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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.[1,2] 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.[3-6]

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.[7-10] 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%.[11] In addition, standard BCT techniques usually result

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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.[12-14]

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.[15-17]

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.[15]

It contains a wide spectrum of different techniques from simple reshaping to more complex techniques encompassing concomitant contra-lateral breast symmetrization procedures.[18]

OBS is characterized by four basic features: wide excision of the tumor, partial reconstruction to correct the defect of resection, complete reconstruction for mastectomy and correction of asymmetry of contra-lateral breast, if necessary.[19]

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.[16]

Techniques of OBS

A wide variety of techniques have been introduced as OBS in the literature. Different classifications 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*.[16] 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.[15]

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.[15] 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.[16,20-22]

From another perspective, OBS techniques can be categorized to volume displacement and volume replacement techniques.[10] 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.[2,19]

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 pedicle mammoplasty techniques.[23]

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 cosmetic 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

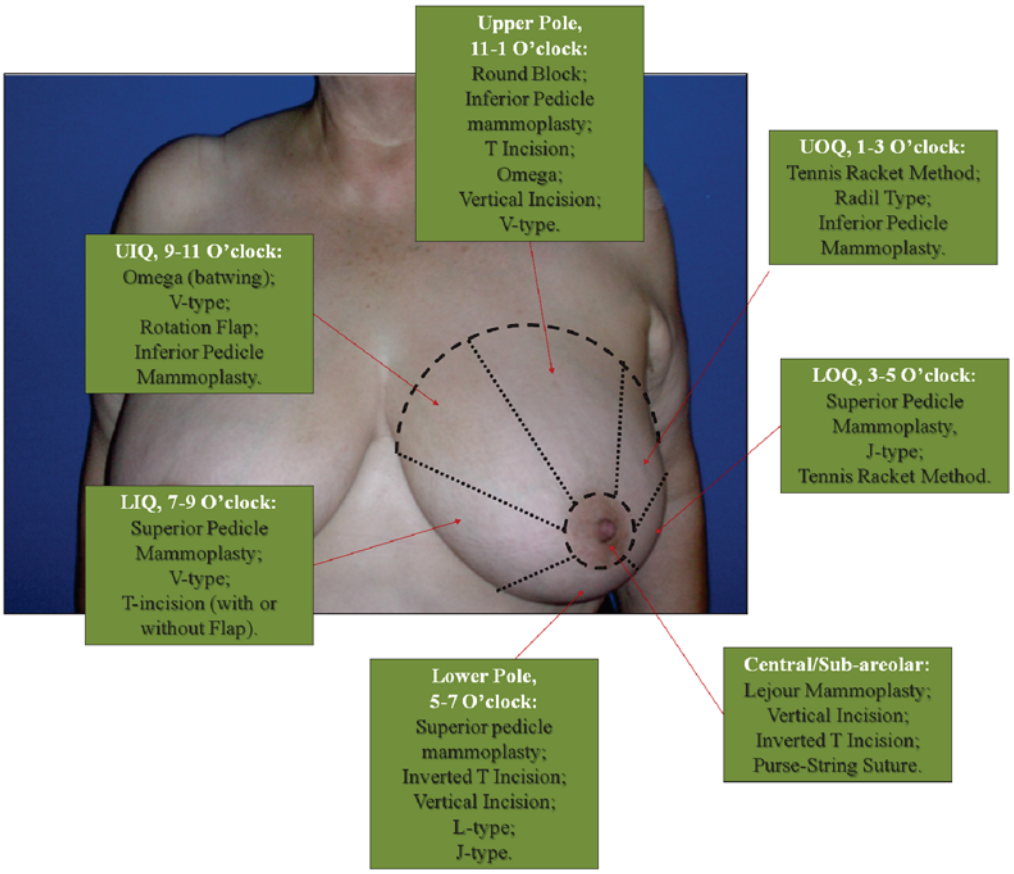

Figure 1. Oncoplastic techniques according to the tumor location. The clock positions are according to the left breast (reprinted with permission).[23]

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.[24]

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.[15]

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.[35]

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.[36]

Another study retrospectively reviewed the results of 46 OBS performed in 45 women. The rate of positive margins were 14% and reduction mammoplasty techniques were used in these series.[37]

In 2011, El-Marakby *et al.* reported 50 patients treated with partial mastectomy and volume

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

	Year	Number of Cases	Positive Margin	local recurrence rate	Median follow-up (month)
Clough[15]	2003	101	10.9%	-	-
Bong[36]	2010	167	22.2%	-	-
Munhoz[39]	2008	209	5.7%	-	-
Semprini[40]	2013	489	15.75%	0.6%	40
Fitoussi[41]	2010	540	18.9%	6.8%	49
Gulcelik[42]	2011	101	5.9%	-	-
Rietjens[43]	2007	148	3.0%	3.0%	74
Chakravorty[48]	2012	150	6.6%	2.7%	28
Meretoja[35]	2010	90	16.2%	0.0%	26
Kaviani[23]	2014	240	5.0%	2.9%	26

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.[38]

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.[39]

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.[42]

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.[43]

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 quadranectomy group and 9.3 mm in OBS group. The rates of positive margins were similar in two groups (3.3%), but more patients in quadranectomy group had close margins (33.3% vs 13.3%).[44]

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 to14.5% 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.

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 Bogucevisious *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.[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%).[52]

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.[33]

Losken *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.[34]

In the report by Clough *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.[15]

In a series of 90 patients reported by Meretoja *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.[35]

Roughton *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.[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.[38]

In another study of 489 patients treated by OBS techniques, Semprini *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.[40]

Kaviani *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.[23]

Fitoussi *et al.* reported the results of OBS in 540 breast cancer patients. Median tumor size was 29.1 mm (range 4-100mm) 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.[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.[43]

Down *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.[46]

Tenofsky *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 post-surgical treatment.[47]

Chakravorty *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.[48]

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%).[49]

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%.[51] 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.[50]

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

evaluated 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.[31,53] 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%.[35] 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 quadrenectomy group.[44-47]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.[36,41] 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%.[54-56]

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.[57] 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.[58]

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.[59] In some studies, tumors operated by OBS were significantly larger or were even locally advanced cancers undergoing neoadjuvant chemotherapy or included some advanced tumors.[41,46,48,51] 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

1. Keynes G. The Place of Radium in the Treatment of Cancer of the Breast. Ann Surg 1937; 106(4): 619-30.
2. Berry MG, Fitoussi AD, Curnier A, Couturaud B, Salmon RJ. Oncoplastic breast surgery: a review and systematic approach. J Plast Reconstr Aesthet Surg 2010; 63(8): 1233-43.
3. Veronesi U, Saccozzi R, Del Vecchio M, Banfi A, Clemente C, De Lena M, *et al.* Comparing radical mastectomy with quadrantectomy, axillary dissection, and radiotherapy in patients with small cancers of the breast. N Engl J Med 1981; 305(1): 6-11.
4. Veronesi U, Cascinelli N, Mariani L, Greco M, Saccozzi R, Luini A, *et al.* Twenty-year follow-up of a randomized study comparing breast-conserving surgery with radical mastectomy for early breast cancer. N Engl J Med 2002; 347(16): 1227-32.
5. Fisher B, Redmond C, Poisson R, Margolese R, Wolmark N, Wickerham L, *et al.* Eight-year results of a randomized clinical trial comparing total mastectomy and lumpectomy with or without irradiation in the treatment of breast cancer. N Engl J Med 1989; 320(13): 822-8.
6. Fisher B, Anderson S, Bryant J, Margolese RG, Deutsch M, Fisher ER, *et al.* Twenty-year follow-up of a randomized trial comparing total mastectomy, lumpectomy, and lumpectomy plus irradiation for the treatment of invasive breast cancer. N Engl J Med 2002; 347(16): 1233-41.
7. Al-Ghazal SK, Blamey RW, Stewart J, Morgan AA. The cosmetic outcome in early breast cancer treated with breast conservation. Eur J Surg Oncol 1999; 25(6): 566-70.
8. Clough KB, Thomas SS, Fitoussi AD, Couturaud B, Reyal F, Falcou MC. Reconstruction after conservative treatment for breast cancer: cosmetic sequelae classification revisited. Plast Reconstr Surg 2004; 114(7): 1743-53.
9. Urban C, Lima R, Schunemann E, Spautz C, Rabinovich I, Anselmi K. Oncoplastic principles in breast conserving surgery. Breast 2011; 20 Suppl 3: S92-5.
10. Haloua MH, Krekel NM, Winters HA, Rietveld

DH, Meijer S, Bloemers FW, *et al.* A systematic review of oncoplastic breast-conserving surgery: current weaknesses and future prospects. Ann Surg 2013; 257(4): 609-20.
11. Cochrane RA, Valasiadou P, Wilson AR, Al-Ghazal SK, Macmillan RD. Cosmesis and satisfaction after breast-conserving surgery correlates with the percentage of breast volume excised. Br J Surg 2003; 90(12): 1505-9.
12. Rose MA, Olivotto I, Cady B, Koufman C, Osteen R, Silver B, *et al.* Conservative surgery and radiation therapy for early breast cancer. Long-term cosmetic results. Arch Surg 1989; 124(2): 153-7.
13. Murphy C, Anderson PR, Li T, Bleicher RJ, Sigurdson ER, Goldstein LJ, *et al.* Impact of the radiation boost on outcomes after breast-conserving surgery and radiation. Int J Radiat Oncol Biol Phys 2011; 81(1): 69-76.
14. Kelemen G, Varga Z, Lazar G, Thurzo L, Kahan Z. Cosmetic outcome 1-5 years after breast conservative surgery, irradiation and systemic therapy. Pathol Oncol Res 2012; 18(2): 421-7.
15. Clough KB, Lewis JS, Couturaud B, Fitoussi A, Nos C, Falcou MC. Oncoplastic techniques allow extensive resections for breast-conserving therapy of breast carcinomas. Ann Surg 2003; 237(1): 26-34.
16. Clough KB, Kaufman GJ, Nos C, Buccimazza I, Sarfati IM. Improving breast cancer surgery: a classification and quadrant per quadrant atlas for oncoplastic surgery. Ann Surg Oncol 2010; 17(5): 1375-91.
17. Kaviani A, Sodagari N, Sheikhbahaei S, Eslami V, Hafezi-Nejad N, Safavi A, *et al.* From radical mastectomy to breast-conserving therapy and oncoplastic breast surgery: a narrative review comparing oncological result, cosmetic outcome, quality of life, and health economy. ISRN Oncol 2013; 2013: 742462.
18. Cothier-Savey I, Rimareix F. [Principles of oncoplastic surgery in breast surgery]. Ann Chir Plast Esthet 2008; 53(2): 102-11.
19. Baildam AD. Oncoplastic surgery of the breast. Br J Surg 2002; 89(5): 532-3.
20. Yang JD, Kim MC, Lee JW, Cho YK, Choi KY, Chung HY, *et al.* Usefulness of Oncoplastic Volume Replacement Techniques after Breast Conserving Surgery in Small to Moderate-sized Breasts. Arch Plast Surg 2012; 39(5): 489-96.
21. Yang JD, Lee JW, Cho YK, Kim WW, Hwang SO, Jung JH, *et al.* Surgical techniques for for personalized oncoplastic surgery in breast cancer patients with small- to moderate-sized breasts (part 2): volume replacement. J Breast Cancer 2012; 15(1): 7-14.
22. Yang JD, Lee JW, Cho YK, Kim WW, Hwang SO, Jung JH, *et al.* Surgical techniques for personalized oncoplastic surgery in breast cancer patients with small- to moderate-sized breasts (part 1): volume displacement. J Breast Cancer 2012; 15(1): 1-6.
23. Kaviani A, Safavi A, Mohammadzadeh N, Jamei K, Ansari-Damavandi M, Salmon RJ. Oncoplastic surgery in breast conservation: a prospective evaluation of the patients, techniques, and oncologic outcomes. Am J Surg 2014:
24. Asgeirsson KS, Rasheed T, McCulley SJ, Macmillan RD. Oncological and cosmetic outcomes of oncoplastic breast conserving surgery. Eur J Surg Oncol 2005; 31(8): 817-23.
25. Papp C, Wechselberger G, Schoeller T. Autologous breast reconstruction after breast-conserving cancer surgery. Plast Reconstr Surg 1998; 102(6): 1932-6; discussion 7-8.
26. Spear SL, Pelletiere CV, Wolfe AJ, Tsangaris TN, Pennanen MF. Experience with reduction mammaplasty combined with breast conservation therapy in the treatment of breast cancer. Plast Reconstr Surg 2003; 111(3): 1102-9.
27. Masetti R, Pirulli PG, Magno S, Franceschini G, Chiesa F, Antinori A. Oncoplastic techniques in the conservative surgical treatment of breast cancer. Breast Cancer 2000; 7(4): 276-80.
28. Petit J, Rietjens M, Garusi C. Breast reconstructive techniques in cancer patients: which ones, when to apply, which immediate and long term risks? Crit Rev Oncol Hematol 2001; 38(3): 231-9.
29. Dixon JM, Venizelos B, Chan P. Latissimus dorsi mini-flap: a technique for extending breast conservation. Breast 2002; 11(1): 58-65.
30. Veiga DF, Veiga-Filho J, Ribeiro LM, Archangelo I, Jr., Balbino PF, Caetano LV, *et al.* Quality-of-life and self-esteem outcomes after oncoplastic breast-conserving surgery. Plast Reconstr Surg 2010; 125(3): 811-7.
31. Clarke M, Collins R, Darby S, Davies C, Elphinstone P, Evans E, *et al.* Effects of radiotherapy and of differences in the extent of surgery for early breast cancer on local recurrence and 15-year survival: an overview of the randomised trials. Lancet 2005; 366(9503): 2087-106.
32. Buchholz TA, Somerfield MR, Griggs JJ, El-Eid S, Hammond ME, Lyman GH, *et al.* Margins for breast-conserving surgery with whole-breast irradiation in stage I and II invasive breast cancer: American Society of Clinical Oncology endorsement of the Society of Surgical Oncology/American Society for Radiation Oncology consensus guideline. J Clin Oncol 2014; 32(14): 1502-6.
33. Caruso F, Catanuto G, De Meo L, Ferrara M, Gallodoro A, Petrolito E, *et al.* Outcomes of bilateral mammoplasty for early stage breast cancer. Eur J Surg Oncol 2008; 34(10): 1143-7.

34. Losken A, Styblo TM, Carlson GW, Jones GE, Amerson BJ. Management algorithm and outcome evaluation of partial mastectomy defects treated using reduction or mastopexy techniques. Ann Plast Surg 2007; 59(3): 235-42.
35. Meretoja TJ, Svarvar C, Jahkola TA. Outcome of oncoplastic breast surgery in 90 prospective patients. Am J Surg 2010; 200(2): 224-8.
36. Bong J, Parker J, Clapper R, Dooley W. Clinical series of oncoplastic mastopexy to optimize cosmesis of large-volume resections for breast conservation. Ann Surg Oncol 2010; 17(12): 3247-51.
37. Roughton MC, Shenaq D, Jaskowiak N, Park JE, Song DH. Optimizing delivery of breast conservation therapy: a multidisciplinary approach to oncoplastic surgery. Ann Plast Surg 2012; 69(3): 250-5.
38. El-Marakby HH, Kotb MH. Oncoplastic volume replacement with latissimus dorsi myocutaneous flap in patients with large ptotic breasts. Is it feasible? J Egypt Natl Canc Inst 2011; 23(4): 163-9.
39. Munhoz AM, Montag E, Arruda E, Pellarin L, Filassi JR, Piato JR, *et al.* Assessment of immediate conservative breast surgery reconstruction: a classification system of defects revisited and an algorithm for selecting the appropriate technique. Plast Reconstr Surg 2008; 121(3): 716-27.
40. Semprini G, Cattin F, Vaienti L, Brizzolari M, Cedolini C, Parodi PC. Oncoplastic surgery and cancer relapses: cosmetic and oncological results in 489 patients. Breast 2013; 22(5): 946-51.
41. Fitoussi AD, Berry MG, Fama F, Falcou MC, Curnier A, Couturaud B, *et al.* Oncoplastic breast surgery for cancer: analysis of 540 consecutive cases [outcomes article]. Plast Reconstr Surg 2010; 125(2): 454-62.
42. Gulcelik MA, Dogan L, Camlibel M, Karaman N, Kuru B, Alagol H, *et al.* Early complications of a reduction mammoplasty technique in the treatment of macromastia with or without breast cancer. Clin Breast Cancer 2011; 11(6): 395-9.
43. Rietjens M, Urban CA, Rey PC, Mazzarol G, Maisonneuve P, Garusi C, *et al.* Long-term oncological results of breast conservative treatment with oncoplastic surgery. Breast 2007; 16(4): 387-95.
44. Kaur N, Petit JY, Rietjens M, Maffini F, Luini A, Gatti G, *et al.* Comparative study of surgical margins in oncoplastic surgery and quadrantectomy in breast cancer. Ann Surg Oncol 2005; 12(7): 539-45.
45. Giacalone PL, Roger P, Dubon O, El Gareh N, Rihaoui S, Taourel P, *et al.* Comparative study of the accuracy of breast resection in oncoplastic surgery and quadrantectomy in breast cancer. Ann Surg Oncol 2007; 14(2): 605-14.
46. Down SK, Jha PK, Burger A, Hussien MI. Oncological advantages of oncoplastic breast-conserving surgery in treatment of early breast cancer. Breast J 2013; 19(1): 56-63.
47. Tenofsky PL, Dowell P, Topalovski T, Helmer SD. Surgical, oncologic, and cosmetic differences between oncoplastic and nononcoplastic breast conserving surgery in breast cancer patients. Am J Surg 2014; 207(3): 398-402; discussion
48. Chakravorty A, Shrestha AK, Sanmugalingam N, Rapisarda F, Roche N, Querci Della Rovere G, *et al.* How safe is oncoplastic breast conservation? Comparative analysis with standard breast conserving surgery. Eur J Surg Oncol 2012; 38(5): 395-8.
49. Song HM, Styblo TM, Carlson GW, Losken A. The use of oncoplastic reduction techniques to reconstruct partial mastectomy defects in women with ductal carcinoma in situ. Breast J 2010; 16(2): 141-6.
50. Mazouni C, Naveau A, Kane A, Dunant A, Garbay JR, Leymarie N, *et al.* The role of oncoplastic breast surgery in the management of breast cancer treated with primary chemotherapy. Breast 2013; 22(6): 1189-93.
51. Bogusevicius A, Cepuliene D, Sepetauskiene E. The integrated evaluation of the results of oncoplastic surgery for locally advanced breast cancer. Breast J 2014; 20(1): 53-60.
52. Losken A, Dugal CS, Styblo TM, Carlson GW. A meta-analysis comparing breast conservation therapy alone to the oncoplastic technique. Ann Plast Surg 2014; 72(2): 145-9.
53. Veronesi U, Marubini E, Mariani L, Galimberti V, Luini A, Veronesi P, *et al.* Radiotherapy after breast-conserving surgery in small breast carcinoma: long-term results of a randomized trial. Ann Oncol 2001; 12(7): 997-1003.
54. Soucy G, Belanger J, Leblanc G, Sideris L, Drolet P, Mitchell A, *et al.* Surgical margins in breast-conservation operations for invasive carcinoma: does neoadjuvant chemotherapy have an impact? J Am Coll Surg 2008; 206(3): 1116-21.
55. Loibl S, von Minckwitz G, Raab G, Blohmer JU, Dan Costa S, Gerber B, *et al.* Surgical procedures after neoadjuvant chemotherapy in operable breast cancer: results of the GEPARDUO trial. Ann Surg Oncol 2006; 13(11): 1434-42.
56. Viswambharan JK, Kadambari D, Iyengar KR, Srinivasan K. Feasibility of breast conservation surgery in locally advanced breast cancer downstaged by neoadjuvant chemotherapy: a study in mastectomy specimens using simulation lumpectomy. Indian J Cancer 2005; 42(1): 30-4.
57. Houssami N, Macaskill P, Luke Marinovich M, Morrow M. The association of surgical margins and local recurrence in women with early-stage

invasive breast cancer treated with breast-conserving therapy: a meta-analysis. Ann Surg Oncol 2014; 21(3): 717-30.
58. Russo AL, Arvold ND, Niemierko A, Wong N, Wong JS, Bellon JR, *et al.* Margin status and the risk of local recurrence in patients with early-stage breast cancer treated with breast-conserving therapy. Breast Cancer Res Treat 2013; 140(2): 353-61.
59. Asgeirsson KS, McCulley SJ, Pinder SE, Macmillan RD. Size of invasive breast cancer and risk of local recurrence after breast-conservation therapy. Eur J Cancer 2003; 39(17): 2462-9.