



Paving the way for changing perceptions in breast surgery: a systematic literature review focused on oncological and aesthetic outcomes of oncoplastic surgery for breast cancer

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Abstract

Background The emphasis on aesthetic outcomes and quality of life after breast cancer surgery has motivated breast surgeons to develop oncoplastic breast conserving surgery (OPS). Training programs are still rare in most countries, and there is little standardization, which challenges the scientific evaluation of these techniques. This systematic review aims to assess oncological and cosmetic outcomes of OPS.

Methods After a strict selection process with precise inclusion and exclusion criteria, oncologic and aesthetic outcomes of oncoplastic surgery were searched, using the MEDLINE database up to September 30th, 2017. Available published literature was classified in levels of evidence. After a thorough screening process, only studies with the best level of evidence were included on selection. Systematic reviews and meta-analyses were not included for methodological reasons.

Results Titles and abstracts of 2,854 citations were identified and after screening 15 prospective studies including 1,391 patients were reviewed and scored in detail. Local relapse was found in 2.8% of cases with a wide range of follow-up (from 6 to 74 months). Close margins were retrieved in 11% of cases and positive margins in 9.4% of cases. Mastectomy was implemented in 6.9% of breast cancer patients to whom OPS was performed. Good cosmetic outcomes were detected in 90.2% of patients undergoing OPS, leaving open issues for who should perform cosmetic evaluation and which method should be used.

Conclusion Tumor margins, mastectomy rates, and cosmetic outcomes of OPS have to be further improved by standardizing various aspects of OPS. Research efforts should focus on level I evidence assessing both oncological and aesthetic outcomes of OPS and survival rates.

Keywords Oncoplastic surgery · Breast cancer · Breast conservation · Oncologic outcomes · Aesthetic outcomes · Cosmesis

Abbreviations

OPS Oncoplastic breast conservation surgery
BCT Breast conserving treatment
BCS Breast conserving surgery

RCTs Randomized controlled trials
DCIS Ductal carcinoma in situ

Introduction

Breast cancer is the most common cancer among women [1], with a 5-year survival higher than 90% in early stage disease [2, 3].

Breast cancer surgery has evolved overtime from Halsted radical mastectomies to modern breast-conserving surgery (BCS). RCTs have proven that BCS has no inferior to mastectomy survival [4, 5] and today BCS and adjuvant whole-breast radiotherapy represent the gold standard for the vast majority of patients with early stage breast cancer [6, 7]. The main goal of BCS is the resection of the tumor

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with adequate surgical margins while achieving a favorable aesthetic result. Good aesthetics have been associated with better psychological recovery and improved quality of life [8], but while large proportionate breast volumes are excised, subsequent defects and deformities are inevitable and contrast to patients' aesthetic desires [9]. In cases of certain unfavorable tumor locations and for significant volumes of resection required for adequate oncologic treatment, cosmetic results are implausible. To this direction, introduction of OPS paved the way to overcome the limits of BCS, allowing larger and more adequate resections, but hiding the defects of excision using various volume-displacement techniques of plastic surgery [10–12].

In the new era of breast cancer surgery, introduction of OPS gains continuous acceptance. Combined goals of OPS are oncological safety and good aesthetic outcomes. The application of aesthetic techniques for therapeutic purposes should never compromise the main objective of breast cancer surgery which is to obtain clear margins with good local disease control [13]. Terminologically, OPS embraces a combination of plastic surgical procedure with breast conserving treatment (BCT) that permits obtainment of wide excisions and prevents breast deformities by immediate reconstruction of large resection defects. Oncoplastic procedures represent a useful alternative for resection of 20–40% of the breast [14–16].

Surgical approaches for OPS could be divided in: volume replacement procedures, which substantially combine resection with immediate reconstruction of the defect [17–21] and volume-displacement procedures which combine resection with a variety of different breast-reduction and -reshaping techniques, according to the location of the tumor. The last approach causes a net loss of breast volume and frequently demands a contralateral procedure to obtain symmetry [22, 23].

Rationale of OPS is obtainment of better cosmetic outcomes together with wider resections, there are although, a few data from the oncologic point of view, regarding its impact on local recurrences, distant metastases and overall survival [24].

It has fundamental importance to remember that there are limitations related to breast cancer patients, to whom this procedure can be offered.

Quality of reporting in published evidence is mandatory to acknowledge oncological and cosmetic outcomes of OPS, to address issues on morbidity and quality of life and, importantly, to direct correctly clinical decisions and inform patients. Objectives of this systematic review were to assess oncological and aesthetic outcomes of OPS in

breast cancer treatment, extracting data from published studies with the best level of available evidence.

Methods

A literature search for relevant articles regarding application of OPS in breast cancer treatment was conducted, using the MEDLINE database. The search was limited to English-written studies involving women with breast cancer undergoing OPS. A comprehensive literature search was conducted using the following search terms: “oncoplastic surgery”, “breast cancer”, “breast conservation”, “oncologic results”, “cosmetic results”, “cosmesis”. Various combinations of the keywords and related terms were used to increase sensitivity. Abstracts from all articles were obtained and those with relevant data on OPS were reviewed. A manual cross-reference search of the bibliographies of relevant articles was conducted to identify studies not found through the computerized search.

Language restrictions were applied (only articles in English were considered eligible); two investigators (I.G.P. and C.D.), working independently, searched the literature and extracted data from each eligible study. Reviews were ineligible, whilst all prospective studies were eligible for this systematic review. We checked all the references of relevant reviews and articles that our search retrieved, so as to identify potentially eligible conference abstracts. In instances where multiple (overlapping) publications stemming from the same study were identified, the larger size study was included. Inclusion and exclusion criteria of this systematic review are reported in Fig. 1.

After the application of precise inclusion and exclusion criteria, which revealed 2,854 citations published between 2000 and 30th September 2017, a first screening was implemented retrieving 141 articles for potential inclusion which were reviewed in detail. A second screening was mandatory to exclude not eligible studies. After the second screening, 126 articles were excluded, leaving 15 articles to form the basis of this systematic review (Fig. 1).

After the first selection of studies for potential inclusion, the eligible articles included were classified into levels of evidence according to the Oxford Centre for Evidence-Based Medicine Levels of Evidence, in a comprehensive effort to extract data from high-quality published literature [25]. Cardinal objectives of this systematic review were assessment of oncological and aesthetic outcomes of OPS, based on the best level of available evidence. As per methodological design, this systematic review targets to include on selection, only published studies with the best level of evidence.

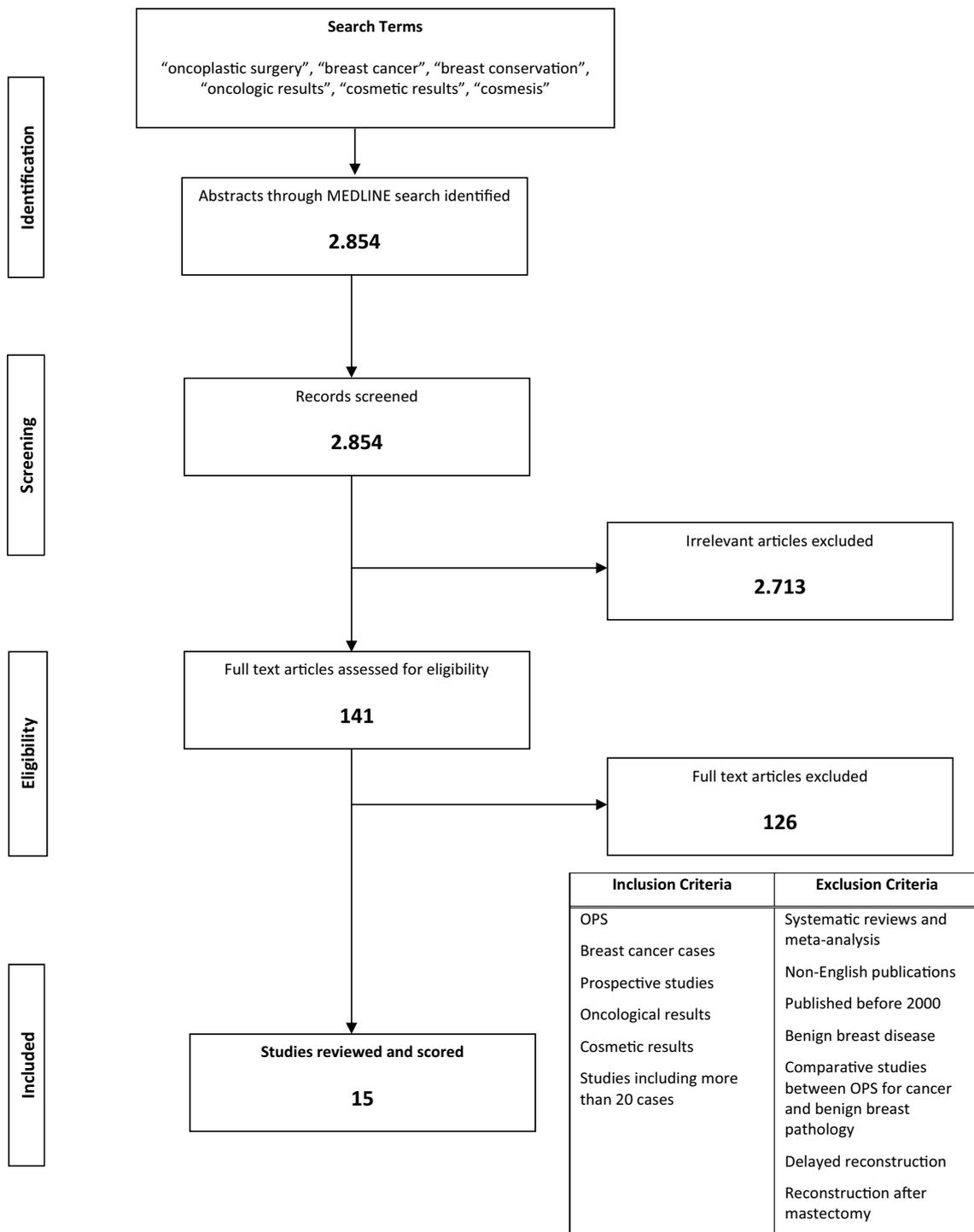


Fig. 1 Literature diagram

Results

Data extraction and obtained outcomes of OPS

Design of included studies

Literature search revealed no randomized controlled trials (RCTs). Only studies with the best level of evidence were included on selection (Fig. 1). A number of 15 prospective studies [10, 24, 26–38] were analyzed and reviewed for the aims of this article. It should be highlighted although, that all included trials were single-center studies, factor which represents one of the major shortcomings of current published evidence on OPS.

Included study population and follow-up

A total number of 1.391 breast cancer patients treated with OPS were included in this systematic review. Mean follow-up was different in assessed studies, although, it did not exceed 6 years, with a range of 1–74 months (Table 1).

All included studies recruited patients from single clinical institutions with small sample sizes. Eight of the analyzed studies included less than 100 patients per study in the OPS group, whereas, none of the remaining 7 studies exceeded 300 patients per study. A total of 1.391 patients were treated using OPS techniques. In these prospective studies, the predominant histotype was invasive ductal carcinoma (Table 1).

Quality metrics of current evidence on OPS

After strict screening, only prospective studies were included, as the only available literature offering the best quality of evidence and reporting. Considering the absence of RCTs (level 1 evidence), a total number of 15 prospective studies report the best available evidence on OPS, whereas, 87 studies report level 3 evidence and 39 studies level 4 (Fig. 1).

All 1.391 breast cancer patients included in this systematic review were operated with different oncoplastic techniques of breast conservation. They examine breast cancer cases scheduled for immediate breast reconstruction following BCS. Only one of the prospective studies which were reviewed and scored, presented complete data and adopted scientifically virtuous methodology for evaluation of oncological and aesthetic outcomes after OPS [10].

Oncological outcomes after OPS

Local recurrence

OPS offers a better control of tumor margins and it is safe as mastectomy in tumors less than 2 cm and probably safer than BCS in larger tumors. However, for the assessment of

local recurrence a follow-up period of 2 years was considered mandatory [39].

Among included articles reviewed and scored for the aims of this systematic review, a total of 11 studies reported data on local recurrence, with a mean follow-up period ranging from 1 month to 74 months [10, 24, 26–31, 35, 37, 38] (Table 1). Eight of these studies assessed local relapse with mean and median follow-up periods exceeding 2 years [10, 24, 26–31].

More particularly, Clough et al. [10], retrieved a 5-year actuarial local recurrence rate of 9.4%, which represents the highest percentage of local relapse in all included studies. Whereas, Rietjens et al. [24] report a 3% of relapse after 74 months of median follow-up, a datum which is in accordance with the 2, 9% of local relapse found by Kaviani et al. [28], after 26 months of follow-up. Veiga et al. [34], in a first publication reported a local recurrence rate of 4.4% which was decreased to 2.2% in a second paper published a year later [35]. OPS techniques were adopted in both studies. In both studies follow-up did not exceed 1 year, which is a limiting factor for adequate evaluation of local recurrence [35, 37]. A local recurrence rate of 2% was found also by Mansell et al. [29] after 5 years of follow-up. Very low rates of local relapse were retrieved by Rusby et al. [27] after follow-up of 44 months. Whereas, in the studies of Meretoja et al. [26], Yang et al. [38], Adimulam et al. [30] and Colombo et al. [31], local recurrence rate was 0%, as no local recurrence was detected in the last four studies (Table 1).

Among eleven included studies, which assessed local recurrence, it is important to highlight that in four studies no local relapse was observed [26, 30, 31, 38]. Among these four studies, only in the study by Yang et al. [38], the follow-up was less than 2 years. No detection of local recurrence in these four studies [26, 30, 31, 38] represents a datum which favors OPS, although, it should be interpreted with caution, particularly in the study of Yang et al. [38] which is limited by the very short follow-up period. Among 15 included studies who assess oncological outcomes of OPS, 4 studies did not report data on local recurrence rate, fact which shows the incomplete reporting in published literature [32, 33, 36, 37].

The included studies suggest that when mean or median follow-up exceeds 2 years, it permits local relapse retrieval at rates ranging from 0 to 9.4%. In these studies, there is a wide range in follow-up periods, ranging from 6 to 74 months.

Margin involvement

Margin involvement rates should always be assessed. The internationally adopted definition of tumor-free margins is a distance of a minimum 1 mm from the exterior tumor border. It is noteworthy that, achieving distances which exceed 1 mm of tumor-free margins, local recurrence rates are not furtherly reduced, despite the rationale of OPS which is

Table 1 Data on included studies and oncologic results of OPS

Study	Groups and no. of pts	Mean/median FU in months	MS	MI		Local recurrence
Clough et al. [10]	1 group OPS <i>n</i> = 101 pts	46 (median)	6.00% (6/101pts)	Free Focal Extensive Unknown	90 (89%) 4 (4%) 3 (3%) 4 (4%)	5 year LR rate: 9.4%
Kaur et al. [33]	2 groups 1st: OPS <i>n</i> = 30 2nd: quadrantectomy <i>n</i> = 30	NR (referred as short FU)	NR	Free Close Positive Unknown	1st group 25 (83%) 4 (13%) 1 (3%) 2nd group 17 (57%) 10 (33%) 1 (3%) 2 (7%)	Cannot be evaluated (short FU)
Rietjens et al. [24]	One group OPS <i>n</i> = 148 pts	74 (median)	6.00% (9/148) 5 to contralateral breast (cancer during FU) 1 due to positive margins 3 due to recurrence	Free Close Focal	135 (91%) 5 (3%) 8 (5%) (with DCIS)	LR rate: 3.00% 2 reoperations
Giacalone et al. [32]	Two groups <i>n</i> = 74 1st OPS: <i>n</i> = 31 2nd quadrantectomy <i>n</i> = 43	NR	1st group: 13% 2nd group: 16.2%	Free Close Positive	1st group 24 (77%) 4 (13%) 3 (10%) 2nd group 29 (67%) 7 (16.5%) 7 (16.5%)	NR
Rusby et al. [27]	Two group OPS <i>n</i> = 115	Median FU 41.4 months (referred in abstract) 44, 1 months (referred in text) (inter-quartile range 21, 1–82 months)	7.00% (8/115) Five due to positive margins One due to close margins One due to risk reduction One due to local recurrence	Final frozen section Free Close (in paraffin section) Positive	107 (93%) 3 (3%) 5 (4%)	1.00% (1/107) 2 reexcisions 1 mastectomy All mastectomies
Veiga et al. [34]	Two groups 1st: OPS <i>n</i> = 45 2nd: BCT <i>n</i> = 42	Median FU 6 and 12 months (OPS group) 36 months (BCT group)	4.4% (2/45 pts)		NR	1st group: 4.4% (2/45) 2nd group: NR
Veiga et al. [35]	Two groups 1st OPS <i>n</i> = 45 2nd BCT <i>n</i> = 45	6 and 12 months	2.2% (1/45 pts)		NR	1st group: 2.2% (1/45) 2nd group: NR
Meretoja et al. [26]	One group OPS <i>n</i> = 90	26 (median)	12.2% (11/90 pts)	Inadequate margins in 11 pts (12.2%) treated with mastectomy		No LR No DR
Chan et al. [36]	One group <i>n</i> = 162	1–3 months	NR		FREE	NR
Bong et al. [37]	One group OPS <i>n</i> = 167	NR	7.00% (11/167 pts)	Close or involved Re-excision Subsequent MS Radiotherapy Plant reoperate	37/ 167 (22.2%) 17 (10%) 11 (6.6%) 3 (1.8%) 5 (3%)	NR
Yang et al. [38]	One group OPS <i>n</i> = 58	21 (mean)	NR		NR	No LR

Table 1 (continued)

Study	Groups and no. of pts	Mean/median FU in months	MS	MI		Local recurrence
Kaviani et al. [28]	One group OPS <i>n</i> = 240 pts	26 (mean)	2.5% (6/240 pts)	Free Involved	228(95%) 12(5%)	2.9% (7/240)
Mansell et al. [29]	Three groups 1st OPS <i>n</i> = 104 2nd WLE <i>n</i> = 558 3rd Ms ± IR <i>n</i> = 318	56.2 (median)	1st group: 12.5% (13/104) 2nd group: 5.4%	Involved	1st group 15 (14.4%) 2nd group 13.1%	5-year LR rate 1st group: 2% 2nd group: 3.4% 3rd group: 2.6%
Adimulam et al. [30]	One group OPS <i>n</i> = 35	28 (mean)	2.9% (1/35 pts)	Positive	3 (8.5%)	28 months LR rate: 0%
Colombo et al. [31]	One group OPS <i>n</i> = 25	25 (median)	8% (2/25 pts) (1 with positive margins + 1 with free margins and BRCA2 mutation)	Free Positive	22 (88%) 3 (12%)	22months LR rate: 0%

WLE wide local excision, Ms ± IR mastectomy with or without immediate reconstruction, *n* number of patients, NR not reported, MS mastectomy, MI margin involvement, FU follow-up, LR local recurrence, DR distant recurrence

obtainment of wider excisions which may improve local relapse rates [40–42].

A total number of eleven prospective studies examined margin involvement rates. For the aims of this systematic literature review, outcomes of these studies were analyzed and compared [10, 24, 26–33, 37]. Authors describe close margins with different definitions resulting in an incongruous reporting. In the vast majority of these studies, close margins were considered to be retrieved when a distance of 1 mm or 2 mm was obtained between the cut edge of the sample and the external border of the tumor. Among included studies the highest rates of tumor-free margins are detected in two studies. Kaviani et al. [28], report tumor-free margins in 95% of cases and Rusby et al. [27], detected similar rates of free margins in 93% of cases. Whereas, Clough et al. [10], found tumor free margins in 89% of cases.

More particularly, we found that in the overwhelming majority of breast cancer patients, adoption of OPS techniques permits obtainment of tumor-free margins in the 88.1% of cases. Whereas, close margins were retrieved in 11% of cases and positive margins in 9.4% of cases. only a 6.97% of breast cancer patients to whom OPS was performed, needed implementation of mastectomy (Table 1; Fig. 2). Giacalone et al. [32] performed mastectomy in 13% of cases after OPS; this percentage (13%), exceeds significantly the mean mastectomy rate (6.97%) of this systematic review.

It is well conceived that when mastectomy rates are as high as 13% of cases, as reported in some studies [32], OPS is not proposed to “eligible cases”, which highlights the need for adequate and appropriate selection of “eligible cases” for OPS. This inappropriate selection of eligible patients for OPS, clearly affects negatively mastectomy rates. In

Fig. 2 Key messages of this systematic review on OPS for breast cancer

Available Evidence:	<ul style="list-style-type: none"> • Poor. • Underpowered studies. • No RCTs. • Prospective studies offer the best available evidence.
Oncologic outcomes:	<ul style="list-style-type: none"> • Local recurrence: 2.8% • Free margins: 88.1 % • Close margins: 11% • Positive margins: 9.4% • Mastectomy: 6.97%
Cosmetic outcomes:	<ul style="list-style-type: none"> • Good cosmesis after OPS in: 90.2% of cases.

addition, specimen weight range in included studies was wide. Mean surgical specimen weight was 552.5 g, while in some cases, specimen weights arrived at 950 g.

Cosmetic outcomes after OPS

The second endpoint of this systematic review was assessment of cosmetic outcomes after OPS. Aesthetic results after OPS for breast cancer were examined, although, in the vast majority of reviewed studies a great discrepancy was observed. This discord among included studies concerned substantially the different methods adopted to examine and

assess obtained cosmetic outcomes after OPS. It should be highlighted that methodology of assessing and reporting cosmetic results is not univocal. Only eight studies [10, 26, 28, 30, 31, 35, 36, 38], among included ones, assessed cosmetic outcomes obtained after OPS and these studies showed significant discrepancies (Table 2).

More particularly, Clough et al. [10], retrieved acceptable cosmetic results in 88% of patients 2 years after OPS and 82% in 5 years [10]. In the study of Adimulam [30], 96% of patients were extremely to moderately satisfied 6 months after OPS. Meretoja et al. [26], found acceptable cosmetic results in 84% of cases in a period of time

Table 2 Cosmetic outcomes after OPS

Study	Cosmetic outcomes		
Clough et al. [10]	acceptable result: 88% at 2 years, 82% at 5 years neoadjuvant RT vs adjuvant RT:worse results for neoadjuvant RT (42.9% vs 12.7%)		
Veiga et al. [35]	Better scores for the OPS group compared to the BCT group		
Meretoja et al. [26]	acceptable reresults 84% of the patients		
Chan et al. [36]		Surgeons	Patients
	Nearly similar	41%	40%
	Slightly different	48%	45%
	Clearly different	11%	14%
	Distorted	0%	1%
Yang et al. [38]		Surgeons	Patients
	Excellent	31%	38%
	Good	52%	45%
	Fair	15%	15%
	Bad	2%	2%
Kaviani et al. [28]	improved cosmesis by OPS		
Adimulam et al. [30]	The cosmetic outcome was assessed in 25pts by a plastic surgeon and a nurse independently, using the same 7 criteria		
	<u>Outcome category</u>		<u>Score</u>
	Poor		≤ 15
	Fair		16–18
	Good		19–22
	Excellent		23–26
	Total score	Surgeon	Nurse
	Average score	8–25	11–26
	Poor cosmetic outcome: 12% of pts (surgeon + nurse both)		
	Patient's self-assessment by questionnaire		
	Extremely satisfied		48% (12 pts)
	Moderately satisfied		48% (12 pts)
	Not satisfied		4% (1 pt)
	96% were moderately to extremely satisfied 6 months after OPS84% (21/25) felt that their social life was not affected by the surgery		
Colombo et al. [31]	Cosmetic evaluation in 15 patients		
	Excellent–good (4–5/5)		14 (93.3%)
	Fair (3/5)		1 (6.6%)
	Poor–bad		None
	Median score		4.4
	Patient's satisfaction median score: 9.6		

of 6–52 months. Improvement of cosmesis using OPS, was equally confirmed by Veiga et al. [35], assessed at the 6th and 12th postoperative months and Kaviani et al. [28] during a median follow up period of 26 months. In the studies of Colombo et al. [31], Chan et al. [36] and Yang et al. [38] cosmetic evaluation after OPS was performed both by surgeons and patients. Considered together, these eight studies describe favorable aesthetic results following OPS, in the majority of patients. In fact, 90.2% of patients had good cosmetic results [10, 26, 28, 30, 31, 35, 36, 38].

Nevertheless, most of these 8 studies provide very limited information on the cosmetic outcome in relation to whether patients received radiotherapy (Table 3). Clough et al. [10] provide a description of the grading system for cosmetic evaluation of the patients; follow up with bilateral mammograms was also consistent for this group of patients. Ninety-five patients with negative surgical margins had an acceptable cosmetic result; postoperative radiation did not alter the cosmetic result. In 13 patients who received preoperative radiation therapy, results were worse compared to postoperative radiotherapy.

In another detailed report of the assessment methodology regarding cosmetic outcomes performed by Adimulam et al. [30], the follow up for 25% of this cohort of 35 patients was 18.8 months, assessed by the surgeon. Meretoja et al. [26], discussed that none of the patients involved in their prospective study developed mild or moderate radiation related complications. Chan et al. [36] report as one of the limitations of their study the short-term follow-up (1–3 months), where radiation effects were not considered. However, they predict minimal adverse cosmetic effects of radiation on patients treated with OPS, due to breast redistribution and the resultant smaller breast after OPS. Yang et al. [38] treated 58 patients with OPS and evaluated cosmetic outcomes at

12 months postoperatively, with an “excellent and good” overall cosmetic result in the majority of cases (83%); all patients received adjuvant radiotherapy and the average follow-up interval was 21 months. Finally, Colombo et al. [31] produced favorable cosmetic outcomes; all 25 patients received postoperative radiotherapy.

Discussion

In recent years, introduction of new surgical concepts permitted better response in patients’ needs for better quality of life and improved aesthetic outcomes after surgery. To that direction, OPS, undoubtedly paves the way of change in surgical perceptions [10, 12, 15].

OPS is a relatively new approach which integrates proper oncologic surgery with reconstructive techniques of plastic surgery, aiming to improve cosmetic outcomes obtained with the classical BCS [43]. OPS expands the indications of BCT, even in cases in which attended cosmesis after the classical BCT seems to be poor [44–46].

A wide range of oncoplastic techniques have been adopted to achieve different patient and tumor requirements but essentially the crucial principle should be to obtain adequate oncological surgery (therapeutic volume reduction) and then, an appropriate breast tissue rearrangement (volume-displacement) to correct the defect [47–49]. Modern breast surgeons should propose OPS for breast cancer to eligible cases [15].

Quality of reporting on OPS

Fragmentary reporting of current literature might be attributed to the recent introduction of OPS techniques in breast cancer treatment. There is still room for development and

Table 3 Data Regarding Radiotherapy in OPS patients

Study	Radiation therapy in OPS patients
Clough et al. [10]	Postoperative radiotherapy did not alter the cosmetic result, and good breast symmetry was maintained over time, but the cosmetic result was related to the timing of radiotherapy. Results were worse in the 13 patients who received preoperative rather than postoperative radiotherapy (42.9% vs 12.7%, $p < .002$)
Meretoja et al. [26]	Received radiotherapy and systemic adjuvant therapy
Veiga et al. [35]	All patients received radiotherapy (control and oncoplastic group)
Kaviani et al. [28]	All cancer patients received radiotherapy (RTx)
Yang et al. [38]	All patients received adjuvant radiotherapy (RTx) 18 patients received chemotherapy and RTx 12 Patients received some form of hormonal therapy and RTx 10 patients received chemotherapy, hormonal therapy and RTx
Adimulam et al. [30]	Whole-breast + boost to tumor bed irradiation in 33 patients, 2 patients received accelerated partial breast irradiation through interstitial brachytherapy ports
Chan et al. [36]	Cosmetic outcome was evaluated before chemotherapy and irradiation

advance in the quality of reporting and adherence to the consolidated standards of reporting trials (CONSORT) recommendations [50, 51]. It is recognized that RCTs provide clinicians with the best level of evidence for the effects of interventions. As observed by Haloua et al. [52], major limiting factors regarding published evidence in regard to OPS, are that it lacks RCTs and contains methodologically inconsistent and underpowered studies, which conceal part of their results.

It should be mentioned that this is the first systematic review on OPS, which extracts data on oncological and aesthetic results of OPS from the most robust, methodologically, published studies and proposes an original methodology for eligible studies screening and selection according to evidence level [21–23]. Inclusion and exclusion criteria, methodology of screening, and selection process are distinctive and peculiar of this systematic review.

Assessment of oncological outcomes after OPS

A rapidly increasing body of published evidence suggests comparable rates of local recurrence between OPS and conventional BCS. Actually, there are oncologic advantages of OPS, since this method, permits obtainment of larger resection specimens than BCS alone [32, 33]. Furthermore, OPS improves patient satisfaction by improving aesthetic outcomes after BCS.

Oncological outcomes of OPS were reviewed and compared in this systematic review. We found that in the overwhelming majority of breast cancer patients, adoption of OPS techniques permits obtainment of tumor-free margins in the vast majority of cases (88.1%). A limited number (6.97%) of breast cancer patients to whom OPS was performed, needed implementation of mastectomy (Fig. 2). These relatively low and acceptable rates of mastectomy highlight the oncological safety of OPS. Despite the large specimens excised in the analyzed studies using OPS techniques, wider resection specimens did not permit obtainment of tumor-free surgical margins in all breast cancer patients, included in this article. Range of specimen weights in included studies presented significant variability.

Oncological results of OPS based on outcomes from the 15 included prospective studies were comparable with the results of various single-center observational studies. Comparing oncological results of OPS found in this systematic review with published evidence and more particularly with the single largest retrospective study evaluating oncological and cosmetic outcomes of 540 patients over a period of 20 years [53], we found comparable oncologic outcomes. In comparison with our results, the aforementioned retrospective study by Fitoussi et al. [53], found tumor-involved margins in 5% of cases, focal involvement in 14% of cases and clear margins in the 81% of cases. In our systematic

review we found clear margins in 86.8% of cases. It should be mentioned that in Fitoussi study, 7% of cases received an additional boost of radiotherapy, an overall 9% required mastectomy and 2% of cases required re-excision [53].

The 15 prospective studies we reviewed and scored, report a mean local recurrence rate of 2.8%. Local recurrence rate varied significantly in included studies from 0 to 9.4% (Fig. 2). The follow-up varied considerably, ranging from 6 to 74 months. The selected studies described survival rates between 92% and 99%. In Fitoussi retrospective study [53], local recurrence rate was higher in comparison with our review (7%), the 5-year survival rate was 93% and the overall disease-free survival rate 88% after OPS with additional treatment. This fact can be partly explained by the shorter follow-up in our systematic review (approximately 2 years) in comparison with the 5 years of follow-up in the retrospective study by Fitoussi et al. [53].

We also examined outcomes obtained by Chakravorty et al. [54]. In this retrospective study, oncological outcomes of OPS were compared with the standard BCS. Authors examined and compared re-excision and local recurrence rates after BCS (440 patients) and OPS (150 patients). Re-excision was 2.7% in the OPS group and 13.4% in the BCS group. It seems that OPS techniques significantly decrease re-excision rates. At a median follow-up of 28 months, local relapse was 2.7% and 2.2% and distant relapse 1.3% and 7.5% for OPS and BCS, respectively. The projected 6-year local recurrence rate in the OPS group was 4.3%. Early follow up data suggests oncological outcomes of OPS are similar to BCS, despite the larger tumor size and the higher grade in the OPS group [54]. These data are comparable with our findings.

Assessment of breast cosmesis after OPS

Which is the best time to evaluate breast cosmesis after breast cancer surgery consists crucial issue in the assessment of cosmetic results after OPS. Addressing that issue, some authors consider that the ideal time to assess cosmesis is at least 2 years after OPS. This timeframe is of importance and it is due to the long-term effects of radiation which worsens breast aesthetics [55–57].

It should be mentioned that open issues in published literature remain: (a) who should perform cosmetic evaluation and (b) with which method. Different methods of cosmetic assessment have been proposed with panel evaluation, breast retraction and patient self-evaluation to be the most frequently adopted. The last one is fundamental because the subjective experience of the patient is the cornerstone for assessment of quality of life. Of note, patients consistently mention higher scores than professionals [58–60]. A truly objective method is the measuring changes in breast symmetry with breast retraction assessment. In general, a

combination of cosmetic assessment methods will produce the most reliable results [59, 60].

Not all included studies which have been reviewed and scored for the aims of this systematic review, assessed cosmetic outcomes. Cosmesis was evaluated in 8 out of 15 prospective studies; these studies reported good cosmetic outcomes in 90.2% of patients (Fig. 2). It is noteworthy that only one of these eight studies reported appropriate assessment of cosmetic results using an independent panel format and a follow-up time of at least 2 years [10].

The same method of cosmetic evaluation adopted by Clough et al. [10] in our review was also used in the retrospective study by Fitoussi et al. [53]. Authors in this retrospective study [53] used a panel composed of a surgeon, a nurse, and a layman. Using a 5-point scale from excellent to poor, the cosmetic outcome was satisfactory in 98% of patients at 12 months, and in 90% of patients 5 years after surgery [53].

Despite the discrepancy among the prospective studies described here concerning follow-up periods and methods of postoperative cosmetic evaluation, the cosmetic outcomes after OPS seem encouraging. Good cosmetic outcomes were detected in 90.2% of patients included who underwent OPS, superior to 60–80% rate of acceptable cosmetic results generally achieved with the standard BCT [61, 62]. This superiority of OPS in the achievement of better cosmetic results compared to the standard BCT, is an issue of fundamental importance for patient's body image and quality of life [34, 35]. Our results are in accordance with published evidence regarding cosmetic outcomes after OPS. In fact, better cosmesis of OPS (in comparison to the standard BCS), favors its application in eligible breast cancer cases [63–65].

According to our results, there are limited data relating radiotherapy treatment with cosmetic outcomes in the 8 articles included in our study [10, 26, 28, 30, 31, 35, 36, 38]. Only one paper [10] reported that patients who received preoperative radiation therapy had worse cosmetic results compared to those who had postoperative radiotherapy. It has been reported that both surgery and radiotherapy-associated fibrosis may have a negative impact on breast symmetry; radiotherapy itself may cause either hypopigmentation or hyperpigmentation in the treated breast [66]. Therefore, further cosmetic evaluation in relation to radiotherapy after OPS is needed.

Cosmesis remains for some centers a qualitative and not quantitative variable, which is still affected by subjective and probably biased evaluations. Validated methods for aesthetic scoring of the breast cosmesis after OPS should be uniform and internationally accepted, to represent a confirmed and univocal tool for cosmetic evaluation, which still nowadays, does not exist [10, 26, 28, 30, 35, 36, 38].

Conclusion

Although OPS has greatly evolved over recent years with acceptable published results on aesthetics, margin involvement, mastectomy and recurrence rate, it has to be further improved. Oncological and aesthetic outcomes are not uniformly reported in studies and applied algorithms which define patient's inclusion and exclusion criteria for OPS are quite different among breast units. Proper patient selection and careful planning are of great importance to achieve acceptable results.

This study proves that current evidence on OPS is limited by the lack of RCTs which are mandatory to compare oncological and cosmetic results of BCS and OPS. High level of evidence is still needed to obtain more generalizable results regarding oncological and cosmetic outcomes of OPS.

Compliance with ethical standards

Conflict of interest The authors declare no conflict of interest.

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