Original article

Updated follow-up of patients treated with the oncoplastic “Crescent” technique for breast cancer

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A B S T R A C T

Background: Conservative treatment of lower pole breast cancer in small or medium sized breasts could be attended with poor cosmetic outcomes. The purpose of this study was to assess the results of the “Crescent” Oncoplastic technique in this indication.

Material and methods: Prospective study in 54 breast cancer patients undergoing the technique.

Results: Post-operative recovery was uneventful except 1 hematoma and 6 breast seromas. With a mean follow-up period of 45 months (range 27–64), no local recurrence was detected. Five patients had fat necrosis. Cosmetic results were assessed as being excellent (39%), good (35%), fair (20%) and mediocre (6%).

Conclusion: We therefore advise this technique as a first step oncoplastic surgery technique for tumors situated near the inframammary fold. We also recommend the systematic check of the final cosmetic results in the standing position in order to obtain the best possible results.

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Introduction

Conservative treatment of lower pole breast cancer in small sized breasts is associated with poor cosmetic results that are often worsened by post-operative radiotherapy.1–5 Reduction mammoplasty techniques, the so called “Oncoplastic Surgery Techniques”, have been suggested by several authors in the early 1990s as a solution to avoid these poor cosmetic sequelae.3–11 While superior pedicle reduction mammoplasty is widely used for medium and large sized breasts, the technique is not feasible for smaller ones. We developed an original oncoplastic technique for those patients based on the use of a deepithelialized submammary fasciocutaneous flap to fill the lumpectomy cavity. In 2008, we published the details of the “Crescent” Technique (named after the shape of the flap) and the 1-year follow-up results of the first 14 patients.12 In this follow-up, a larger number of patients (54) were assessed at a longer follow-up duration (4 years).

Patients and methods

This prospective study was carried out between two centers namely Georges Pompidou Hospital and the Paris Breast Center. From August 2005 to March 2009, 54 consecutive patients, including 14 patients from the preliminary study, with small (cup size A/B) or medium (cup C) sized breasts were enrolled.12 Patient selection for this technique was based on the ratio of tumor/ breast volume, tumor location and fat repartition in the chest wall. All patients had either invasive or ductal carcinoma in situ (DCIS) located in the lower pole of the breast near the inframammary fold. They all had wide local excision followed by the “Crescent” technique reconstruction. No contralateral breast symmetrization was performed initially.

Surgical description of the “Crescent” technique

1. Patients are placed supine and fastened on an electrically foldable operating table. Both breasts are included in the sterile operating field, for comparison.
2. The “Crescent” is designed by drawing two lines, the first situated 0.5 cm above the true inframammary fold and the second 1 cm below it, corresponding to the width of the flap (Fig. 1).

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3. The skin is first incised at the superior line situated above the inframammary fold.
4. Wide local excision is performed (Fig. 2).
5. Orientation, marking and weighting of the excised breast tissue.
6. Deepithelialization of the skin area situated between the incision and the inferior line (Fig. 3).
7. Incising the inferior line laterally on both sides while leaving the central skin and subcutaneous tissue attachment so as to create a fasciocutaneous flap in the shape of a “Crescent” (Fig. 4). No preoperative or intraoperative check for intercostals artery perforators was performed. The random pattern flap is formed of the full thickness of tissue starting from the deepithelialized skin till the fascia above the muscle. The length of the flap is calculated according to the required size for the rotation flap, in case of lateral or medial defect. The length of the base of the flap is calculated to be equal to the length of a hemiflap.
8. After checking volume of the flap and bleeding of its extremity, the two edges of the “Crescent” are approximated, positioned and stitched together to fill the wide local excision cavity using a 2/0 absorbable suture (Fig. 4).
9. The skin is closed using an interrupted absorbable 3/0 suture followed by a continuous subcuticular one.
10. Final result is assessed while the patient is in the sitting position (Fig. 5).

Patient’s evaluation and follow-up

Local recurrence and fat necrosis assessment
All patients were clinically assessed for signs of locoregional recurrence as well as fat necrosis and were followed up with yearly mammograms for the same purpose. Reporting followed the American College of Radiologists (ACR) Breast Imaging Reporting and Data System (BI-RADS) assessment categories. No systematic MRI was performed.

Cosmetic assessment
Patients were assessed yearly for the cosmetic outcome. Assessment was performed by both the surgeons and the patients. In order to do that, follow-up pictures were taken from both views front, lateral and with the arms up. Patients were asked about their opinion with regard to the global results of surgery, including:

Fig. 1. Patient with a 12 mm tumor in the lower quadrant (6 o’clock), cup size A. Drawing of the “Crescent”: the upper line is 0.5 cm above the real fold, and the lower line is 1 cm below the real fold.

Fig. 2. Intraoperative photograph showing the wide local excision specimen and the post-excision defect just before the reconstruction.

Fig. 3. Intraoperative photograph showing the deepithelialized fasciocutaneous flap at the submammary fold.

symmetry, radiotherapy and breast symptoms on a scale from 5 to 1 (5 = excellent (Fig. 6), 4 = good, 3 = fair, 2 = mediocre, 1 = poor). For our point of view, we used the same objective assessment scale of the cosmetic results that we used in our previous studies, but assessment between excellent and good results was done taking into consideration the different positions of the patient’s arms, in the anatomical position and above the head (Figs. 5 and 6). We considered that excellent results were achieved if there was no shape defect even with the arms up.

Results
The mean age of the 54 patients was 54.2 years (range: 35–76). All tumors were adjacent to the inframammary fold: 24 (44%) in the lower inner quadrant, 8 (15%) in the lower outer quadrant and 22 (41%) at the 6 o’clock position at the junction of the lower quadrants. Seven patients (13%) had a breast cup size A, 31 (57%) cup B, 16 (30%) cup C. The mean body mass index (BMI) was 22.3 kg/m² (range: 18–27). Only two patients had a T2 tumor while the large majority (45 patients: 83 %) had a T1c tumor and 7 patients had a T1a or b. Fourteen preoperative mammograms were reported as BI-RADS 4 (suspicious of malignancy with lumps or micro-califications) and 30 as BI-RADS 5 (highly suggestive of malignancy).
All the patients had a segmentectomy orientated with complete excision from skin to pectoral muscle. In twenty cases, no reexcision was performed and in 34 cases either one or two additional shaves were performed during the same surgery after intraoperative examination of the specimen by the pathologist. The mean volume of excised breast tissue was $44 \text{ cm}^3$ (range: 5–126).

On definitive pathological examination the mean size of the specimen was 15.7 mm (range: 3–50). In four cases the tumor was multicentric. In thirty cases (55%), the lateral margins were free and larger than 5 mm, two patients (4%) had 4 mm free lateral margins, two patients (4%) had 3 mm, four patients (7%) 2 mm, and five patients (9%) 1 mm. Only five patients out of 54 (9%) had involved lateral margins on definitive histopathological examination and subsequently underwent a completion mastectomy. Of the five, only one patient had an immediate breast reconstruction using a prosthesis. All these five patients had cup size B and four out of the five had a tumor located in the lower inner quadrant. The histopathology results showed: 7 ductal carcinomas in situ, 43 infiltrating ductal cancers and 4 infiltrating lobular cancers. Fifty out of 54 patients underwent a synchronous sentinel lymph node biopsy performed via a separate incision, 10 of which were found to be metastatic ($pN1$); 8 with macro and 2 with micrometastasis. All 10 patients had completion axillary lymph node clearance.

Forty-seven patients had uneventful post-operative recovery. Conversely, one developed a hematoma requiring surgical evacuation; six breast seromas needing drainage were observed and three of them were associated with wound infections.

All 49 patients with conservative treatment had post-operative radiotherapy to the breast. Twenty patients had adjuvant chemotherapy.

**Local recurrence and fat necrosis results**

The mean follow-up period of the 49 patients with conservative breast treatment was 45 months (range 27–64). During this time no local recurrence was detected but two patients developed contralateral breast cancer and one patient died from metastatic disease.

Ten of those patients had a clinical non-suspicious induration at the site of the tumor bed which was explored using mammography, US and MRI. One of them had microcalcifications reported by the radiologist as ACR4; as he was not unaware of the crescent reconstruction technique, he performed a core biopsy that confirmed the presence of fat necrosis. Five other patients had fat necrosis detected on mammography BI-RADS 3. The area of fat necrosis measured respectively, 2 mm, 8 mm, 10 mm, 10 mm and 16 mm with a follow-up period from 42 to 64 months. The follow-up mammograms were reported as BI-RADS 2 (benign) for 43 out of the 49 patients.

**Cosmetic results**

Cosmetic results of the 49 patients with the “Crescent” technique are shown in Figs. 6–9. Generally, all patients were satisfied with the symmetry, only one patient with large sized breasts asked for a contralateral symmetrization 38 months after the initial surgery. As per the surgeons and their precise cosmetic evaluation scale, cosmetic results were assessed as being excellent in 39% of cases (Fig. 6), good in 35% of cases (Fig. 7), fair in 20% (Fig. 8) and mediocre in 6% of cases (Fig. 9). The three patients with the mediocre results had post-operative wound infections. The only specific complication to radiation therapy was the telangiectasia observed on the submammary fold.

**Discussion**

There are few reports of long-term follow-up of cosmetic results. Oncoplastic surgeons have proposed a superior pedicle mammoplasty with an inverted T scar to avoid cosmetic sequelae after breast conservation surgery. As this technique is only possible for large/medium sized breasts, it was necessary to search for another technique for smaller breasts.3,5 The “Crescent” technique

![Fig. 4. The shape of the “Crescent”.](image1)

![Fig. 5. Post-operative photograph of the breast showing the final result in the sitting position.](image2)
is easy to perform single handed, respects the oncological rules of breast cancer treatment and does not require any further symme-
trization of the contralateral breast. The technique is new and is different from all other techniques used for lower pole breast tumors that were described by Ogawa, Kijima or Holmstrom. Ogawa proposed secondary breast reconstruction to patients with cosmetic sequelae related to lower pole breast cancer. In a series of four patients, the authors used a wide ipsilateral cranial based adipofascial flap harvested from above the rectus abdominus muscle, to fill the cavity resulting after tumor excision. They placed the incision at the inframammary fold and the skin was spared. The flap was 7 cm in length and was bent upwards to fill the cavity being vascularized by the cranial part of the rectus abdominus muscle fascia. Kijima described a similar surgical technique, but he used it for immediate breast reconstruction. This technique had satisfactory cosmetic results in his only two patients. Our technique is also different from the technique of Holmstrom that relies on the use of a wide fasciocutanous flap harvested from the lateral thoracic wall and combined with a prosthesis for breast recon-
struction. Perforator flaps are other alternative methods in conservative breast surgery. For instance, the intercostal artery perforator (ICAP) flap described by Munhoz is an elegant option in lower pole tumors with small or moderate volume breasts. This flap is raised from adjacent tissue located on the lateral and thoracic region and based on perforators originating from the costal and muscular segment of the intercostal vessels. Although it appears more difficult to perform as compared to our technique, the authors show that the ICAP flap is a reliable and advantageous technique because it does not require the use of muscle transfer, with minimum donor site morbidity.

The “Crescent” technique moves the inframammary fold 0.5–1 cm below its normal position. This does not affect the cosmetic outcomes and is clearly demonstrated by the excellent and good cosmetic results in 74% of the patients. The 45 months median follow-up would be considered long enough to prove that the cosmetic results are not affected by post-operative radio-
therapy. In our opinion, the cause of the fair results is mainly in relation with the position of the patient during surgery. It is mandatory to settle the patient in a sitting position at the end of the procedure because some excellent results with the patient lying flat are only fair when the patient is sat up and this can be easily repaired by modifying the way the fasciocutaneous flap is stitched in the cavity. The poorest results were related to patients who developed post-operative wound infection. The inconvenience of this technique is that in case of involved margins requiring a mastectomy, it may be difficult to perform an immediate breast reconstruction with a prosthesis, due to the scarcity of the available skin. A mastectomy was performed in five of the patients with involved margins and in only one of them an immediate breast reconstruction was done using a tissue expander. Our surgical evaluation is equal to the ones commonly used in the literature. But to be more precise, we have systematically assessed the patients with good cosmetic results in the classical anatomical position, but also with the arms raised above the head in order to be able to differentiate excellent from good cosmetic results. We have always noticed that the post-operative defects were much more accentuated when the patient raised the arms above the head. As a result, during the follow-up evaluation, several of the results that were scaled as 5 were downstaged to 4. One major concern in this study was the ability of the follow-up mammograms to pick up fat
necrosis of the flap. Six of our patients had partial fat necrosis that was detected on the annual mammography.

Conclusion

The “Crescent” technique is a new oncoplastic technique, that can be performed quickly and that does not require any contralateral symmetrization. We highly recommend its use in patients with small or medium sized breasts in order to fill the cavities resulting from the excision of the tumors situated near the inframammary fold. We also recommend the systematic check of the final cosmetic results in the standing position in order to obtain the best possible results. Forty five months of mean follow-up showed satisfactory cosmetic results. We therefore advise this technique as a first step oncoplastic surgery technique for this specific category of patients.

Conflict of interest statement

The authors have not disclosed any potential conflict of interest.

Ethical approval

This work was approved by the local ethical committees and subjects gave informed consent.

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