Original Study

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The Results of Surveillance Imaging After Breast Conservation Surgery and Partial Breast Reconstruction With Chest Wall Perforator Flaps; A Qualitative Analysis Compared With Standard Breast-Conserving Surgery for Breast Cancer

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Abstract

There are few published data on mammographic surveillance after partial breast reconstruction using chest wall perforator flaps (CWPF). In this study we compared 36 patients who underwent breast conservation surgery with CWPF or standard wide local excision. Over a median 4-year follow up, 138 surveillance mammograms demonstrated no significant difference in mammographic features between the 2 groups. Only 1 CWPF patient was recalled for further imaging.

Introduction: Partial breast reconstruction (PBR) using chest wall perforator flaps (CWPF) allows for excision of tumors in the outer quadrant of the breast in women with small to moderate non-ptotic breasts resulting in a good aesthetic outcome. There are limited data available in the literature regarding long-term follow-up and the effect of CWPF on subsequent surveillance mammographic interpretation and recall rates. A retrospective audit with qualitative analysis of initial mammograms was performed to assess this. **Patients and Methods:** This retrospective analysis of a prospectively maintained database included all consecutive patients who underwent either PBR with CWPF or wide local excision (WLE) between January 2013 and December 2014 by a single surgeon in a tertiary referral center. Qualitative analysis of the postoperative mammograms was performed after review by 2 blinded radiologists. **Results:** Thirty-six patients were included in the study, 18 in each arm. The CWPF group was younger and had larger tumor size anticipated on preoperative imaging, which correlated with larger specimens excised. Both groups were comparable with respect to tumor pathological characteristics. Comparing the first postoperative mammograms, both groups were similar in features reported such as calcifications, fat necrosis, volume loss, and radiotherapy changes. During the follow-up period (median 4 years), 138 surveillance mammograms were performed. One patient was recalled for further imaging in the CWPF group. There was no significant difference in the need for diagnostic imaging and biopsy between the groups. **Conclusion:** Patients who underwent PBR using CWPF had similar features on postoperative surveillance mammograms compared with that post WLE.

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Introduction

Breast-conserving surgery (BCS) has been recognized as a suitable alternative to mastectomy for treatment of breast cancer since the 1980s. BCS is an important part of breast-conserving therapy, which is defined as a combination of conservative surgery for resection of the primary tumor followed by radiotherapy for the

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eradication of residual microscopic disease of the breast. It has been shown to have similar disease-free and overall survival rates compared with mastectomy.[1,2]

Traditionally, BCS refers to wide local excision (WLE) followed by radiotherapy to the affected breast, with no real focus on the management of the resultant cavity. The essence of BCS is not only to preserve the breast, but also to achieve an aesthetically acceptable result. Oncoplastic breast surgery was developed with the incorporation of plastic surgery techniques to improve the aesthetic outcomes of BCS and there are now data published proving the safety of the approach as well as improved psychological outcomes.[3,4] Recent evidence has shown the safety of BCS using oncoplastic techniques for tumor sizes that were conventionally considered to be unsuitable for BCS.[5-7]

The challenging group for BCS are the patients with relatively large tumors in small/moderate non-ptotic breasts. This group of patients is usually not suitable for volume displacement techniques and therefore might be considered for volume replacement or partial breast reconstruction (PBR). Various techniques have been described in the literature ranging from the use of mini latissimus dorsi flap[8] to omental flap[9] to free flaps[10] to reconstruct the resulting defect. Volume replacement using chest wall perforator flaps (CWPF), fasciocutaneous flaps described by Hamdi et al[11] in 2004 attract attention because of minimal donor morbidity, common availability of tissue excess on the lateral chest wall, and "like for like" tissue replacement. These allow for the excision of tumors especially, although not limited to, the outer quadrant of the breast in women with small/moderate non-ptotic breasts.

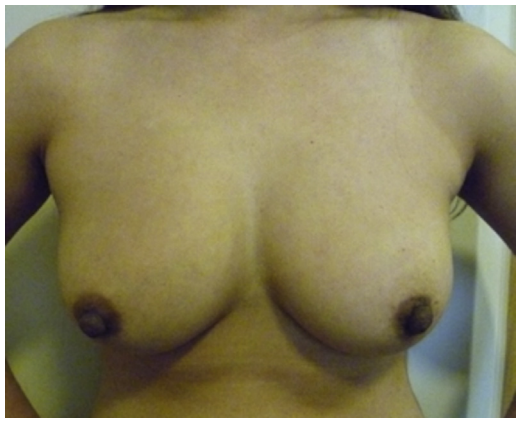
Use of CWPF is a relatively new technique and very little has been published on the effects of CWPF on postoperative imaging which is pertinent in cancer surveillance. So far, only 4 articles[12-15] have described the effects of volume replacement BCS on postoperative mammograms, of which only 1 described the features of those after CWPF. To our knowledge, there is no published study of the effects on imaging after BCS with volume replacement compared with standard WLE.

Furthermore, because CWPF requires more complex surgical techniques compared with WLE, there is therefore a perception that the postoperative complication rate might be higher because of the degree of complexity, potentially resulting in higher rates of fat necrosis and adverse mammographic findings. This could increase the rate of recall after surveillance mammogram and subsequent need for diagnostic biopsy. Because of their potential effect on cancer surveillance, we sought to compare the effect of surgical techniques on postoperative imaging as well as outcomes after BCS in both groups.

Patients and Methods

This was a retrospective analysis of a prospectively maintained database on all patients who underwent BCS by a single surgeon in a tertiary referral center. We included all consecutive patients who underwent CWPF and WLE for the period between January 2013 and December 2014. Patients were selected for CWPF on the basis of the lateral location of the tumor and tumor size relative to breast volume (ie, level 2 oncoplastic resection).[16] The patients who underwent PBR were selected to either have resection and reconstruction done as 1 surgery (1-stage approach) or in 2 surgeries (2-stage approach); the details of selection criteria are in another publication.[17] For this study, patients who underwent the 1-stage approach were selected (Figure 1). In the WLE group, cancers located in the outer quadrants were included so that the postoperative mammograms were comparable in the 2 groups. Patients in the WLE group underwent WLE of the tumor with glandular mobilization, when appropriate.

Figure 1 A 47-Year-Old Woman Diagnosed With 25-mm Breast Cancer in the Left Upper Outer Quadrant in C-Cup Breasts. She Underwent Breast Conservation Surgery With Partial Breast Reconstruction With Lateral Intercostal Artery Perforator Flap. Preoperative Photo

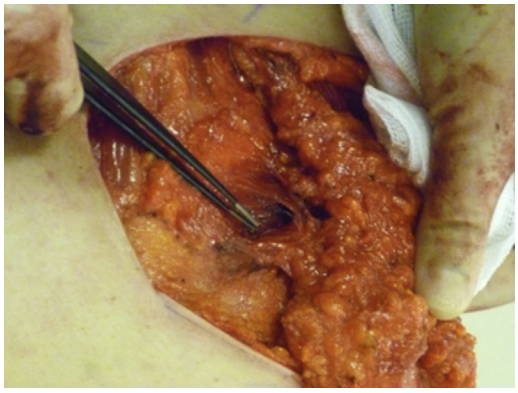


The CWPF[11,18,19] are fasciocutaneous pedicled flaps on the basis of various named perforators: the lateral intercostal artery perforators (Figure 2), the branch of the lateral thoracic artery, and the thoracodorsal artery perforator. It is assessed by pinching the redundant roll of fat on the lateral chest wall with variable extension around the back, depending on the tissue needed to fill the defect (Figure 3). The flap is orientated parallel to the skin tension lines with the tip curving up posteriorly parallel to the underlying ribs and following angiosome description.[20,21] This technique often avoids scars on the breast, because the oncological resection can be performed through the flap incision. The use of redundant tissue also results in a flattened chest wall lateral to the breast with no dog-ears, making the scar aesthetically acceptable (Figures 4 and 5).

Surveillance mammograms are performed in asymptomatic patients after the initial treatment of a primary breast cancer. This is usually performed annually for at least 5 years after cancer diagnosis, as per National Institute for Health and Care Excellence guidelines.[22] Symptomatic patients have access to symptom review clinic at all times. Patients are discharged from clinical review after completion of treatment but have access for urgent clinical review should any concerns be raised by patients or their general practitioner.

Mammograms done after surgery were reviewed and reported by consultant breast radiologists at the point of imaging. The need for recall for further imaging and/or biopsy was performed as indicated. All available imaging studies were retrieved for this project and independently reviewed by 2 breast radiologists who were blinded to

Figure 2 Intraoperative Photograph Showing the Dissected Perforator



the surgery rendered and the initial clinical assessment. The first postoperative surveillance mammograms were analyzed for characteristic qualitative features. Mammographic appearance of the postsurgical site was compared with preoperative and contralateral mammograms. Breast parenchymal density was categorized according to the Wolfe classification.[23] Other features such as architectural distortion, masses, calcifications, fat necrosis, and radiation-induced changes were documented.

Outcomes of surveillance, whether normal or recalled for additional imaging/biopsy, were analyzed. The incidence and outcomes of diagnostic imaging for symptomatic patients were also evaluated. The study was carried out as a part of routine clinical care with approval from the hospital audit department to assess the outcomes in accordance with local audit guidelines. Formal ethical approval was therefore not required. The data were statistically described in terms of mean, median and range, or frequencies (number of cases) and percentages when appropriate. Findings for both groups were compared using Mann–Whitney test, χ^2 test, or Fisher exact test. All statistical tests and P values were 2-tailed and P values of $< .05$ were considered significant.

Figure 3 Preoperative Marking of the Tumor Site and the Lateral Chest Wall Perforator Flaps. The X-Mark Refers to Surface Marking of Lateral Intercostal Artery Perforator Vessels Detected Using a Hand-Held Doppler

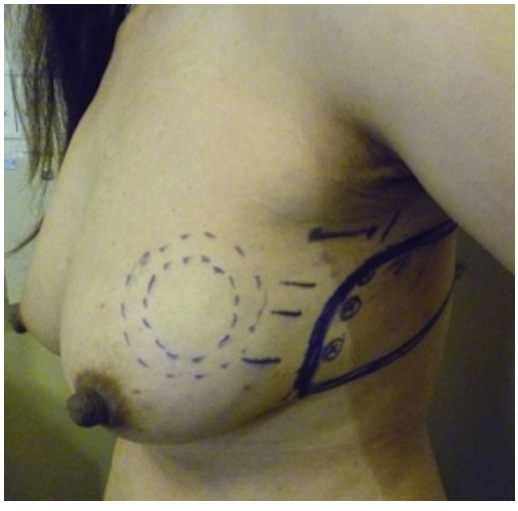


Figure 4 Postoperative Photograph Showing the Scar on the Lateral Chest Wall (2 Years After Treatment)

Results

Between January 2013 and December 2014, 28 patients had PBR using CWPF after BCS for breast cancer. Eight were excluded because they were performed at a different institution and their mammograms were unavailable for qualitative assessment. A further

Figure 5 Postoperative Photograph Showing the Breast Symmetry and Lack of Scars on the Breast (2 Years After Treatment)

Table 1 Demographic Characteristics of Patients

Characteristic	WLE (n = 18)	CWPF (n = 18)	P
Mean Age, Years	58.9 ± 9.8	50.2 ± 5.1	<.05
Screen Detected, n	12	4	<.05
Clinically Palpable, n	6	13	<.05
Mean Tumor MMG Size, mm	15.4 ± 8.4	34.3 ± 11.8	<.05
Mean Tumor US Size, mm	14.7 ± 10.1	23.6 ± 13.8	<.05
Post NACT, n	1	6	.088

Abbreviations: CWPF = chest wall perforator flaps; MMG = mammogram; NACT = neo-adjuvant chemotherapy; US = ultrasound; WLE = wide local excision.

2 were excluded because they went on to have completion mastectomy. Eighteen patients who underwent CWPF were included in the analysis.

This group of patients was compared with 18 consecutive patients who underwent WLE for breast cancers located in the outer quadrants during the same time period.

Patient Demographic Characteristics

All patients were female. The patients who underwent CWPF were younger (mean age, 50.2 years) compared with the group who underwent WLE (58.9 years; $P < .05$). They were also more likely to present with clinically palpable tumors and had larger cancers seen on preoperative imaging (Table 1).

Surgical Specimens

The pathology records were retrieved for all patients and both groups were comparable for margin clearance, lymphovascular invasion, and tumor characteristics. The CWPF group had larger specimen size and weight; this was expected because of the larger tumor size seen on preoperative imaging in this group. This group also tended toward a larger final tumor size (including ductal carcinoma in situ) on pathology report, although this did not achieve statistical significance (Table 2).

Qualitative Analysis of Mammographic Features at 1 Year After Surgery

The CWPF are fasciocutaneous flaps, encompassing the subcutaneous adipose tissue and dermis from the lateral chest wall meaning they might not be very obvious on postoperative mammograms, because no muscle density is present. In this study, the flap was not visible in up to 60% of the patients. Post-treatment features such as architectural distortion, fat necrosis, volume loss, and radiotherapy changes were comparable between the 2 groups (Table 3).

Outcomes of Follow-up

In total, 138 surveillance mammograms were reviewed in this study. The median follow-up was 4 years with mean of 3.83 years. Two patients did not return beyond their first surveillance mammogram, one of whom died of metastatic disease and the other was lost to follow-up.

During the follow-up period of 3 to 5 years, only 1 patient was recalled for imaging. This was a patient in the CWPF group, resulting in a recall rate of 1.4% in this group. This patient was found to have microcalcifications on their surveillance mammogram at 5 years (classified as M4 as per the Breast Imaging Reporting and Data System [BIRADS] classification). This was followed-up with an ultrasound examination, which showed an area of fat necrosis (U2 according to the BIRADS classification), therefore no biopsy was performed.

There was no significant difference in need for diagnostic imaging between the groups ($P = .0695$). Among the CWPF group, 2 patients (11.1%) required diagnostic imaging for evaluation of patient-reported symptoms. One patient presented with breast nodularity, evaluated using ultrasound and biopsy revealing fat necrosis, whereas the other presented with axillary pain and had a normal ultrasound examination. In the WLE group, 7 patients (38.9%) presented with symptoms requiring diagnostic imaging, all of which were normal postoperative changes not requiring biopsy. Most (n = 5; 71%) presented with nodularity and a small number presented with pain.

Table 2 Tumor Characteristics

Characteristic	WLE (n = 18)	CWPF (n = 18)	P
Mean Size, mm	18.4 ± 7.9	27.2 ± 10.5	.078
Specimen Weight, g	40.4 ± 47.0	103.7 ± 45.7	<.05
LVI, n	2	5	.404
Margins Clear, n	18	17	1
ER-Positive, n	13	10	.326
PR-Positive, n	13	8	.108
HER 2-Positive, n	1	4	.338
Axillary node clearance performed, n	3	9	.075

Abbreviations: CWPF = chest wall perforator flaps; ER = estrogen receptor; LVI = lymphovascular invasion; PR = progesterone receptor; WLE = wide local excision.

Table 3 Incidence of Ipsilateral Mammographic Findings Noted at 1-Year Post Surgery

Finding	WLE (n = 18)	CWPF (n = 18)	*P*
Parenchymal Density			<.05
Fatty	0	2	
Scattered density	8	14	
Heterogeneously dense	10	2	
Extremely dense	0	0	
Flap Visibility			
Not seen	14	11	
Indistinctly visible	2	4	
Distinctly visible	2	3	
Architectural Distortion	18	18	1
Mass	0	0	1
Calcifications	5	2	.402
Fat Necrosis	0	2	.486
Skin Thickening	14	16	.418
Breast Edema	4	7	.308
Volume Loss	8	11	.505

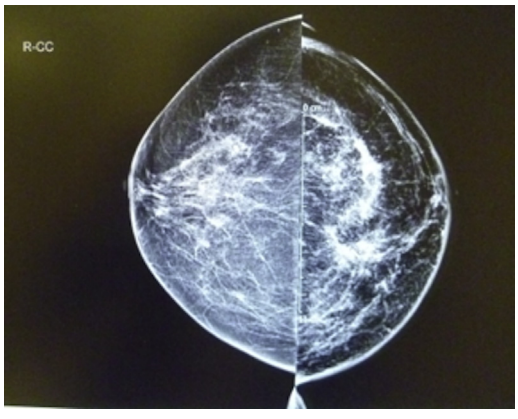
Abbreviations: CWPF = chest wall perforator flaps; WLE = wide local excision.

Discussion

Use of CWPF allow for excision of larger tumors that would otherwise not be suitable for BCS by providing a means of volume replacement. In our study, we compared the surveillance mammogram results and need for diagnostic imaging in women who underwent CWPF with those who underwent standard WLE. We have shown that there was no significant difference in need for diagnostic imaging between the 2 groups and both groups were comparable for postoperative qualitative findings on surveillance mammograms.

Chest wall perforator flaps used to replace the volume of the resected breast tissue are fasciocutaneous flaps, therefore the flap might not be obvious on postoperative mammograms because no muscle density is present. The presence of dermis can sometimes show the flap outline on the mammogram (Figure 6). The review by the blinded breast radiologists reported similar features on the postoperative mammograms in both groups. A perceived flap was, in fact, reported by the radiologist in 22% of patients in the WLE group, highlighting that the flap is generally not apparent in the group with PBR.

Figure 6 Bilateral Postoperative Mammogram With the Flap Inset on the Left Side



Of note, CWPF allows for a larger volume of breast tissue to be resected with no discernible volume loss compared with the group of patients who underwent WLE. The rates of adverse radiological features were similar in both groups despite CWPF involving the migration of moderate to large fasciocutaneous flaps from the lateral chest wall into the resection cavity in the breast. This suggests that it is a very robust flap with a low rate of complications with adequate blood supply to withstand the radiotherapy.

In this study, the group of patients who underwent PBR using CWPF were younger and were associated with bigger cancers clinically and on preoperative imaging. However, both groups had similar tumor characteristics as seen on the pathology reports of the surgical specimens. The larger tumor size detected preoperatively in the CWPF group resulted in a larger specimen being excised and the invasive component tended to be larger than in the WLE group but without gaining significance in this series.

Although CWPF requires more complex surgical techniques, surveillance mammogram after PBR using CWPF has a low recall rate of 1.4% in this series. This is comparable with a study by Piper et al,[24] in which volume displacement using breast reduction techniques with WLE on postoperative cancer surveillance were compared.

Many studies[14,25,26] have suggested that oncoplastic BCS, in particular volume displacement techniques, might contribute to the development of lumpiness/nodularity in the breast that require further investigation. This not only can lead to increased diagnostic imaging and possible biopsy, but also can provoke undue anxiety in

patients. However, our study suggests that the need for symptomatic diagnostic imaging after CWPF is comparable with post-WLE. Indeed more patients in the WLE group presented with symptoms (38.9%) such as nodularity and/or pain requiring diagnostic imaging compared with the post-CWPF group (11.1%), although this did not attain significance. This could be because of mobilization of breast parenchyma during WLE to fill the defect whereas in the CWPF group the flap fills the defect with very little mobilization of the breast parenchyma.

Although in our study we investigated only 18 patients in each group, it is one of the largest series of surveillance mammogram in patients after CWPF. Furthermore, it is the only series to compare the postoperative mammogram of those after CWPF with those after WLE. Our study is limited by small numbers of patients and a medium-term follow-up period (median of 4 years). However we would expect that the changes after radiotherapy are established in the first couple of years thus making this follow-up period clinically relevant.

Conclusion

Women treated with breast conservation surgery with CWPF for breast cancer had similar features on postoperative surveillance mammogram with low recall rates and did not require additional diagnostic imaging compared with those treated with standard WLE.

Clinical Practice Points

- We performed a comparison of imaging after breast conservation surgery with CWPF and WLE.
- Thirty-six patients with a median of 4 years of follow-up were included.
- No difference in surveillance imaging findings between groups were found.
- Only 1 patient in the flap group was recalled for further imaging.

Disclosure

The authors have stated that they have no conflicts of interest.

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