Oncological Outcome of Oncoplastic Breast Surgery: A Review of the Literature

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ABSTRACT
Oncoplastic breast surgery (OBS) has gained widespread acceptance during the last two decades as an integral component of breast cancer surgery. OBS combines oncological principles of breast cancer surgery with plastic surgery techniques to provide the best cosmetic results without compromising oncological outcome of breast cancer treatment and it has opened up the possibility to perform breast conservation in large tumors.

The purpose of this review is assessment of the oncological outcome of OBS in the treatment of breast cancer. We performed an extensive search of PubMed for articles published on oncological results and safety of OBS. There are few randomized clinical trials (RCTs) comparing the results of OBS with standard breast conservation techniques; however, based on the results of several prospective studies, it can be concluded that in terms of oncological outcome, OBS is at least as safe as standard techniques for breast conservation.

Introduction
Management of breast cancer has changed dramatically over the last decades. The most important revolution in surgical treatment of breast cancer occurred with the introduction of breast conserving therapy (BCT) [breast conserving surgery (BCS) and radiation therapy]. The concept of breast conservation was introduced by Keynes in 1937 and addition of radiotherapy to decrease local recurrence was suggested in 1939. The results of the two well-known clinical trials and their twenty-year follow-up provided evidence for equivalence of BCT and mastectomy in terms of disease free survival and overall survival.

The goal of BCT is to obtain optimal local control and acceptable cosmetic outcome. Nonetheless, cosmetic outcome is unfavorable in 20-40% of patients treated with standard lumpectomy. This poor cosmetic outcome might be due to location of the tumor (inferior, medial, central) in the breast or large size of tumor in relation to breast size. In a study by Cochrane et al., the cosmetic results of BCT were unfavorable when the estimated percentage of breast volume excised was more than 10%. In addition, standard BCT techniques usually result...
in poor cosmetic outcome for tumors in inferior and
medial part of the breast even when 5% of the breast
is resected.²

Radiotherapy, which is an inseparable part of
BCT, might affect the cosmetic results of breast
conservation in a negative way and correction of
poor aesthetic outcome in irradiated breast is more
challenging than anticipation and prevention of
deformities.³

These limitations of standard BCT, led to the
evolution of oncoplastic breast surgery (OBS),
which integrates wide tumor excision with plastic
surgery techniques for immediate breast
reshaping.⁴⁻⁵

Definition

Oncoplastic surgery is an evolving approach
which includes a combination of BCS and plastic
surgery methods. OBS improves the aesthetic
outcome after partial mastectomy and widens the
indications of conservative surgery.⁶

It contains a wide spectrum of different
techniques from simple reshaping to more complex
techniques encompassing concomitant contra-
lateral breast symmetrization procedures.⁷

OBS is characterized by four basic features: wide
excision of the tumor, partial reconstruction to
correct the defect of resection, complete reconstruc-
tion for mastectomy and correction of asymmetry
of contra-lateral breast, if necessary.⁸

There are three major considerations to select
patients for OBS. Tumor location and excision
volume are two important factors, while some
authorities suggest tissue density as the third element
in choosing patients for OBS.⁹

Techniques of OBS

A wide variety of techniques have been intro-
duced as OBS in the literature. Different classifica-
tions of oncoplasty techniques are suggested to
facilitate understanding and selecting appropriate
techniques for each patient.

Bi-level classification system of oncoplasty
techniques is proposed by Clough et al.¹⁰ Level I
OBS is appropriate for patients who need resection
of less than the 20 percent of breast volume. In this
type of OBS, the skin is not resected and the tumor is
excised with adequate margins. The resulting defect
is repaired using simple tissue approximation. Level
I is applicable for tumors in any quadrant of the
breast, and reshaping of the breast is performed at the
final stage of operation. All breast surgeons without
any special training in plastic surgery can perform
these procedures.

Level I OBS includes six steps: skin incision,
skin undermining, nipple areola complex (NAC)
undermining, full thickness glandular resection,
closure of glandular defect and repositioning of
NAC, if required. Level I OBS is not appropriate for
fatty breast. Dual plane mobilization of glandular
tissue in fatty breast increases the risk of fat
necrosis.¹¹

Level II OBS is indicated when 20–50 percent
excision of breast tissue is required according to
oncologic considerations. Level II OBS is based on
different mammoplasty techniques and its
performance requires special training in OBS.¹² It
includes a variety of techniques for different breast
sizes and tumor locations. Smaller defects are
repaired by tissue displacement techniques
(glandular reshaping), while larger defects are
reconstructed through tissue replacement techniques
or a combination of both techniques.¹³⁻¹⁴

From another perspective, OBS techniques can be
categorized to volume displacement and volume
replacement techniques.¹⁵ In volume displacement
techniques, dermo-glandular transposition of breast
tissue is performed to fill the defect of tumorectomy.
These techniques include glandular rotation, NAC
elevation or centralization, round block, radial
technique and oncoplastic breast reduction.

Volume replacement utilizes the patient’s own
tissue from another site to fill defects resulting from
major breast resection. This category includes
latissimus dorsi myocutaneous flap, transverse
rectus abdominis myocutaneous (TRAM) flap, deep
inferior epigastric perforator (DIEP) flap and
lipofilling.

Symmetrization of contra-lateral breast is an
integral component of OBS which can be performed
concomitant with breast cancer surgery or as a
delayed procedure.²³⁻²⁴

There are numerous techniques in OBS chosen
according to tumor size and location, breast size and
breast tissue density. Figure 1 demonstrates a guide
to technique selection for tumors located in different
quadrants of the breast. For instance, tumors in upper
inner quadrant of the breast might be operated with
Omega (batwing), V-type, rotation flap and inferior
dedicle mammoplasty techniques.²⁵

Important Considerations in OBS

The aesthetic sequelae of conventional BCS are
reported to be as high as 30 percent in some series.⁷⁻¹⁰
OBS techniques are developed to avoid poor
esthetic outcome of conventional BCS; however,
mastectomy and immediate breast reconstruction
can be performed by means of tissue, implant or a
combination of both. There are some drawbacks for
each technique. All these techniques are complex
procedures which require experienced and trained
surgeon so they are mostly performed in referral
centers. In addition, there are some potential
disadvantages to these procedures.

Performing OBS requires several surgical
considerations. Tissue-based reconstructions are at
risk for flap complications which might delay
adjuvant treatment. Furthermore, implant-based
reconstruction interferes with adjuvant radiation therapy. Another important issue is multidisciplinary team development including all specialties involved in the management of breast cancer. The team should be familiar with the management of patients treated by OBS techniques in terms of pathologic evaluation of the specimen, clips placement in the bed of tumor for radiation treatment and possible delays in adjuvant treatments.

Biology of the tumor should also be taken into account when deciding to perform OBS. Not every patient is a good candidate for OBS. Natural history of the tumor and its biology is the first point which should be considered. For instance, a rapidly growing large tumor which is hormone-receptor negative / HER2 positive, would be a candidate for OBS after neoadjuvant chemotherapy. Nonetheless, a slow growing tumor, which would not probably respond to neoadjuvant chemotherapy, is a good candidate for oncoplastic surgery, as long as the procedure does not delay the adjuvant treatments. On the other hand, a small tumor in which conventional BCS results in optimum cosmetic outcome should not be considered for OBS.

A large tumor within a small breast which would result in positive margin after BCS even by OBS techniques, benefits more from mastectomy with/without immediate breast reconstruction. In this way, margins would not be an important issue anymore.

**Outcome of OBS**

The cosmetic outcome of BCT is not always satisfactory to the patients or the surgeons and cosmetic failure rates after BCT are approximately 30%, while this rate is 0–18% for OBS in some series.8,24-29

According to the limited evidence on the association between quality of life and OBS, it seems that OBS results in improved quality of life due to better cosmetic outcomes.30

Despite widespread acceptance of OBS, its long term oncological results in terms of local recurrence are not available yet. Meanwhile, distant recurrence is mostly related to tumor biology and local treatment might not have a major impact on systemic recurrence.

The oncologic safety of OBS is related to the rate of local recurrence (LR). LR after BCT will affect survival of the patients.31 The most important factor affecting LR is margin status of the lumpectomy. The aim of this review of literature was to review current evidence regarding oncologic safety of oncoplastic breast surgery. Evidence regarding OBS...
and margin status, the need for re-excision and LR rate are reviewed in this study.

Methods
The PubMed database was searched for relevant English language literature. The following keywords were used: breast cancer, oncoplasty, oncoplastic breast surgery. Studies published from January 2000 to July 2014 were included. Additionally, the references found in each article were searched and other relevant papers were included. Publications comparing the results of OBS with standard BCT were included, regardless of the number of patients included in the study. Studies reporting the results of OBS without comparing it to standard BCT were included, only if the number of cases were more than 50, positive margin rate was reported and patients were followed up for local recurrence. The articles were reviewed with regard to the following issues: OBS and margin status, and OBS and local recurrence.

Results
The results of positive margin rate and local recurrence are summarized in table 1. It should be considered that according to the recent ASCO guidelines, the definition of free margins is going to be modified. In the new concept of margins in breast conserving surgery, no cancer cells adjacent to any inked edge/surface of the specimen is considered as adequate margin. 32

Margin status in OBS
Numerous studies have evaluated the margin status in OBS. Most of these studies are case series reporting the result of OBSs performed at a single institution. 33 Caruso et al. reported the results of reduction mammoplasty performed for the treatment of 63 early stage breast cancer patients. In this study, negative margins were achieved in 92% of the patients and margin width was more than 10 mm in 77.7% of the specimens. 33

A series of 63 patients treated with various reduction mammoplasty techniques was reported by Losken and colleagues. These patients included 10 cases of benign pathology. There was an 11% rate of positive margin in breast cancer patients in this group. 34

Another study reported the results of OBS performed in 101 patients. The technique used in these patients was mainly reduction mammoplasty. Eleven patients had positive margin and the mean margin width was not reported. 35

In 2010, Meretoja et al. reported a series of 90 breast cancer patients treated with a variety of oncoplastic operations. About 16.2% of patients had positive margins. In patients with negative margins, the median value for smallest margin was 20 mm. 36

Bong et al. reported his series of 167 patients treated with OBS. A variety of OBS techniques were used but the most commonly used technique was batwing and parallelogram mastopexy. The rate of close or positive margin was 22.2% in their patients. Higher stage, positive lymph nodes and neoadjuvant chemotherapy were associated with increased risk of positive margin. 37

Table 1. Summary of positive margin rate and local recurrence rate of oncoplastic breast surgery

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of Cases</th>
<th>Positive Margin</th>
<th>Local recurrence rate</th>
<th>Median follow-up (month)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2003</td>
<td>101</td>
<td>10.9%</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2010</td>
<td>167</td>
<td>22.2%</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2008</td>
<td>209</td>
<td>5.7%</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2013</td>
<td>489</td>
<td>15.75%</td>
<td>0.6%</td>
<td>40</td>
</tr>
<tr>
<td>2010</td>
<td>540</td>
<td>18.9%</td>
<td>6.8%</td>
<td>49</td>
</tr>
<tr>
<td>2011</td>
<td>101</td>
<td>5.9%</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2007</td>
<td>148</td>
<td>3.0%</td>
<td>3.0%</td>
<td>74</td>
</tr>
<tr>
<td>2012</td>
<td>150</td>
<td>6.6%</td>
<td>2.7%</td>
<td>28</td>
</tr>
<tr>
<td>2010</td>
<td>90</td>
<td>16.2%</td>
<td>0.0%</td>
<td>26</td>
</tr>
<tr>
<td>2014</td>
<td>240</td>
<td>5.0%</td>
<td>2.9%</td>
<td>26</td>
</tr>
</tbody>
</table>
replacement with latissimus dorsi flap in national cancer institute of Egypt. They did not report the rate of positive margin; but the average margin was 1.8 ± 0.5 cm.46

Munhoz et al. reported 209 patients with breast cancer who underwent different type of OBS. He presented an algorithm for selection of appropriate OBS technique. In this series, 12 patients (5.7%) had positive margin on permanent pathology. Eight patients underwent re-excision of the margins and 4 patients needed skin sparing mastectomy.37

One of the largest series reporting oncological outcomes of OBS is reported by Semprini et al. In their series of 489 patients, 15.75% of patients had positive margins and underwent re-excision.40

Kaviani et al. reported the results of OBS in 228 patients and the rate of positive margin was 5% in this study.23

Fitoussi et al. reported the largest series of OBS which include 540 patients. OBS were performed by a variety of techniques. The rate of positive margin was 18.9% in this report.41

Gulcelik et al. reported 101 mammoplasties performed in breast cancer patients with macromastia. Six patients had positive margin (5.9%) in this report.32

Rietjens et al. reported oncological results of 148 patients who underwent OBS and compared it with historical data of BCT trials. The oncoplastic techniques used in these patients were reduction mammoplasty, round block and latissimus dorsi flap for large defects. Focally positive margins were observed in 5% and close margins were present in 3% of the patients. The mean width of the margin was not reported. The rate of positive or close margin in this study was 8% which is less than 10% rate in NSABP B-06 trial and 48% in EORTC trial.35

There are a few studies which compare the results of OBS and conventional breast conservation and these studies are mostly retrospective. For instance, Kaur et al. compared two groups of patients undergoing standard quadrantectomy and OBS regarding the mean volume of excised specimen and the margin. Each group consisted of 30 patients. Reduction mammoplasty techniques were performed in the majority of OBS group (22 patients). The volume of excised tissue was significantly larger in the OBS group compared to the standard quadrantectomy. The average length of surgical margin was 6.6 mm in quadrantectomy group and 8.5 mm in OBS group. The average length of negative margin was 9.5 mm in quadrantectomy group and 9.3 mm in OBS group. The rates of positive margins were similar in two groups (3.3%), but more patients in quadrantectomy group had close margins (33.3% vs 13.3%).41

Giacalone et al. compared the results of breast conservation performed by standard quadrantectomy (43 patients) and OBS (31 patients). The average volume of the resected specimen and the margin widths were larger in OBS group compared to standard quadrantectomy. The rate of positive or close margin was similar in both groups; but more patients in OBS group had margins wider than 10 mm.45

Down et al. reported the results of 121 cancers treated with standard breast conservation and 37 patients treated with OBS. The weight and volume of the specimen were significantly higher in OBS group. Mean distances to furthest and nearest margins were significantly larger in OBS group compared to standard breast conservation group. They performed re-excision for margin less than 5 mm according to their local unit policy. Re-excision was performed for 28.9% of patients in the standard BCS group and 5.4% of patients in OBS group. They did not mention the percentage of patients with margin less than 2 mm in each group.46

Tenofsky et al. performed a retrospective study on 142 breast conserving surgeries including 58 cases of OBS and 84 cases of non-oncoplastic surgeries. OBS included a variety of techniques such as reduction mammoplasties, “Donut” mastopexy and tissue transfer. The rate of positive margin was 5.1% in OBS and 13.1% in non-oncoplastic group which were not significantly differed.47

Chakravorty et al. reported the results of 150 OBS performed at Royal Marsden hospital and compared it with 440 standard breast conservations. The weight of the specimen was significantly higher in OBS group. Patients in OBS group had 6.6% reoperation rate compared to 14.5% in the standard breast conservation group which was statistically significant. The width of the margins and the rate of close or positive margins were not reported in this study.48

In most studies, the results are reported for invasive and in situ carcinomas together. There was only one study which reported the results of OBS in DCIS. Song et al. reported the results of oncoplastic breast reduction performed in 28 women with DCIS.49

In this study, 32% of patients had positive margins. Positive margins were more prevalent in patients with intermediate or high grade DCIS.49

Two studies reported the results of OBS in locally advanced breast cancer and after neoadjuvant chemotherapy. Mazouni et al. compared the results of standard breast conservation (214 patients) with OBS (45 patients) after neo-adjuvant chemotherapy in breast cancer patients. The volume of resected specimen was larger in OBS group, but the rate of clear margins was similar in OBS and standard group.50 The other study performed by Boguicevisiou et al. reported the results of OBS in 60 patients with locally advanced breast cancer, 32 of the patients underwent OBS after neoadjuvant chemotherapy and the rest of the patients were candidates for surgery first. Margin status was not
reported in this study.\textsuperscript{51}

One meta-analysis comparing the results of OBS performed on 3165 patients with standard BCT performed on 5494 patients concluded that OBS results in significantly lower positive margin rate (12% vs 21%) and re-excision rate (4% vs 14.6%).\textsuperscript{32}

**Loco-regional recurrence in OBS**

In the study performed by Caruso, 61 patients (63 cancers) were followed up for a mean of 68 months (range 36-120 months). They had one case of local recurrence (1.5%) and 6 patients developed distant metastasis.\textsuperscript{33}

Losken \textit{et al.} reported 2% local recurrence rate in 49 patients treated with OBS techniques. The mean follow-up was 3.25 years in this study (ranging from 2 months to 11 years). No case of distant metastasis was reported.\textsuperscript{34}

In the report by Clough \textit{et al.}, 101 patients followed up for a median of 46 months (ranging from 7-168), the 5-year local recurrence rate was 9.4%. The 5-year actuarial overall and metastasis-free survival was 95.7% and 82.8% respectively.\textsuperscript{35}

In a series of 90 patients reported by Meretoja \textit{et al.} followed up for a median of 26 months (range 6-52), no patient developed loco-regional recurrence and 3 patients developed distant metastasis.\textsuperscript{36}

Roughton \textit{et al.} reported 45 patients with 46 tumors followed up for a mean of 38 months (range 4-82 months). There was no loco-regional recurrence in the follow-up period but two patients developed distant metastasis.\textsuperscript{37}

In a report from Egypt, 50 patients with T2 tumors treated with OBS were followed up for a mean of 33 months (range 20-54). Two patients (4%) developed local recurrence and one patient developed bone metastasis.\textsuperscript{38}

In another study of 489 patients treated by OBS techniques, Semprini \textit{et al.} reported only 3 cases of recurrence in the same breast during 5 years of follow-up. They considered these cases as second primary tumors due to the differences in histological features and the time interval between primary surgery and these events.\textsuperscript{39}

Kaviani \textit{et al.} reported 240 patients treated with OBS techniques. A total of 93.3% of patients had stage 0, I or II breast cancer and 193 patients were followed up for a median of 26 months (range 10-63). Local recurrence occurred in 7 patients and 10 patients developed distant metastasis.\textsuperscript{40}

Fitoussi \textit{et al.} reported the results of OBS in 540 breast cancer patients. Median tumor size was 29.1 mm (range 4-100 mm) and 108 patients received neoadjuvant therapy. The median follow up was 49 months (range 6-262). Local recurrence developed in 6.8 percent of patients. Five-year overall and disease-free survivals were 92.9 and 87.9 percent, respectively.\textsuperscript{41}

The rate of local recurrence was 3% in 148 patients treated by OBS in European Institute of Oncology. Median follow-up was 74 months (range 10-108). Distant metastasis occurred in 13% of the patients. The results of this study were compared to historical data and it was concluded that OBS is as safe as mastectomy for T1 tumors and probably safer than standard breast conservation for larger tumors.\textsuperscript{42}

Down \textit{et al.} compared the results of OBS (37 patients) with standard breast conservation (121 patients). OBS provided wider margins of resection and lesser need for re-operation; but, the rate of loco-regional recurrence did not differ between the two groups with an overall follow-up of 23.7 months (22.1 months in standard group and 29.3 months in OBS group). In that study, the tumors in OBS group were significantly larger than tumors of the other group.\textsuperscript{43}

Tenofsky \textit{et al.} compared the results of 58 OBS with 84 non-oncoplastic surgeries. The mean follow-up was 26.2 months for non-oncoplastic group and 24.6 months for OBS group. There was only one local recurrence in the non-oncoplastic group in a 90-year-old patient who did not receive adjuvant postsurgical treatment.\textsuperscript{44}

Chakravorty \textit{et al.} reported 440 standard breast conservation and 150 OBS cases followed for a median of 28 months (range 6-81) with a local relapse rate of 2.2% and 2.7% and distant relapse of 7.5% and 1.3%, respectively. There was no statistically significant difference between the two groups in local recurrence or overall survival.\textsuperscript{45}

In a series of 28 women with DCIS treated with OBS and followed up for an average of 2.7 years (range 8-180 months), there was only one loco-regional recurrence (3.5%).\textsuperscript{46}

Two studies evaluated the results of OBS in locally advanced breast cancer. In one study, 60 patients with stage III disease underwent OBS (42 cases after neoadjuvant chemotherapy). Local recurrence occurred in 10% and 5-year distant metastasis-free survival was 61.7%.\textsuperscript{47} The other study which compared the results of OBS with standard breast conservation, all patients received neoadjuvant chemotherapy. With a median follow-up of 46 months, local recurrence and overall survival were similar in the two groups.\textsuperscript{48}

**Discussion**

Breast conserving surgery (BCS) combined with postoperative radiotherapy has been accepted as the standard of care for treatment of early stage breast cancer. The poor cosmetic results of standard techniques of BCS in 20-40% of patients led to the development of OBS. Combining plastic surgery techniques with oncologic principles in OBS help surgeons in obtaining acceptable cosmetic outcomes without compromising oncologic safety. OBS has gained widespread acceptance in the recent decade. Though, its oncologic safety has not been
evaluate thoroughly, yet.

The most important aspect of oncologic safety of OBS concerns local control and margin status. Studies have confirmed that local control affects survival of breast cancer patients. Many studies evaluated the width of the free margin in OBS claiming that free margins obtained in OBS is wider than standard BCS techniques. Though some studies reported free margins width of 20 mm, the rate of positive margin in OBS series were between 5 to 18.9%. Two studies that compared OBS and standard quadrantectomy reported similar rates of positive margin in both groups; but in other studies the rate of re-excision was higher in standard quadrantectomy group. The rate of positive margin in OBS was unexpectedly high in the mentioned study. It should be noted that these studies included patients with more advanced tumors who underwent BCS after neoadjuvant chemotherapy. For instance, in the two studies with the highest rates of positive margin (reported by Bong et al. and Fitoussi et al.), the percentage of patients who received neoadjuvant chemotherapy were 18.2% and 20%, respectively. The rate of positive margin in these studies should be compared to the studies reporting BCS utilizing standard techniques after neoadjuvant chemotherapy which has been up to 47%.

It should be mentioned that clear margin of 2 mm is oncologically safe in breast conservation and wider margin does not reduce the rate of local recurrence. A meta-analysis of 28,162 patients from 33 studies revealed that obtaining negative margin in BCS reduces the risk of local recurrence; but, increasing the distance of free margin has no effect on local recurrence rate. Another study evaluating the effect of margin status on local recurrence in 906 women with early stage breast cancer concluded that close surgical margins and maximally resected close/positive margins were not associated with increased rate of local recurrence compared to widely negative margins. The authors ascribe this finding to the modern era of adjuvant systemic therapy of the patients.

Another issue of oncological importance is long term local recurrence rate. It should be pointed out that most of these studies are retrospective and the follow-up is relatively short with a median duration around 2-3 years in most studies. Local recurrence rate in different series of OBS are reported between 0 to 10%.

Another consideration is the size of the tumors operated by OBS techniques. Larger size of the tumor might be a risk factor for local recurrence. In some studies, tumors operated by OBS were significantly larger or were even locally advanced cancers undergoing neoadjuvant chemotherapy or included some advanced tumors. Considering that the reported rates of local recurrence in OBS are not greater than standard BCS – though these studies usually include larger tumors, we can conclude that OBS is at least as safe as standard BCS in terms of local recurrence. Prospective studies and randomized trials with larger number of patients and longer duration of follow up are needed to compare oncological outcome of OBS with standard BCS.

In conclusion, OBS is safe in terms of oncological outcomes and the rate of positive margin and local recurrence is at least comparable to standard BCS techniques. It provides the possibility of breast conservation in larger tumors with acceptable cosmetic outcome.

**References**


