1], Jorge Gamboa[1,2]

ABSTRACT

Oncoplastic techniques in breast cancer treatment allow increasing indications of breast-conserving surgery and improving cosmetic results. Breast tumors located at the superior edge of the upper quadrant or at the upper inner quadrant represent a challenge for conservative surgery due to insufficient breast thickness and risk of skin involvement. We present a modified Burow's triangle advancement flap for breast-conserving surgery in patients with breast tumors at these locations. This retrospective observational study analyzed 8 out of 213 patients submitted to major oncoplastic breast procedures, who underwent breast-conserving surgery with matrix rotation mammaplasty, using a modified Burow's triangle advancement flap. All patients were treated in public and private health systems in Santiago, Chile. The median age at diagnosis was 47 years. The average initial tumor size was 5.9 cm, and the mean excised breast weight was 117 g. Patients required neither symmetrization nor displacement of the nipple-areola complex. Only one patient had a minor complication (wound dehiscence). During follow-up, no local recurrences were reported. We conclude that the modified Burow's triangle advancement flap is a safe and effective technique to manage tumors at this complex location. It provides adequate oncological margins, good cosmetic results, and contralateral symmetry, with complication rates similar to those of standard conservative surgery.

KEYWORDS: breast neoplasms; surgical flaps; mastectomy, segmental; mammaplasty.

INTRODUCTION

Breast-conserving surgery (BCS) including axillary treatment and radiotherapy has become the standard of care for most breast cancer patients, reaching long-term survival rates similar to those of radical mastectomy[1,2]. However, in many cases, the cosmetic results are unsatisfactory given the percentage of breast volume to be resected or its location, leading to severe breast deformities, skin retraction, nipple-areola complex (NAC) distortion or deviation, and secondary contralateral breast asymmetry. Oncoplastic breast surgery (OBS) techniques were developed to offer an advantage over classical breast-conserving treatment in selected patients. OBS allows larger breast resection for cancer treatment with minimal deformities, larger free resection margins, and lower re-excision rates while maintaining equivalent oncological outcomes[3,4]. According to a recently published volumetrically-based OBS classification system, volume displacement or replacement techniques can be used depending on the proportion of breast volume resected[5]; for all of them, including different types of reduction mammaplasty with large breast reshaping, local advancement flaps have been described whenever the defect cannot be covered with the same breast[6-10].

Even with many oncoplastic techniques, some patients will still need a total mastectomy to obtain satisfactory cosmetic or adequate oncological results. Tumors located at the superior edge of the upper quadrant or at the upper inner quadrant usually replace the whole breast thickness, compromising the anterior margin and making it difficult to preserve the skin. Tumors at these locations are a challenge for conservative surgery, whenever necessary to resect the entire breast thickness, as it might produce secondary glandular deformity, high risk of positive tumor margins, and upper NAC deviation[11].

We present a modified triangular advancement flap for breast cancer to preserve the breast in difficult cases.

The present study aimed to assess the reliability and safety of Burow's triangular advancement flap. This technique, usually described

[1]Breast Surgery Department, Obstetrics and Gynecology Service, San Borja Arriarán Clinical Hospital – Santiago, Chile.
[2]Academic Obstetrics and Gynecology Department, University of Chile Medical School, Santiago, Chile.
[3]Private practice breast surgeon – Santiago, Chile.
***Corresponding author:** jaime.letzkus@gmail.com
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for the correction of facial defects[12-18], can be applied to the breast so as to preserve it in difficult cases, with minimal effect on breast volume and mostly without need of contralateral breast symmetrization.

METHODS

This retrospective observational study analyzed a prospectively maintained database cohort of female patients with breast cancer diagnosed at the Breast Surgical Unit of San Borja Arriarán Clinical Hospital and private practices in Santiago, Chile, between August 2010 and November 2019. In the study period, 213 patients were treated with conservative surgery and major oncoplastic procedures. Among them, eight patients were diagnosed with tumors located at the high upper quadrant or at the upper inner quadrant. They were treated with BCS, using the triangular resection described below. The same senior breast surgeon, who was fully trained in oncologic and reconstructive breast surgery, performed both procedures and followed up the patients.

Descriptive statistics was carried out to analyze the results.

Selection criteria

All patients were diagnosed with breast cancer and managed by a multidisciplinary breast cancer team. They were submitted to conventional preoperative exams and had a previous percutaneous biopsy, with histological and immunohistochemical (IHC) analysis for hormone receptor status, HER2, and Ki67. Clinical evaluation was performed to determine the location of the tumor in the breast, distance to the skin, possible multicentricity, and potential axillary involvement. Patients fulfilling the inclusion criteria had tumors located closer than 16 cm from the sternal notch and/or less than 7 cm from the sternal midline.

Imaging studies included mammogram, ultrasound, computed tomography (CT) scan, and bone scan to identify local and distant involvement. The indication for primary conservative surgery was based on the tumor/breast ratio and IHC results. Patients with cT3 tumors received neoadjuvant chemotherapy. Other factors were taken into account for surgical planning, such as previous breast surgery that could hinder adequate local blood supply for advancement glandular flaps. Associated risk factors for local complications, such as diabetes, active smoking, and obesity, were recorded. Furthermore, contralateral breast shape was considered when evaluating the need for symmetrization surgery.

Surgical technique

Skin markings were made on patients in a standing position right before surgery. The inframammary fold, sternal midline, breast boundaries, and tumor location were marked. The nipple position was not changed. A curved line with inferior concavity was drawn from the mid-axillary line with the arm abducted 90º, extending medially parallel to the clavicle, 1–2 cm above the tumor location in the breast. Next, a triangle was drawn with the upper base in this line. The base width depended on the tumor size and should have at least 1 cm of macroscopic safe surgical margins. The triangle vertex was drawn long down in relation to the lateral margin of the tumor toward the NAC in order to achieve posterior orderly and harmonic breast rotation without deformity of central breast projection. At the axillary region, a small upside-down triangle (Burow's triangle) was drawn to enable access to the axilla for either sentinel lymph node biopsy or axillary dissection, which later allowed skin compensation when the rotation advancement dermoglandular flap was done (Figure 1).

Under general anesthesia, a triangular incision was performed, with resection of the main triangle, including the whole breast thickness, the tumor, its overlaid skin, and the pectoral fascia. Histologic tumor margins were assessed by a pathologist contemporarily. Free margins were defined as no tumor cells at the inked margin of the specimen for invasive carcinoma and a 2 mm margin for ductal carcinoma *in situ*[19]. Tumor bed was marked with vascular clips. A simultaneous axillary study was carried out through the small triangular resection drawn before. The curved line incision was completed between both triangles straight to the pectoralis major muscle. Afterward, this lateral dermoglandular flap was raised from the muscle just enough to allow its advancement toward the medial border of the main triangle resected before (Figure 2). Accurate hemostasis was performed. If necessary, closed-suction drains were placed on the breast and axilla. The advancement flap was closed in 2 layers with 2-0 interrupted absorbable Vicryl® sutures (Vicryl®: Ethicon, J&J), 3-0 subcutaneous Vicryl®, and 3-0 or 4-0 absorbable monofilament (Monocryl®; Ethicon, J&J). Wounds were dressed with gauze. Patients were discharged the day after surgery. Drains were removed 2–7 days after surgery.

Postoperative assessment

Weekly clinical examinations were performed until the final histology was received. Oncological treatments were completed according to national protocols, with chemotherapy, radiotherapy, biological treatment, and hormonal blockade if needed.

Cosmetic evaluation

Cosmetic outcomes were assessed using photographic documentation of each patient taken preoperatively and 6–12 months post-surgery and radiotherapy. Seven surgeons independently analyzed each case and classified them into excellent, good, fair, or poor, according to the Harris Scale[20].

RESULTS

The median patient age at diagnosis was 47 years (range 26–71). The mean body mass index (BMI) was 25 (range 21–29). All patients were symptomatic at diagnosis (palpable tumor). Histological reports showed seven invasive ductal and one invasive lobular carcinoma. The IHC analysis revealed five luminal, one luminal

HER2+, and two triple-negative breast cancers. At diagnosis, one patient had stage I cancer, three patients had stage II, and four had stage III. The mean initial clinical tumor size was 5.9 cm (range 3–13). Three patients received neoadjuvant chemotherapy, one with pathological complete response, one with pathological partial response, and the last one with initial clinical response, but having a secondary progression during chemotherapy, forcing us to advance the surgery before completing neoadjuvant chemotherapy (Figure 3). No patient required contralateral breast symmetrization. The mean resected tumor size was 2.9 cm (range 0–7). The mean resected specimen weight was 117 g (range 53–257). All patients had adequate histological margins on final pathologic reports, and none required re-excision surgery before adjuvant radiotherapy. According to the Harris scale, the cosmetic result was considered excellent in 28.6% of cases, good in 51.8%, fair in 16.1%, and poor in 3.5%. No major complications were reported. One patient had minor wound dehiscence, requiring only outpatient management. Median follow-up was 59 months (range 1–129). To date, no patient has had local recurrence. A patient developed contralateral breast cancer 48 months after the first diagnosis and was diagnosed with distant metastasis at 93 months of follow-up. Among these patients, no deaths have been reported (Table 1).

DISCUSSION

Oncoplastic surgery increases the indication for BCS in case of large tumors or tumors at difficult locations of the breast, making it possible to obtain better cosmetic results and adequate surgical margins[1,2,7,10]. Tumors located at the upper quadrants can be excised and repaired by different oncoplastic techniques, including glandular reshaping or undermining, inferior pedicle mammaplasty[21], round-block[22], racket resection[7,23], batwing technique[24], among others. The main issues of all these techniques are repositioning the areola at the center of the new breast and avoiding a filling defect due to insufficient tissue after reshaping. However, in some areas, repairing partial mastectomy defects is extremely difficult, like in the site known as "no man's land"[25], which refers to tumors located closer than 16 cm from the sternal notch and/or less than 7 cm from the sternal midline.

Tumors in this area usually leave a significant filling defect, especially if the skin section must be excised. The solution comes with volume replacement techniques, such as the latissimus dorsi flap[26] and the more recently described immediate fat grafting, which shows promising results[27].

The application of Burow's triangle advancement flap — first described in the early 19th century[12] for facial defects — to the breast[11,28] has become a fast and straightforward technique, allowing resecting the whole thickness of the affected breast quadrant, including its skin, and partial breast reconstruction with a volume displacement approach involving lateral dermoglandular rotation and advancement flap. Burow's triangle corresponds to a compensatory excision of redundant tissue at the proximal edge of any advancement flap in order to improve cosmesis and avoid standing cones[14]. The size of the Burow's triangle can be reduced by extending the length of the flap, especially useful when resecting breast tumors at the "no man's land

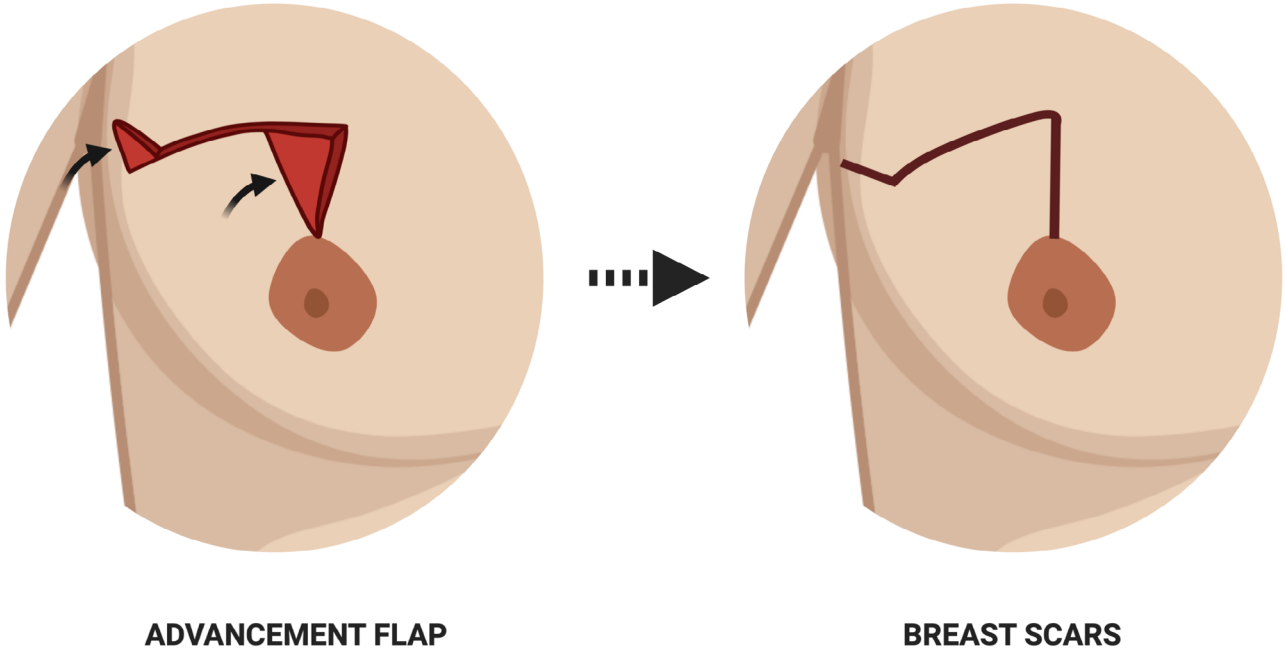

Figure 1. Schema of breast advancement flap after a triangular resection and a small upside-down "Burow" triangle to allow skin compensation in the axillary region.

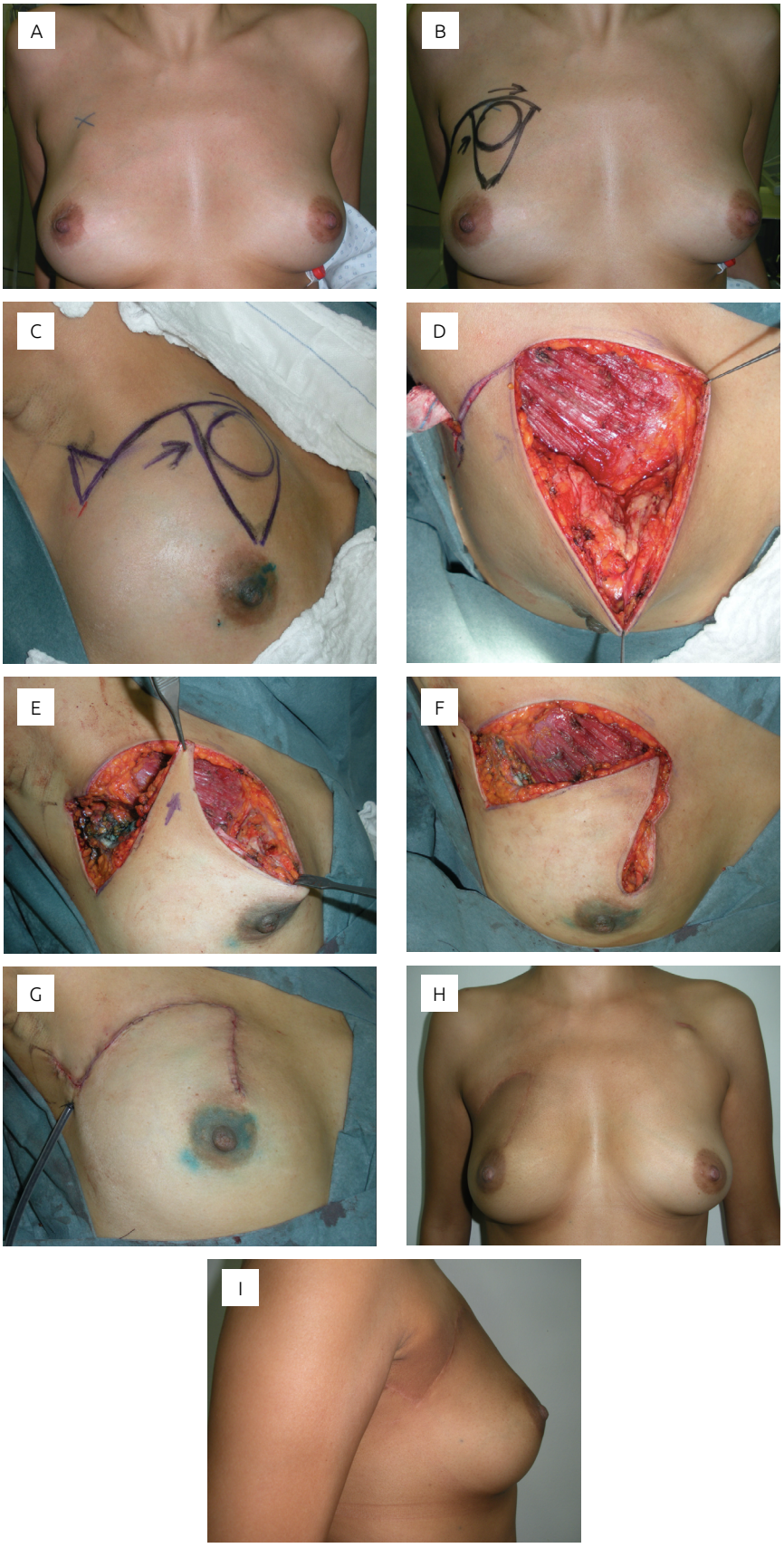

Figure 2. 37-year-old patient. 3.5-cm luminal A invasive ductal carcinoma, located 10 cm from the sternal notch. Triangular quadrantectomy (90 g) with negative SLNB* (A–D). Lateral glandular matrix rotation to cover the breast defect (E–G). 4-year follow-up pictures (H and I) with symmetrical breast shape and scars that tend to fade after radiotherapy.
*SLNB: sentinel lymph node biopsy.

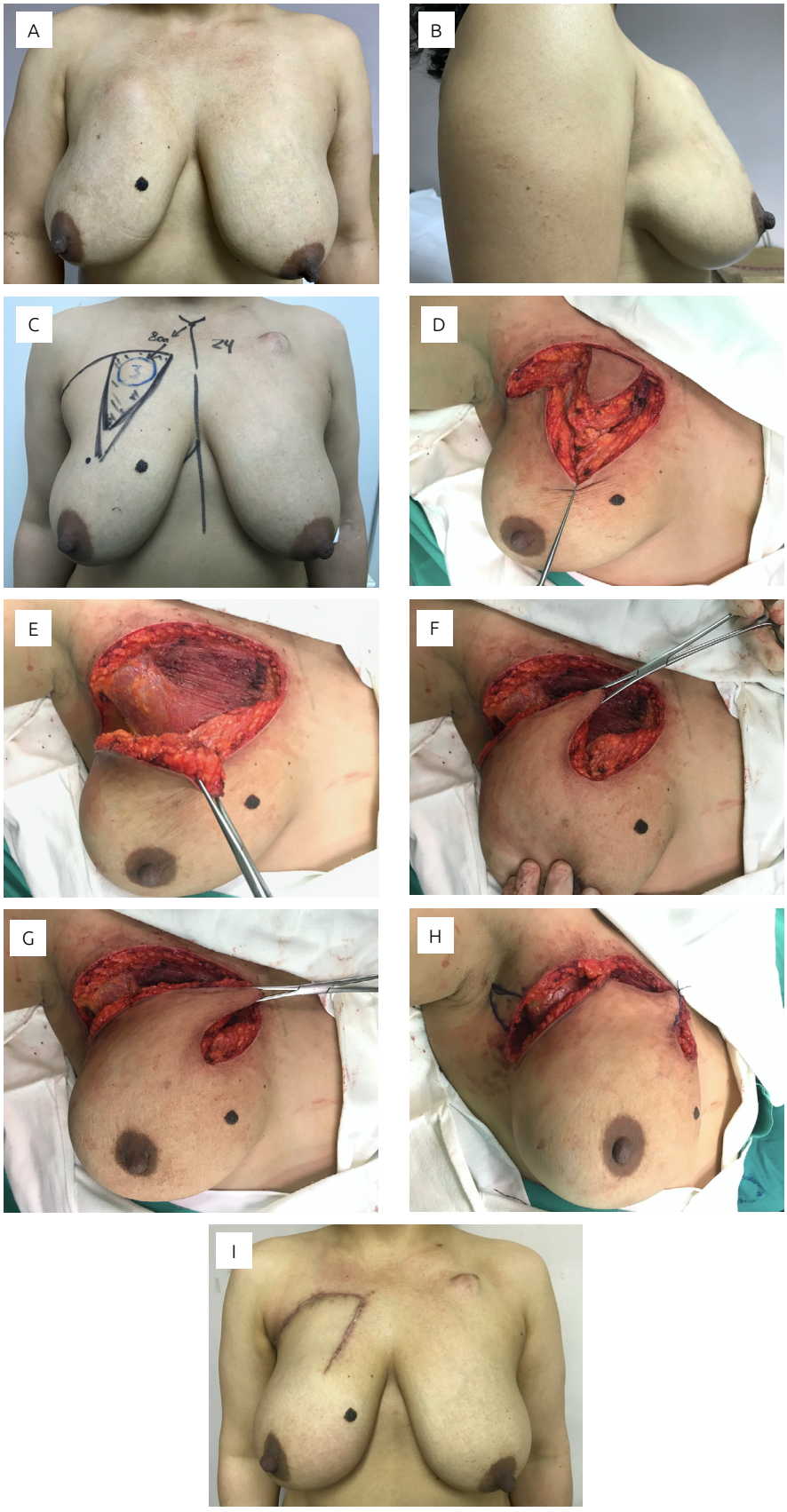

Figure 3. 34-year-old patient. 5-cm triple-negative invasive ductal carcinoma (IDC). (A, B) T3N2M0 neoadjuvant chemotherapy with adequate response to anthracycline regimen but progression with taxanes. (C–E) Large breast resection, including skin and a superficial layer of the pectoral muscle (65 g). Pathology report: 2.5-cm IDC, Elston III. Axillary dissection: 17 negative lymph nodes. (F–H) Lateral glandular matrix rotation. (I) 3-month follow-up pictures with acceptably symmetrical breast shape.

area" and when access to the axilla is necessary. The advantages of this flap include a wide, well-vascularized pedicle and the ability to place the compensatory triangle relatively far from the oncological defect, allowing good access to the axilla[14-18]. If the flap is judiciously planned, the breast shape can be preserved without major NAC displacement. Operative time does not increase significantly from a standard BCS. Since symmetrization surgery is not required, a second surgical team is not needed. The complication rate is low. In our cohort, only one partial wound dehiscence was described, requiring outpatient treatment. A disadvantage of this technique is the large scar, sometimes in a visible area; however, the cosmetic result was excellent or good in most patients, according to the postoperative photographic evaluation (80.4%). No patient required conversion to total mastectomy. This could be explained by the adequate preoperative breast assessment with images, the careful management of margins during surgery, and the concept that oncoplastic techniques are associated with lower incidence of positive margins and secondary reoperations[29,30,31].

By applying the oncoplastic partial breast reshaping technique described herein, we can avoid converting these surgeries to total mastectomy and posterior breast reconstruction, reducing the high postoperative complication rate associated with breast reconstruction and posterior radiotherapy[32]. This technique allows performing wider excisions and, therefore, obtaining adequate surgical margins. The local breast recurrence rate should be as low or even lower than that of conventional partial mastectomy[29,30]. In our cohort, only one patient developed contralateral breast cancer and distant metastasis, but, to date, none of them has had any local recurrence, showing the safety of this technique[33].

Table 1. Characteristics of patients who underwent breast surgery with modified Burow's triangle technique (N=8).

Median age (year, range)	47 (26–71)
Mean initial tumor size (cm, range)	5.9 (3–13)
Mean pathological size (cm, range)	2.9 (0–7)
Mean excised breast volume (g, range)	117 (53–257)*
Mean BMI (range)	25 (21–29)
Histological type (core biopsy)	
Invasive ductal carcinoma	7
Invasive lobular carcinoma	1
Molecular subtype (according to IHC)	
Luminal	5
Luminal HER2+	1
Triple-negative	2
Stage at diagnosis	
Stage 0 (*in situ*)	0
Stage I	1
Stage II	3
Stage III	4
Stage IV	0
Median follow-up (range, months)	59 (1–129)
Local recurrence	0
Distant metastasis	1
Contralateral new breast cancer	1

*One patient had a pathological complete response after neoadjuvant chemotherapy, corresponding to the 0 value in range; BMI: body mass index; IHC: immunohistochemical analysis.

CONCLUSION

Local breast advancement flaps are an essential part of partial breast reconstruction tools, with which every breast surgeon should be familiar. The Burow's triangle advancement flap offers significant benefits, such as a straightforward and fast coverage of upper inner surgical breast defects. This flap allows an excellent matching of skin color, texture, thickness, shape, volume, and sensibility regarding the original breast and very close similarity to the contralateral one, often avoiding the need for a symmetrization surgery. The compensatory triangle can be hidden in the axillary region. Its main disadvantage is the evident geometrical scar outside the esthetic landmarks of the breast, which must be understood and accepted by the patient. Fortunately, most of the time, the scars partially fade after radiotherapy.

Modified Burow's triangle advancement flap is a technique that can be safely used in breast surgery, with adequate oncological and cosmetic outcomes, avoiding total mastectomy and giving more patients the opportunity to have a BCS.

AUTHORS' CONTRIBUTIONS

J.L.: Conceptualization, data curation, formal analysis, investigation, methodology, project administration, resources, software, supervision, validation, visualization, writing – original draft, writing – review & editing.
M.R.: Data curation, formal analysis, investigation, methodology, validation, surgical technique, visualization, writing – review & editing.
C.R.: Conceptualization, validation, visualization, writing – original draft, writing – review & editing.
A.B.: Validation, visualization, writing – original draft, writing – review & editing.
G.I.: Validation, visualization, writing – original draft, writing – review & editing.
D.H.: Validation, visualization, writing – original draft, writing– review & editing.
J.G.: Validation, visualization, writing – original draft, writing – review & editing.

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