

Update on oncoplastic breast surgery

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Abstract. – Oncoplastic surgery of the breast (OPS) has generated great excitement over the past years and has become an integrated component of the surgical treatment of breast cancer.

Oncoplastic surgical procedures associate the best surgical oncologic principles to achieve wide tumor-free margins with the best principles of plastic surgery to optimize cosmetic outcomes. Thanks to oncoplastic techniques, the role of breast conserving surgery (BCS) has been extended to include a group of patients who would otherwise require mastectomy to achieve adequate tumor clearance.

As OPS continues to gain acceptance and diffusion, an optimal and systematic approach to these techniques is becoming increasingly necessary. This article has the aim to review the essential principles and techniques associated with oncoplastic surgery, based on the data acquired through an extensive search of the PUBMED and MEDLINE database for articles published using the key words “breast cancer oncoplastic surgery”. This review analyzes possible the advantages”, classifications, indications, and the criteria for a proper selection of oncoplastic techniques to facilitate one's ability to master these procedures and make OPS a safe and an effective procedure.

Key Words:

Breast cancer, Oncoplastic surgery.

Introduction

Breast conserving surgery (BCS) combined with postoperative radiotherapy has become the gold standard of locoregional treatment for the majority of patients with early-stage breast cancer, offering equivalent survival as compared to mastectomy and improved body image and lifestyle scores. The goals of BCS are to achieve a complete removal of the tumor with adequate surgical margins while preserving the natural shape and appearance of the breast. In some cases, achieving both goals may be quite challenging and the need to ensure an oncologically safe resection may generate unsatisfying cosmetic results.

In the effort to overcome this difficulty and expand the use and efficacy of BCS, oncoplastic surgery (OPS) techniques have been introduced in recent years gaining widespread attention both among surgeons and patients. These procedures associate the best principles of surgical oncology with the best plastic principles of reconstruction to optimize oncologic safety and cosmetic outcomes.

The diffusion of this procedures comes from reported data that seem to indicate an higher oncological safety and better cosmetic efficacy. As these oncoplastic techniques become more sophisticated, questions about the various applications are becoming more common. There is a clear need for surgeons and patients to become familiar with the indications and the available techniques in order to make OPS a safe and effective procedure. The purpose of this article is to review many of the essential principles, concepts, and techniques associated with OPS and emphasize some of the landmark studies and important conclusions.

Methods

The data for this review was compiled by searching the PUBMED and MEDLINE database for articles published, between 1996 and 2011, using the key words “breast cancer oncoplastic surgery”. A total of 111 articles were reviewed and prioritized according to content. We have reviewed all articles in the effort of evaluating the shared beliefs on open questions about OPS, such as the advantages, classifications, indications, and the criteria for a proper selection of oncoplastic techniques, oncological and cosmetic outcomes.

History and Definition

The history of OPS is relatively new and has not been well chronicled. The term “oncoplastic surgery” was coined by Audretsch¹ to describe

the blending of techniques from the fields of surgical oncology and plastic and reconstructive surgery²⁻⁷.

A handful of surgeons scattered over many countries began utilizing these techniques in the early 1990s. However, only in the past decade has this approach gained widespread acceptance and diffusion. Introduction of OPS into clinical practice has been slow, because OPS requires the simultaneous deployment of the skills of a general surgeon with experience in the oncological aspects of breast surgery and the skills of a plastic surgeon with experience of breast reconstruction. This slow process of adoption was also necessary in order to ensure that new techniques would not jeopardize oncological safety.

Nowadays, OPS includes a wide range of breast-conserving surgical techniques, applied to various clinical situations, that associate the best oncological principles of resection to achieve wide tumor-free margins with the best plastic principles of reconstruction to optimize cosmetic outcomes and minimize complications⁸.

Advantages

Early reports indicate that there are a range of possible benefits associated with the use of oncoplastic techniques (Table I):

1. OPS may allow wider excision of the tumor with safer margins and reduced cosmetic penalties^{6,8}.
2. OPS may avoid the need for mastectomy in a number of patients, without compromising local control. The patient avoids more extensive surgery and the higher complication rate and greater morbidity associated with total mastectomy and immediate reconstruction. Moreover, sensory loss and disability are minimized, and, finally, the need for implant surveillance is avoided^{8,9-12}.
3. OPS permits to achieve good to excellent cosmetic results in a higher number of cases, avoiding the need for secondary operations to correct breast deformities. Immediate oncoplastic procedures eliminate the need for complex delayed reconstruction of deformities after BCS, often severe and difficult to manage^{8,13-16}.
4. Oncoplastic mammoplasty reduces the breast size thus providing the radiation oncologist with a medium-size breast, which makes radiotherapy less problematic in patients with macromastia¹⁶⁻¹⁸.

Table I. Advantages of OPS.

Allows to perform very wide excision
Allows to avoid the need for mastectomy in many cases
Allows to achieve good to excellent cosmetic results and to prevent breast asymmetries
Allows to go to the operating room one time to perform the definitive procedure
Allows to limit some of the skin toxicity and potential inhomogeneous dosing of adjuvant radiotherapy associated with large, ptotic breasts.
Allows to check the contralateral breast and, occasionally, the discovery of an occult contralateral neoplasia in bilateral oncoplastic surgery

5. Bilateral OPS prevents breast asymmetries, let to check the contralateral breast and, occasionally, permits the discovery of an occult contralateral neoplasia⁸.

Classifications

Volume Displacement and Replacement Techniques

The OPS may be classified in two fundamentally different approaches according to the reconstruction techniques following BCS that have been established (Table II).

Firstly, *volume displacement techniques*, when the resection defect is reconstructed using one of a range of local glandular or dermoglandular flaps within the breast, which are mobilised and advanced into the defect. This approach leads to a loss in breast volume, and contralateral surgery is usually required to restore symmetry. The options include adjacent tissue rearrangement and mammoplasty techniques¹⁸⁻²³.

Adjacent tissue rearrangement: is perhaps the most common method by which the partial mastectomy defect is reconstructed. This is because these techniques rarely require a two-team approach as the ablative surgeon will apply the principles and techniques to close these defects.

Table II. Classification of OPS.

The techniques that are currently used for the reconstruction of the BCS defect are based on two different concepts:
• Volume displacement procedures: local tissue rearrangement and reduction mammoplasty.
• Volume replacement procedures: autologous tissue from an extramammary site (usually latissimus dorsi).

Although several surgeons have described various procedures, it is generally accepted that adjacent tissue rearrangement techniques includes accurate decision of skin incision, skin undermining, NAC undermining, glandular reapproximation and deepithelialization and NAC repositioning^{10,24-25}.

An indirect incision along the areola border is preferable; if a direct incision over the tumor is chosen the general principle is to follow Kraissl's lines of tension to limit visible scarring. An extensive subcutaneous undermining is one of the key factors in adjacent tissue rearrangement techniques; it follows the mastectomy plane and extends anywhere from one-fourth to two-thirds of the surface area of the breast envelope; skin undermining facilitates both tumor resection and glandular redistribution after removal of the tumor; NAC undermining avoid NAC deviation towards the excision area; glandular mobilization and redistribution allow creation of glandular flaps that are used to close the defect without creating a contour abnormality²⁴⁻²⁵.

A number of conventional *mammoplasty techniques* have been adapted to allow reconstruction of resection defects with parenchymal flaps using a variety of different approaches²⁶⁻⁴². Typically, one of two approaches can be used: the superior pedicle approach or the inferior pedicle approach. The superior pedicle approach enables wide resection of tumors located in the lower quadrants of the breast, where extensive volume loss will often lead to the very unsightly 'bird's beak' deformity. The inferior pedicle approach enables reconstruction of resection defects in the upper pole of the breast (Figure 1). A range of other approaches have recently been described, which are adaptations of the superior and inferior pedicle approaches^{6,10,19}.

Other established techniques, such as the "Grisotti" technique, the 'round block' and "batwing" approach, can be adapted to enable resection of tumors in particular clinical situations (Figure 2)^{6-10,39,43-46}.

Secondly, *volume replacement techniques*, when the resection defect is reconstructed by replacing the volume of tissue removed with a similar volume of autologous tissue from an extramammary site. The options include musculocutaneous flaps and perforator flaps that can be transferred on a vascularized pedicle or as a free tissue transfer^{10,18,47-59}.

The most commonly used flap for immediate reconstruction of the partial mastectomy defect has been the latissimus dorsi musculocutaneous flap (Figure 3). This flap has been effectively used for deformities of the superior, lateral and inferior aspects of the breasts. In general, a two-team approach is needed for this operation owing to the technical aspects in designing, elevating, and mobilizing the flap⁶⁰⁻⁷⁰.

There have been several methods described by which the latissimus dorsi flap can be harvested. The traditional technique incorporated a posterolateral thoracic incision, whereas the more modern technique utilizes an endoscope. With the endoscopic technique the muscle is accessed through the breast and axillary incision and no skin is removed⁷¹⁻⁷².

Another method of harvesting the latissimus dorsi is as a mini-flap. The advantage of the mini-flap is that variable amounts of the latissimus dorsi muscle can be harvested based on the volume requirements of the breast. The flap is generally harvested through an anterolateral breast incision that is used for the resection as well.

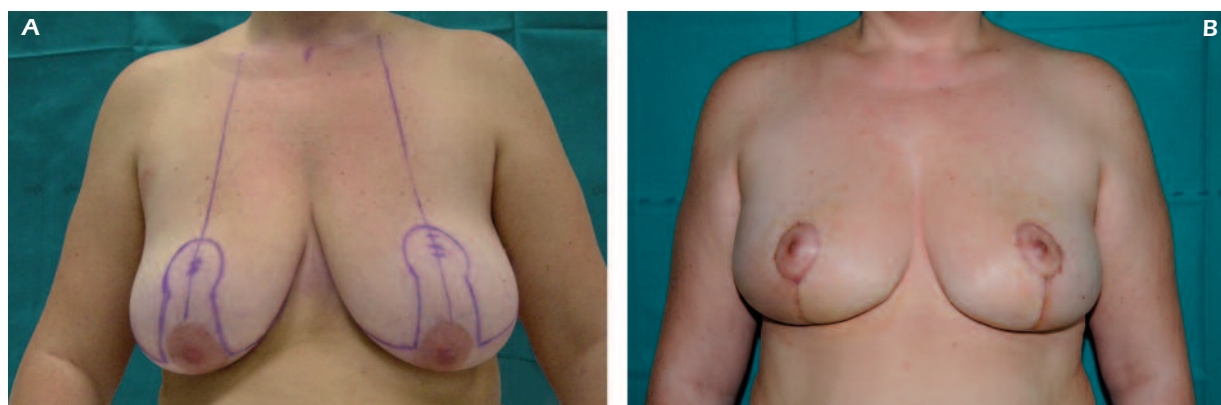


Figure 1. Volume displacement technique with reduction mammoplasty for a carcinoma invasive of right breast. **A.** Preoperative view. **B.** Postoperative view at 1 month.

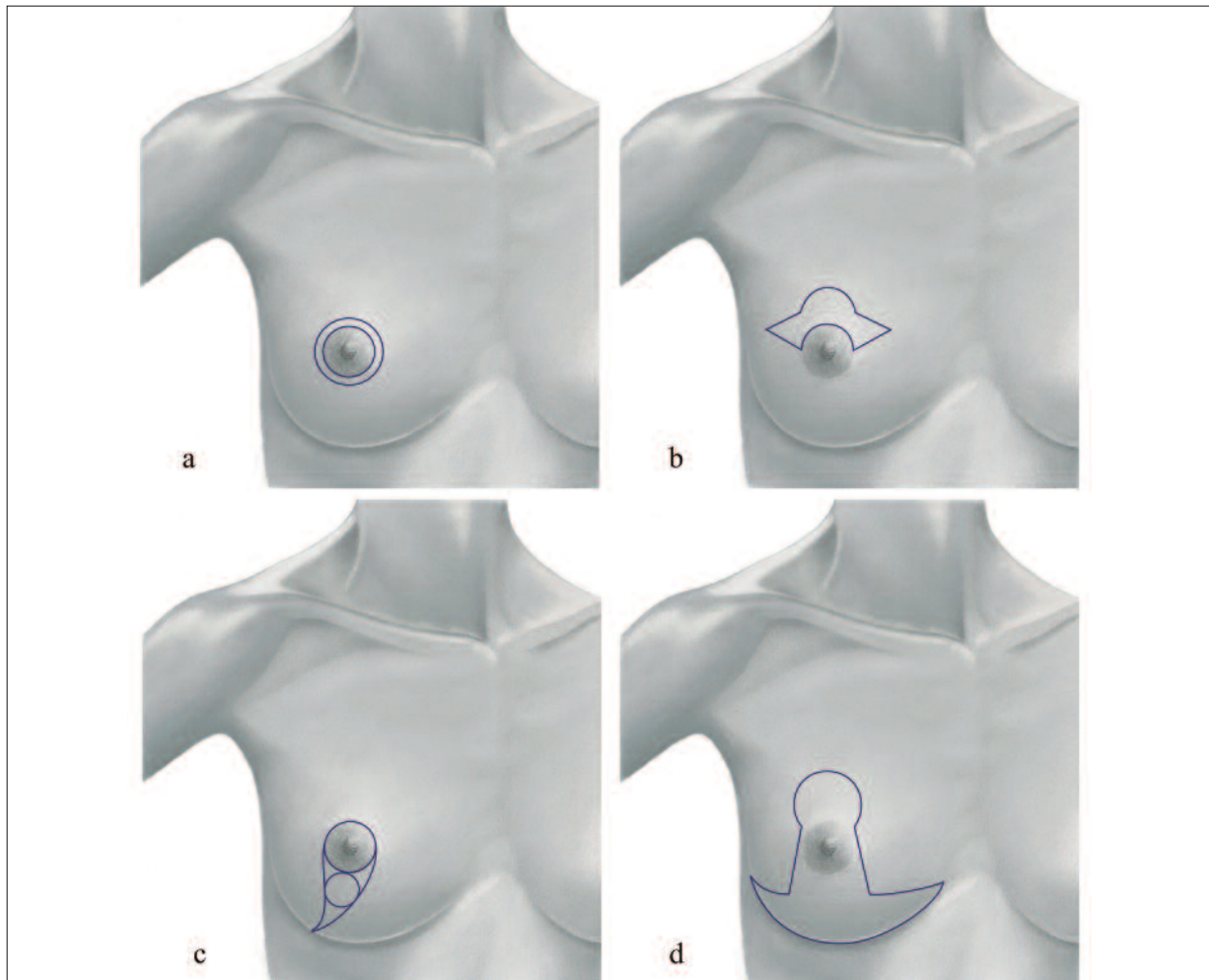


Figure 2. Skin incisions in volume displacement techniques. **a**, In the donut mastopexy, two concentric circles of different diameter are designed around the nipple. **b**, In the batwing mastopexy, two halfcircle are designed and connected with angled wings on each side of the areola. **c**, In the Grisotti procedure, two circles are drawn, one along the borders of the areola, the other below the areola and lines from the medial and lateral sides of the areolar circle are connected down and laterally on the inframammary fold. **d**, In the reduction mammoplasty, a key-hole pattern incision may be used.

The use of perforator flaps for the reconstruction of the partial mastectomy has been receiving increasing attention. There are three flaps that have been used for this purpose: the thoracodorsal artery perforator flap (TDAP), the lateral thoracic flap, and the intercostal perforator flap⁷³⁻⁷⁴. The TDAP is an adipocutaneous flap in which the latissimus dorsi muscle is totally spared. The vascularity of the flap is derived from the perforating branches of the thoracodorsal artery and vein. The lateral thoracic flap is a fasciocutaneous flap that is perfused via either the lateral thoracic or thoracodorsal artery and vein. The intercostal perforator flap is usually perfused via a perforating intercostal artery and vein that is based along the inferior aspect of the

anterior axillary line. These flaps are usually transferred on a vascularized pedicle.

Other Classifications

Urban et al⁷⁵⁻⁷⁷ developed in order to improve surgical trainees another classification based on 3 distinct skills:

- **Class I:** monolateral breast reconstruction techniques such as aesthetic skin incisions, de-epithelization of the areolar margins, glandular mobilization and reshaping techniques, purse-string sutures for central quadrant reconstruction, and immediate breast reconstruction with temporary expanders. Specific competence in plastic surgery is not required at this point.

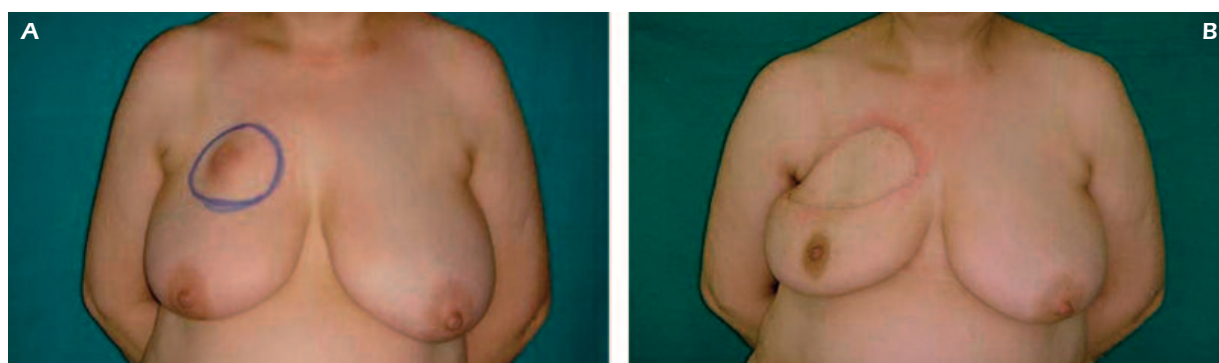


Figure 3. Volume replacement technique with a thoracodorsal artery perforator flap (TDAP) after superior quadrantectomy of the right breast. **A**, Preoperative view. **B**, Postoperative view at 6 month.

- **Class II:** bilateral procedures such as immediate and delayed breast reconstruction with implants, lipofilling, breast augmentation, breast reduction, mastopexy, Grisotti flap, and nipple and areola reconstruction. Specific competence in plastic surgery techniques of the breast is required to achieve better symmetry.
- **Class III:** more complex monolateral or bilateral procedures involving autologous flaps (pedicled or free flaps) or a combination of techniques. A higher standard in plastic surgery techniques is required.

Hoffmann et al⁷⁸ proposed a complex classification system capable of accommodating, on the basis of surgical complexity, any major oncological, oncoplastic or reconstructive procedure used in the surgical treatment of primary and locally recurrent breast cancer. A novel two-type, six-tier classification system comprising 12 main categories, 13 subcategories and 39 sub-subcategories of oncological, oncoplastic and reconstructive breast cancer-related surgery was developed.

Clough et al^{24,25,79} proposed a new classification based on the amount of tissue excised and the relative level of surgical difficulty (this classification concerns the volume displacement procedures but does not include the volume replacement techniques):

1. Level I approach in which < 20% of breast volume is excised and no skin resection is required; there are six steps for level I (skin incision, skin undermining, NAC undermining, full-thickness excision, glandular reapproximation, deepithelialization and NAC repositioning)
2. Level II approach in which up to 50% of breast volume is excised and therapeutic mammoplasties with extensive skin excision and

breast reshaping are performed; to simplify the selection of the appropriate technique, Clough et al devised an Atlas based on tumor location; this atlas provides one or two surgical techniques for each tumor location.

Indications

The main indication for OPS is breast cancer for which a standard BCS with safe margins would either seem impossible or lead to a major deformity^{10,15,18,19,24,25,27,79-84}.

Wide resections of more than 10-20% of the breast volume, for large tumor, extensive ductal carcinoma in situ, multifocality, are all potential indications for OPS intervention. Tumors in central, medial and lower pole resections may be managed with OPS to optimize aesthetic results (Table III).

OPS remains contraindicated when clear margins cannot be assured without performing a mastectomy (Table III); patients with large tumors, T4

Table III. Indications and contraindications for OPS.

Indications for OPS.

- Wide excision required (large tumor, multifocality, extensive ductal carcinoma in situ, partial or poor response to neoadjuvant treatment, high tumor to breast ratio with resection of more than 10-20% of the breast volume).
- Tumors in any location and in particular in central, medial and lower pole resections

Contraindications for OPS

- Large tumors that need a mastectomy to achieve clear margins
- Insufficient residual breast tissue following resection
- Multicentric disease
- Extensive malignant mammographic microcalcification
- Inflammatory carcinoma
- History of prior irradiation
- Prior augmentation mammoplasty
- Multiple medical comorbidities

tumors, with multicentric disease, with extensive malignant mammographic microcalcification and with inflammatory carcinoma must be treated with radical breast surgery. Contraindications include also patients where there is insufficient residual breast tissue following resection to allow reshaping or with a history of prior irradiation. Patients with multiple medical comorbidities, active smokers are not ideal candidates for some complex oncoplastic techniques (reduction mammoplasty, volume replacement technique), and the risks will often outweigh the benefits in these situations.

Selection Criteria of the Technique

The selection criteria for oncoplastic techniques are not without controversy, scrutiny, and criticism. The indications for every oncoplastic technique are different and various algorithms have been devised to assist with the decision process. The choice is usually based on tumor characteristics (size and location), extent of resection, breast characteristics (size, shape and glandular density), previous surgery and the expectations and wishes of the patient^{10,15,18,19,24,25,27,79-84} (Table IV).

Volume displacement techniques with adjacent tissue rearrangement are indicated for < 20% breast volume excision and for patients with large-medium sized breasts, ptosis and dense glandular tissue. These procedures are particularly appropriate for tumor localized in lateral and superior quadrants^{8,10,18,24,25}.

Volume displacement techniques with reduction mammoplasty are indicated for 20-50% breast volume excision and for patients with large-medium sized breasts. These procedures are particularly appropriate for tumor localized in any site but

especially for unfavourable location as central, inner-upper and lower quadrants. Reduction mammoplasty techniques are suitable for patients with heavy, ptotic breasts, symptomatic macromastia who will benefit physically from the use of a bilateral breast reduction procedure^{8,10,18,24,25,27}.

Volume replacement is indicated for 20-50% breast volume excision and for patients with small-medium sized breasts and minimal ptosis, who cannot afford to lose the volume associated with volume displacement techniques, or who wish to avoid mastectomy or contralateral surgery. The volume replacement is appropriate for tumor localized in any site. These procedure cannot be used in lack of latissimus musculature and in a previous thoracotomy or axillary surgery if the pedicle has been injured or ligated^{18,55-62}.

Evaluation of Oncological and Cosmetic Outcomes

The outcome measures most frequently reported on studies of OPS are local recurrence, cosmesis and patient satisfaction. These studies are mostly retrospective and based on a limited number of patients and sometimes only a single surgeon's experience⁸⁵⁻¹¹¹. Furthermore, the methods of assessing cosmesis and patient satisfaction vary greatly. Where these outcomes have been reported, the length of follow-up is relatively short, with a median duration of around 3 years. Given these limitations, the reported rates of local recurrence and cosmetic failure are within acceptable limits when compared with conventional BCS. Some studies that have demonstrated the utility of OPS with volume displacement and replacement are listed in Tables V and VI.

Table IV. Factors influencing the selection of OPS techniques.

Factors	Volume displacement (adjacent tissue rearrangement)	Volume displacement (mammoplasty)	Volume replacement (latissimus dorsi flap)
Maximum excision volume ratio	< 20%	20-50%	20-50% with resection that preclude the use of volume displacement
Beast size	Medium or large	Medium or large	Small or medium
Breast characteristics	Heavy, ptotic	Heavy, ptotic, macromastia	Not Relevant
Preferible tumor position	Any position (preferable in lateral or superior locations)	Any position (preferable in central, inner-upper and lower locations)	Any site
Previous surgery to lateral chest wall, posterolateral thoracotomy	Not Relevant	Not Relevant	Not possible

Table V. Oncological and cosmetic outcomes using volume displacement techniques.

Author	Year	Technique	Patients	Tumor size (cm)	Follow-up (months)	Margin involvement (%)	Local recurrence (%)	Cosmetic result/patient satisfaction (good-excellent) (%)
95	1998	Reduction mammoplasty	10	NR	52	0	5	95
96	1998	Reduction mammoplasty	50	3.25	48	10	7	85
97	1999	Reduction mammoplasty	20	NR	54	0	5	95
98	2001	Reduction mammoplasty	28	1,5	24	7	0	NR
6	2000	Reduction mammoplasty	56	NR	23	NR	0	91
94	2003	Reduction mammoplasty	101	3.2	46	10.9	6.9	88
99	2003	Reduction mammoplasty	11	NR	24	0	0	NR
100	2004	Reduction mammoplasty	37	0.6-5.2	NR	2.7	0	70
101	2005	Reduction mammoplasty	55	NR	18	0	13	82
102	2006	Reduction mammoplasty	74	55.4% < 2 44.6 % 2 < T < 4	22	7	0	93
89	2010	Reduction mammoplasty	540	2.9	49	18.9 (close and involved) (focal 14.3; diffuse 4.6)	6.8	90

Conclusions

OPS has generated great excitement over the past years and has become an integrated component of the surgical treatment of breast cancer. The enthusiasm for this procedures comes from reported data that seem to indicate an higher oncological safety and better cosmetic efficacy.

However, to date, the evidence in the literature on the oncological and cosmetic outcomes of these techniques are limited and based on relatively few, small and retrospective studies where the selection criteria is open to interpretation and debate. Where oncological and cosmetic outcomes have been assessed, OPS is associated with low rates of local recurrence and better cosmetic results.

Table VI. Oncological and cosmetic outcomes using volume replacement techniques.

Author	Year	Technique	Patients	Tumor size (cm)	Follow-up (months)	Margin involvement (%)	Local recurrence (%)	Cosmetic result/patient satisfaction (good-excellent) (%)
103	1990	Latissimus dorsi flap reconstrction	23	NR	32	0	0	91.3
104	2002	Latissimus dorsi flap reconstrction	25	NR	NR (4-30)	12	NR	NR
105	1999	Latissimus dorsi flap reconstrction	30	NR	NR (3-30)	0	NR	100
106	2003	Latissimus dorsi flap reconstrction	49	2.2	53 (7-102)	0	4	82
107	1998	Latissimus dorsi flap reconstrction	5	NR	52	0	5	100
108	2004	Latissimus dorsi flap reconstrction	18	3	24 (8-63)	5.5	0	94.5
109	2004	Latissimus dorsi flap reconstrction	39	NR	44	NR	5,1	NR
110	1997	Latissimus dorsi flap reconstrction	20	2,5	10 (3-19)	10	NR	90
111	2006	Lateral thoracodorsal fasciocutaneous flap	34	64.7% < 2 35.3% 2 < T < 4	23 (6-71)	17.6	0	88.2%

Because of these limitations, there is an obvious need for further appraisal of OPS and prospective randomized studies.

As these oncoplastic techniques become more sophisticated, questions about the various applications are becoming more common. Clarifying the advantages, classifications, indications, criteria for proper selection of patients as well as of oncoplastic techniques is warranted in order to facilitate one's ability to master these procedures and make OPS a safe and effective procedure.

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