Review Article

A clinical perspective on oncoplastic breast conserving surgery

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Abstract: Breast conserving surgery (BCS) plus radiation treatment is the favored alternative for mastectomy in patients with breast cancer. To allow for breast conservation in patients with large invasive tumors and poor response to neoadjuvant systemic treatment (NST) or patients with extensive ductal carcinoma in situ (DCIS), oncoplastic breast conserving surgery (OPBCS) techniques are introduced. OPBCS allows for breast conservation in a selective group of breast cancer patients who initially would have been treated with mastectomy due to the unfavorable tumor-to-breast ratio. With OPBCS, the oncological tumor excision is combined with plastic surgical breast conservation techniques without compromising oncological safety and maintaining aesthetic outcomes by preserving the shape of the breast. OPBCS should however not be applied to all breast cancer patients and the selection of patients who benefit from OPBCS and the timing of OPBCS are best discussed in a multidisciplinary team (MDT). Caution is required in patients with higher risk of positive margins [e.g., multifocal breast cancer, invasive lobular carcinoma (ILC), larger tumors and DCIS]. In these patients, delayed OPBCS is recommended to facilitate re-excision and maintain excellent breast conserving rates. Despite proven benefits in selected patients, the increase in the adoption of OPBCS is relatively low. This article provides a clinical perspective on OPBCS.

Keywords: Breast cancer; breast conserving surgery (BCS); oncoplastic breast conserving surgery (OPBCS); breast reconstruction

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Introduction

Breast conserving surgery (BCS) plus radiation treatment is the favored alternative for mastectomy in patients with breast cancer (1-9). Nowadays, around two-thirds of breast cancer patients undergo BCS (10). Since the survival of breast cancer patients increases, quality of life (QoL) after breast cancer (treatment) becomes more important. With the shift towards more BCS, there is a growing emphasis on aesthetic outcomes after surgery, which is an important aspect of QoL (11).

The challenges for standard BCS (s-BCS) are seen in patients with large invasive tumors that did not respond well on neoadjuvant systemic treatment (NST) and in patients with extensive ductal carcinoma in situ (DCIS). In both situations, there is an unfavorable tumor-to-breast volume ratio. In these cases, maintaining both oncological safety and aesthetic outcomes with s-BCS is difficult. To allow for breast conservation in such patients, oncoplastic breast conserving surgery (OPBCS) techniques are introduced. The goal of OPBCS is to combine the oncological tumor excision with plastic surgical breast conservation techniques, without compromising oncological safety and maintaining aesthetic outcomes by preserving the shape of the breast (12-17).

Table 1 Definition and classification system of oncoplastic breast conserving surgery developed by the American Society of Breast Surgeons (21)

Classification	Definition
OPBCS	OPBCS involves the combination of an oncological resection with volume displacement or volume replacement techniques to reconstruct the breast
Level I	<20% of breast volume excised, no skin excision required, no mammoplasty techniques required
	- Simple volume displacement
Level II	20–50% of breast volume excised
	Excision of excess skin required, based on mammoplasty techniques
	- Volume displacement technique (reduction)
	- Volume replacement, autologous tissue from outside the breast is used for reconstruction and volume compensation

OPBCS, oncoplastic breast conserving surgery.

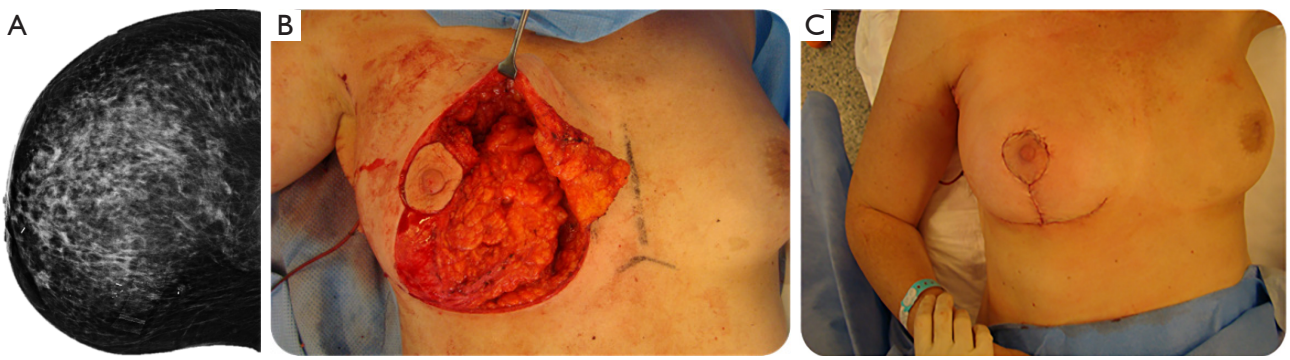

Figure 1 Patient A with usage of OPBCS. A 69-year-old patient, with a screen detected right-sided cT1N0M0, invasive lobular carcinoma with extensive DCIS (A: mammography). She underwent primary OPBCS (volume displacement) using a reduction technique following the Wise-pattern (B: per-operative, C: postoperative). OPBCS, oncoplastic breast conserving surgery; DCIS, ductal carcinoma in situ.

The first techniques used for OPBCS were introduced at the end of the previous century (18-20). Since then, a broad range of techniques have been developed. Despite the promising role OPBCS plays in clinical practice, the demand for standardization is recognized (21-25). At the same time, the adoption rates of OPBCS are relatively slow (24). This article provides a clinical perspective on OPBCS.

Definitions

Recently, the American Society of Breast Surgeons (ASBrS) developed a consensus on the definition and classification system for OPBCS (21). OPBCS involves the combination of an oncological resection with volume displacement or volume replacement techniques to reconstruct the breast. The various definitions used in this article can be found in *Table 1*.

OPBCS is mostly considered if there is a significant dead space remaining after the excision of the tumor (26,27). If the excised volume is lower than 20% of the total volume of the breast, no large skin excision is required, and no further mammoplasty techniques are necessary, other than simple volume displacement techniques (level-1 OPBCS). When 20% to 50% of the breast volume is excised (level-2 OPBCS), excision of excess skin is required and reduction with mammoplasty techniques may be applied (28).

In case of volume displacement in level-2 OPBCS, breast tissue from the same breast is used, and replaced into the surgical defect (*Figure 1*, patient A). With volume replacement techniques, autologous tissue from outside the breast is used for reconstruction and volume compensation, such as the latissimus dorsi (LD) flap, local perforator flaps [e.g., lateral and anterior intercostal artery perforator flaps (LICAP and AICAP), thoracodorsal artery perforator

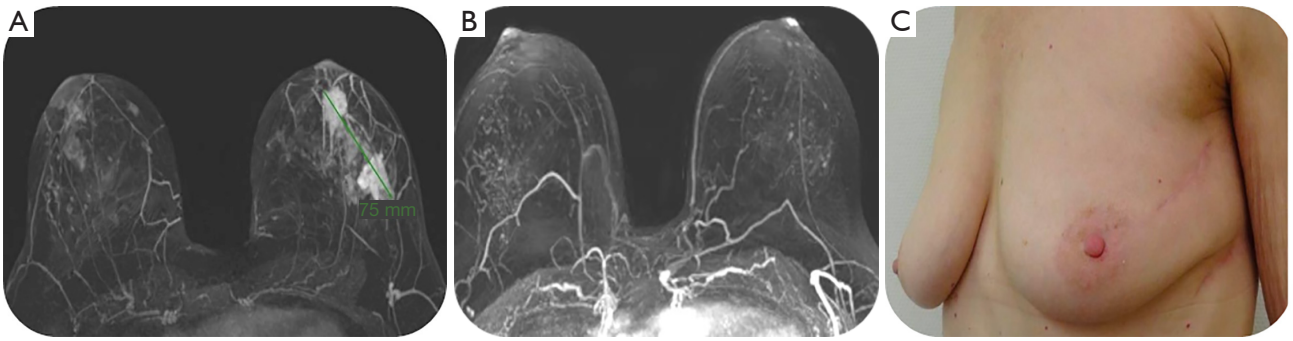

Figure 2 Patient B with usage of OPBCS. A 51-year-old patient, with a left-sided breast tumor: stage cT2mN1M0, HR-positive/HER2-negative of no special type with extensive DCIS. Imaging was performed before (A) and after (B) four cycles of doxorubicine and cyclofosfamide combined with 12 times paclitaxel, showing a radiological complete response. She underwent OPBCS (volume replacement) by use of TDAP flap technique due to extensive DCIS in the left breast (C). OPBCS, oncoplastic breast conserving surgery; HR, hormone receptor; HER2, human epidermal growth factor receptor 2; DCIS, ductal carcinoma in situ; TDAP, thoracodorsal artery perforator.

flap (TDAP, also shown in *Figure 2*, patient B), internal mammary artery perforator flap (IMAP) or the thoraco-abdominal flap (TAP)].

The indication for, and selection of the appropriate reconstruction technique depends on personal preferences and expertise of the MDT (20,26,29-31).

Current use of OPBCS

Despite the proven benefits of OPBCS regarding cosmetic outcomes and patient satisfaction, the increase in the adoption of OPBCS is relatively low (24). Kimball *et al.* showed that, although the high number of s-BCS performed annually in the US, the annual growth rate of OPBCS is less than 10% in the last 6 years (24). Large variation in its use, varying from nineteen percent in the Pacific to only three percent in the East South Central of the US, illustrates the need for standardization and awareness among breast cancer surgeons. Standardization of the goals and indications for OPBCS is important to optimize patient selection and for adequate evaluation of cosmetic- and oncologic outcomes and QoL (22,32). Most surgeons agree that the objectives of OPBCS include broadening the indications for s-BCS to include patients with large and/or multifocal tumors as an alternative to mastectomy, enhancing cosmetic outcomes, improving QoL, and reducing reoperations due to positive margins (22). Indication for OPBCS is preferably discussed within a MDT including a plastic surgeon and radiation oncologist. OPBCS is mostly considered in patients with significant dead space remaining after s-BCS or when more than 20% of the breast volume needs to be excised (27).

Volume displacement techniques (e.g., breast reduction techniques) can be used in patients in whom s-BCS would result in nipple malposition, breast hypertrophy, breast ptosis and in patients with a tumor located primarily in the upper quadrant of the lower half of the breast (27). In these patients, reduction of the contralateral breast is often necessary to obtain symmetry.

Volume replacement techniques are indicated in patients to ensure the preservation of shape and sufficient volume of the breast that cannot be achieved with volume displacement techniques and for those who do not want smaller breasts (27).

OPBCS can be performed in different stages during breast cancer treatment: in the primary surgery setting (*Figure 1*) as well as after NST (*Figure 2*). OPBCS can be performed as one-step procedure (= immediate OPBCS) or two-step procedure (= delayed OPBCS).

Immediate OPBCS has the advantage that the oncological excision and reconstruction are performed in one procedure. However, in case of positive resection margins requiring re-excision, a cosmetically successful reconstruction may have to be dismantled when re-excision is required. Moreover, re-excisions due to positive resection margins increase the risk of complications such as surgical site infections (SSIs), impaired cosmetic outcome and may delay adjuvant treatment (33-36). Thus, patients with a high risk for positive resection margins after s-BCS could benefit from delayed instead of immediate OPBCS. Risk factors for positive resection margins include multifocal breast cancer, invasive lobular carcinoma (ILC), larger tumors and DCIS (*Figures 1,2*) (37). Van Loevezijn *et al.* furthermore showed

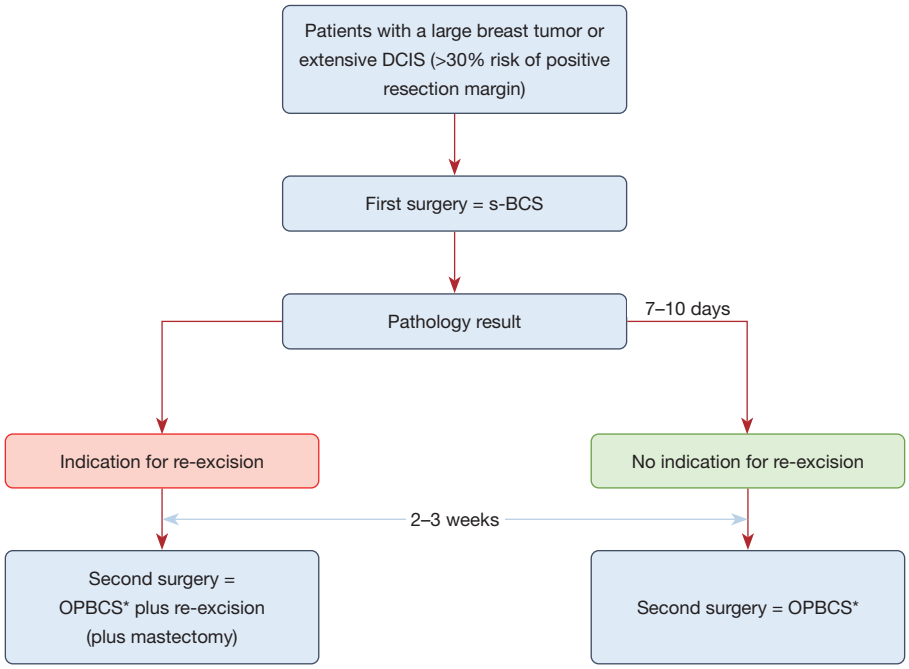

Figure 3 Two-step approach of OPBCS. OPBCS* = level 2 oncoplastic surgery using either volume displacement or volume replacement techniques. OPBCS, oncoplastic breast conserving surgery; DCIS, ductal carcinoma in situ; s-BCS, standard breast conserving surgery.

that risk factors differ between patients treated with and without neoadjuvant chemotherapy, except for ILC (38).

Delayed OPBCS (*Figure 3*) can be explained as a two-step OPBCS: the first surgery aims for a radical excision of the tumor. The second surgery is already planned within a short period of time (e.g., within 2 to 3 weeks) enabling re-excision if necessary based on the histology report, prior to the oncoplastic procedure.

Van Loevezijn *et al.* recently investigated the timing of OPBCS and its short-term surgical outcomes (38). If the risk of positive resection margins after s-BCS was deemed (>30%) significant, patients were selected for delayed OPBCS. Results of this study showed that both immediate- and delayed OPBCS allowed breast conservation in 97% of all cases (n=251) with a low complication rate (3%). Despite a re-excision rate of 66% in the delayed-OPBCS group, the breast-conserving rate was high (93%).

One of the disadvantages of this two-step approach in delayed OPBCS is the need for a second operation. However, if there is an indication for an oncological re-excision, dismantling the potential reconstruction is avoided. Another potential downside of the two-step approach is that a second operation may be associated with an increased risk of postoperative wound healing (31,39-42).

Outcomes

Surgical outcomes

Regarding surgical outcomes of OPBCS, such as excision margins, re-excision rates and short-term surgical complications, the results seem to be in advantage compared to s-BCS. Heeg *et al.* reported on the excision margins after OPBCS compared to s-BCS and showed a small difference in re-excision rates in favor of the OPBCS group (15.6% *vs.* 14.1%, P=0.012) with a similar conversion rate to mastectomy in both groups (3.7% *vs.* 3.2%, P=0.105) (43). Nanda *et al.* (16) recently published a Cochrane Review on 78 non-randomized cohort studies and their results on OPBCS. The re-excision rate for OPBCS compared to s-BCS was lower [risk ratio (RR) 0.76; 95% confidence interval (CI): 0.69–0.85]. In line with these results, the OPBC-01/iTOP study reported on the resection margins by comparing BCS/level-1 OPBCS with level-2 OPBCS. Between the groups, the proportion with a margin below one millimeter differed significantly (17% in BCS/level-1 OPBCS *vs.* 6% in level-2 OPBCS, P<0.001) (44). The re-excision rates due to positive margins was 11% in the BCS/level-1 OPBCS group *vs.* 7% in the level-2 OBPCS group (P=0.025). The non-inferiority of OPBCS to s-BCS alone

regarding surgical outcomes is supported by a recently published consensus (45). Few studies reported on short-term surgical complication rates after OPBCS. The Cochrane Review emphasizes that OPBCS may increase the number of complications, and the number of recalls for biopsies (16). Carter *et al.* analyzed the complications of OPBCS compared to s-BCS and mastectomy with- and without reconstruction. In their study population (n=10,607), patients treated with OPBCS had few seromas and hematomas (13.4% and 1.9% *vs.* 18.0% and 2.5%, P≤0.05). Wound-related complications and SSIs were seen more often with OPBCS than s-BCS (4.8% and 4.5% *vs.* 1.4% and 4.1%, P≤0.05). Compared to patients who underwent a mastectomy with reconstruction, there were fewer wound-related complications and SSI in the OPBCS group (respectively 4.8% and 4.2% *vs.* 11.6% and 13.0%, P≤0.05) (13).

Oncological outcomes

Although the surgical outcomes are in favor of OPBCS, oncological outcomes appear not to differ from s-BCS (16). Multiple studies have shown no significant difference in local recurrence (LR) rates and overall survival (OS) of OPBCS compared to s-BCS without oncoplastic reconstruction (15,44,46,47).

There are several studies reporting on QoL and cosmetic satisfaction after OPBCS compared to s-BCS and both similar or improved results are described (48,49).

Losken *et al.* performed a meta-analysis comparing OPBCS with s-BCS in which they found a significantly higher patient satisfaction with aesthetic outcome after surgery in the OPBCS group compared to s-BCS (89.5% *vs.* 82.9%, P≤0.001) (50). In an observational study, Santos *et al.* compared 57 patients who underwent OPBCS with 65 patients undergoing s-BCS. Although oncological and plastic surgeons, as well as semiautomatic software, rated the aesthetic outcome in favor of OPBCS, patients did not report a significant difference in the aesthetic results between OPBCS and s-BCS (51). Recently, a Brazilian study was published comparing the patient-reported outcomes based on the BREAST-Q after OPBCS compared to mastectomy with reconstruction. In the OPBCS group, the satisfaction rates with the breast(s) were higher as well as psychosocial and sexual well-being (52).

In attempt to fill the gap regarding QoL, the ANTHEM study group is currently performing a prospective study on the outcomes of OPBCS to support informed decision making in the future (53).

Radiotherapy after OPBCS

Adjuvant RT plays a central role in breast conserving treatment (54). After OPBCS, recognizing the target area for adjuvant RT can potentially be difficult since breast tissue may be replaced from one side to another, or tissue is displaced. In some patients, a radiation boost is indicated to maintain local control of disease (55). However, boost therapy increases the chance on developing moderate to severe fibrosis (56). In OPBCS, the target area for RT, and thus for the boost, may increase due to surgical manipulation of tissue. Therefore, in all patients, but specifically in patients with an indication for boost therapy, the benefits of OPBCS should be discussed multidisciplinaryly, keeping both oncological and aesthetic outcomes in mind. Metz *et al.* (57) reported on some crucial multidisciplinary recommendations when considering OPBCS:

(I) Consultation by a radiation oncologist pre-operative is advised.
(II) Discuss the eligibility for OPBCS in a MDT.
(III) The use of surgical clips enables precise target delineation during radiation therapy (planning) (58). Surgical clips should, at least, be placed on all sides of the cavity. Placing the marking clips ensures more accurate target volumes for post-operative radiotherapy, which reduces toxicity (26,58).
(IV) The surgical report should consist of clear notations about the topographic location of resection planes of the lumpectomy cavity after reconstruction; the location of placed marking clips; the three-dimensional rearrangement of surrounding tissue; the marking of the specimen and in case of nipple displacement or re-centering, the vascularization of the nipple-areola complex needs to be reported (27).
(V) Oncological surgeons and radiation oncologists should speak each other's language regarding the basic understanding of the surgical and radiation techniques.

Conclusions

In conclusion, OPBCS allows for breast conservation in a selective group of breast cancer patients who initially would have been treated with mastectomy due to the unfavorable tumor-to-breast ratio. Preserving the breast with OPBCS improves the QoL compared to mastectomy. In contrast

to a recently published recommendation (45), our opinion is that OPBCS should not be applied to all breast cancer patients. Selection of patients who benefit from OPBCS as well as the timing of OPBCS techniques are best discussed in a MDT. Caution is required in patients with higher risk of positive margins (e.g., multifocal breast cancer, ILC, larger tumors and DCIS). In these patients, delayed OPBCS is recommended to facilitate re-excision and maintain excellent breast conserving rates.

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Footnote

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Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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