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Conventional breast conserving surgery versus Oncoplastic volume displacement breast Surgery in moderate to Large-breasted Patients

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Abstract
Conventional breast-conserving surgery (CBCS) and oncoplastic volume displacement breast surgery (OPBS) in patients with moderate to large breasts are frequent. CBCS involves tumor excision with preservation of breast shape, but cosmetic deformities occur in 25–30% of cases, especially when more than 20% of breast volume is removed. It is generally suitable for tumors smaller than 2–3 cm or involving less than 20% of the breast. In contrast, OPBS allows safe resection of 20–50% of breast tissue using volume displacement techniques such as parenchymal advancement (Level I) and complex rearrangement with reduction mastopexy and pedicle-based reconstruction (Level II). OPBS is indicated in women with macromastia or ptosis, tumors in the medial, central, or inferior quadrants, extensive ductal carcinoma in situ, invasive lobular carcinoma, salvage after failed BCS, and incomplete response to neoadjuvant therapy. It preserves aesthetics, improves symmetry, and permits wider excision without increasing recurrence. Complication rates include fat necrosis (5%), seroma (8–10%), and rare nipple necrosis (0.5%). OPBS achieves high rates of oncologic safety, with 95% overall survival and 90% disease-free survival, while also enhancing cosmetic outcomes and quality of life.
Keywords: *Breast-conserving surgery, Oncoplastic surgery, Volume displacement, Macromastia*

INTRODUCTION

The female breast is anatomically complex and surgically important, especially in cancer and reconstruction. Detailed anatomical knowledge minimizes surgical complications [1, 2].

Gross Anatomy

The breast consists of skin, fat, 15–20 fibroglandular lobes, ducts, and neurovascular structures overlying the chest wall [3, 4]. It extends vertically from the 2nd to 6th/7th ribs and horizontally from the sternum to the mid-axillary line. A loose retromammary space separates it from underlying muscles.

Lobules contain alveoli for lactation, and Cooper's ligaments maintain structure but contribute to sagging with age [5, 6]. The nipple, surrounded by the pigmented areola, contains smooth muscle; the areola houses Montgomery's glands for lubrication [5] Each lobe drains via a lactiferous duct into the nipple, expanding into lactiferous sinuses—arranged radially, guiding radial surgical incisions [7].

Embryology and Development

Breast development begins in weeks 5–6 as ectodermal milk lines regress except in the thorax. A breast bud forms from ectoderm ingrowth, with 16–24 secondary buds by week 12 [7].

Blood Supply

Arterial Supply

About 60% of arterial blood is from the internal mammary artery, 30% from the lateral thoracic artery, and 10% from thoraco-acromial, intercostal, subscapular, and thoracodorsal arteries [8]. Internal mammary perforators from the 2nd–6th intercostal spaces (mainly 2nd and 3rd) are used in reconstructions [9]. The

lateral thoracic artery, entering near the axilla, supplies the superolateral breast. Anterior and posterior intercostal perforators supply the lateral and central inferior portions of the breast [10].

Venous Drainage

Venous outflow is via superficial and deep systems. Superficially, transverse veins (91%) drain medially into internal mammary veins, while longitudinal veins (9%) drain into neck veins. Deep drainage involves (a) internal mammary vein branches, (b) axillary tributaries, and (c) posterior intercostal veins connecting with vertebral and azygos veins [11].

Nerve Supply

Sensory innervation is from anterolateral and anteromedial thoracic intercostal nerves (T2–T6) and cervical plexus branches. The lateral breast receives nerves through serratus anterior interdigitations (T3–T6), while medial innervation follows internal mammary vessels (T2–T6). The nipple and areola are mainly innervated by T3–T5. Secretory function is hormonally mediated by prolactin and oxytocin, not by somatic nerves [12].

Lymphatic Drainage

Lymphatic flow begins in lobules and drains via Sappey's plexus. About 75% drains to axillary nodes (levels I–III), 20% to internal mammary, and 5% to posterior intercostal nodes [13].

Level I: lateral to pectoralis minor

Level II: behind pectoralis minor

Level III: medial to pectoralis minor [14]

Axillary nodes are the most significant, receiving ≥75% of lymphatic drainage [15-17].

Histology

Glandular Tissue

The breast contains 15–20 lobes, each draining via a lactiferous duct. Lobes comprise lobules, which include 10–100 acini. The ductal system progresses from terminal ducts to segmental ducts, ending in lactiferous ducts and sinuses. TDLUs are hormone-sensitive units made of secretory acini and terminal ducts, enclosed in connective tissue [18]. Ducts and acini are lined with cuboidal epithelial and outer myoepithelial cells [19].

Stroma

Intralobular stroma is cellular and hormone-sensitive, with collagen and fibroblasts. Interlobular stroma is denser, less cellular, and hormone-independent [20]

Conservative Breast Surgery (BCS)

Since the 1980s, large randomized trials have confirmed breast-conserving surgery (BCS) with radiotherapy (BCT) as a safe alternative to mastectomy for early breast cancer. Despite BCT being the standard due to excellent outcomes and tolerability, mastectomy remains a common choice. BCS terms include lumpectomy, quadrantectomy, and partial mastectomy [21]. Patient decisions may favor mastectomy due to recurrence fears, prioritizing health over breast preservation, or concerns about radiation. Recently, skin- and nipple-sparing mastectomies with reconstruction have gained popularity for improved aesthetics and QoL, despite lacking long-term oncologic data. Media coverage of prophylactic mastectomy, especially among BRCA-positive celebrities, further influences patient choices. Decision-making is often shaped by clinician bias and patient-specific factors. Advances in screening and adjuvant therapies have reduced recurrence, aided by stage migration and tumor biology-based treatment [21].

Definition

BCS involves removing the tumor (including multifocal ones) with clear surgical margins, maintaining a cosmetically acceptable breast. Synonyms include lumpectomy, segmental mastectomy, and tylectomy [22].

Conventional BCS (CBCS)

CBCS with radiotherapy offers survival equal to mastectomy. Its success depends on achieving clear margins and preserving breast aesthetics, but this balance is not always possible [23]. Resection extent is limited by tumor-breast volume ratio. In cases where both oncologic and cosmetic goals cannot be met, mastectomy or neoadjuvant therapy may be needed. CBCS suits tumors <2–3 cm and <20% breast volume. Larger tumors may distort appearance, and 25–30% of women report deformities post-BCS [24].

Indications

Indicated in early-stage BC where negative margins can be achieved while preserving breast contour [25].

Contraindications

Absolute contraindications include inability to achieve negative margins without deformity and inflammatory breast cancer [26]. Oncoplastic techniques allow resection of up to 50% of breast volume with satisfactory cosmesis depending on tumor and breast characteristics. Re-excisions increase complications, stress, delays, and recurrence risk [27].

Absolute: early pregnancy, multicentric tumors, diffuse malignant microcalcifications, prior chest radiation, persistent margin positivity [28].

Relative: poor tumor-to-breast ratio, connective tissue disorders, patient preference for mastectomy, limited access to radiotherapy [28].

Goal of BCS

The aim is to excise the tumor with clear margins while preserving breast symmetry and shape. Up to 30% of patients may still experience unsatisfactory cosmetic outcomes [29].

Advantages

BCS ensures quicker recovery and better QoL in most patients [30].

Surgical Technique

BCS aims at oncologic control and cosmetic preservation. Oncoplastic BCS has evolved with techniques tailored by tumor location to reduce deformity [30]. BCS with radiotherapy improves 15-year survival by 5.3%, versus 4.4% for mastectomy with radiotherapy. Chemotherapy now reduces local recurrence by up to 50% [31].

Prophylactic Antibiotics

Infection risk is 1–5% post-lumpectomy, 2–17% after mastectomy, and 6–15% after reconstruction. A single dose of cephalosporins or ampicillin-sulbactam is recommended [32].

Incision

Preferred incisions are circumareolar and parallel to Langer's lines. Radial incisions are used at 3, 6, or 9 o'clock. Incisions from the inframammary fold are discouraged [33]. For tumors in the upper lateral quadrant, separate axillary and tumor incisions yield better result. Poor incision planning can cause visible scars and deformities [34].

Tumor Removal

Excision should include ~10 mm of healthy tissue. Microscopically, "no ink on tumor" is the margin standard. Morrow et al. [35] reported mastectomy in 38% of 2030 patients, 9% of whom requested it, and 13% received it without re-excision attempts. Re-excision was needed in 22% post-BCS. Margin definitions vary: in North America, 46% define "negative" as no tumor-ink contact, 22% use 2 mm, and 15% ≥5 mm; in Europe, 28%, 9%, and 45%, respectively. Among 188 U.S. surgeons, 13% accept "no ink on tumor," 25% ≥2 mm, and 55% >5 mm. Intraoperative ultrasound reduces incision length, excised volume, and re-excision risk. Excising larger volumes affects aesthetics, especially in small breasts. Tumors near skin require en bloc removal with skin; preserving subcutaneous fat improves outcomes [36].

Complications

Common long-term BCS + radiotherapy complications include lymphedema, skin fibrosis, shoulder mobility limitations, radiation pneumonitis, neuropathy, fat necrosis, and rib fractures [37].

Quality of Life

QoL encompasses survival, function, emotional wellbeing, social support, and personal satisfaction. Oncoplastic BCS offers better aesthetic and fewer sequelae than mastectomy, but high-volume resections may increase complications. PROMs such as BREAST-Q, assessing physical, psychosocial, and sexual outcomes, are essential for evaluating patient satisfaction [31].

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Aesthetic Outcomes

Classic BCS was limited to tumors ≤5 cm. However, advances in neoadjuvant therapy and consideration of tumor-to-breast volume ratio have expanded eligibility. Poor aesthetic results occur in 25–30% of BCS cases, often due to removal of >10–20% of breast volume depending on tumor site [38].

Overview of Oncoplastic Breast-Conserving Surgery (OPBS)

Oncoplastic breast surgery (OBS) merges oncological and plastic techniques to optimize tumor clearance and cosmetic outcomes. It permits excision of tumors >4 cm or locoregional ones without mastectomy, while reducing postoperative deformities—especially after radiotherapy. OBS is gaining acceptance as standard care [39].

Oncological and Aesthetic Integration

OBS allows wide excision with immediate reconstruction, preserving symmetry via contralateral surgery if needed. Post-radiation corrections are difficult and less effective [40]. Approaches are categorized into volume displacement (VD) and volume replacement (VR) [41].

Volume Replacement: Implants vs. Autologous Tissue

Though implants have been tried in VR, their use in radiated breasts carries risks like capsular contracture and implant exposure [42]. Autologous tissue shows better outcomes post-radiation [43] (Fig 1).

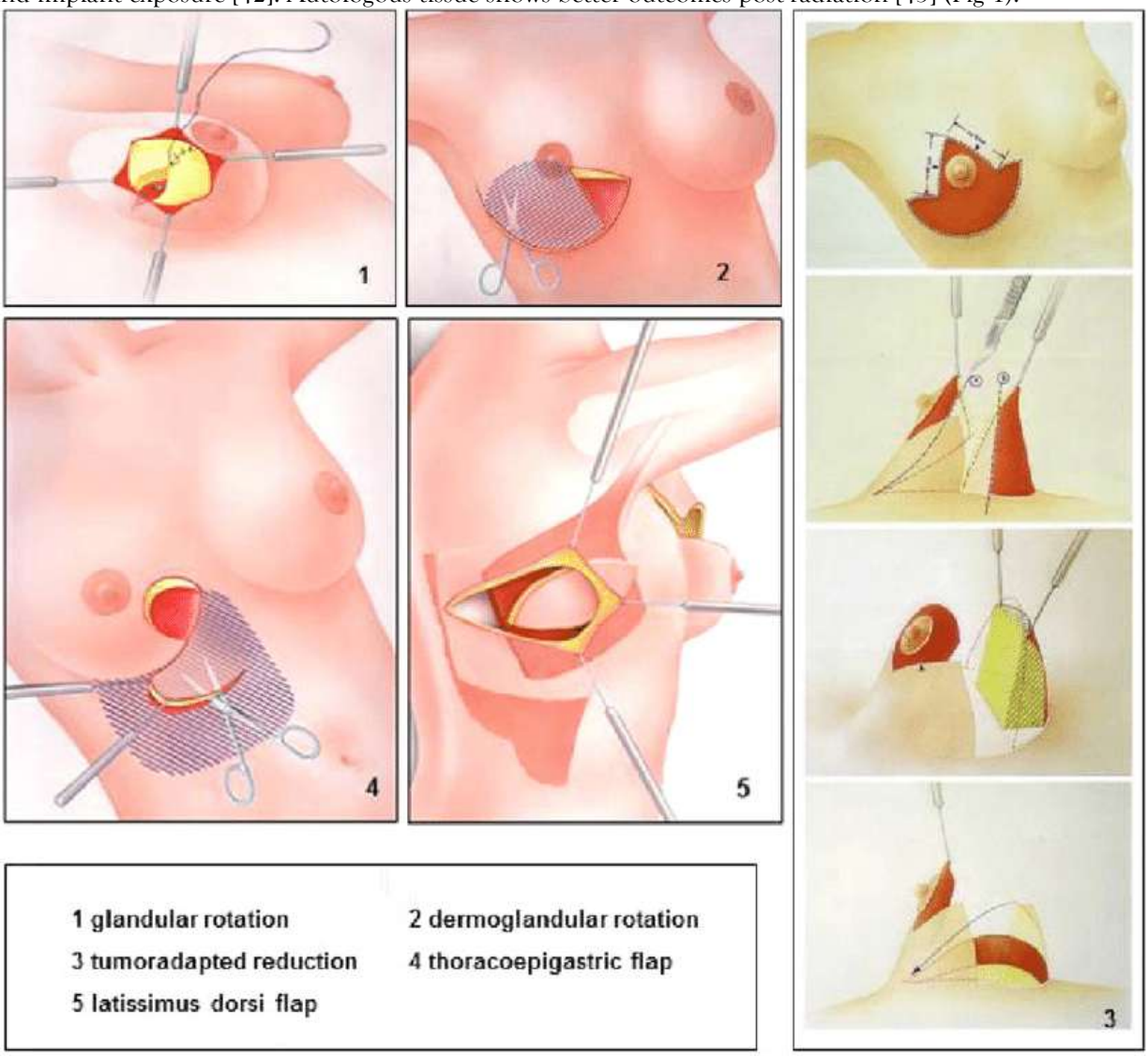

Figure 1: illustrates five OPBS principles [44].

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Techniques of Oncoplastic Reconstruction

Partial breast reconstruction is grouped into VD and VR based on tissue source [45] (Fig 2).

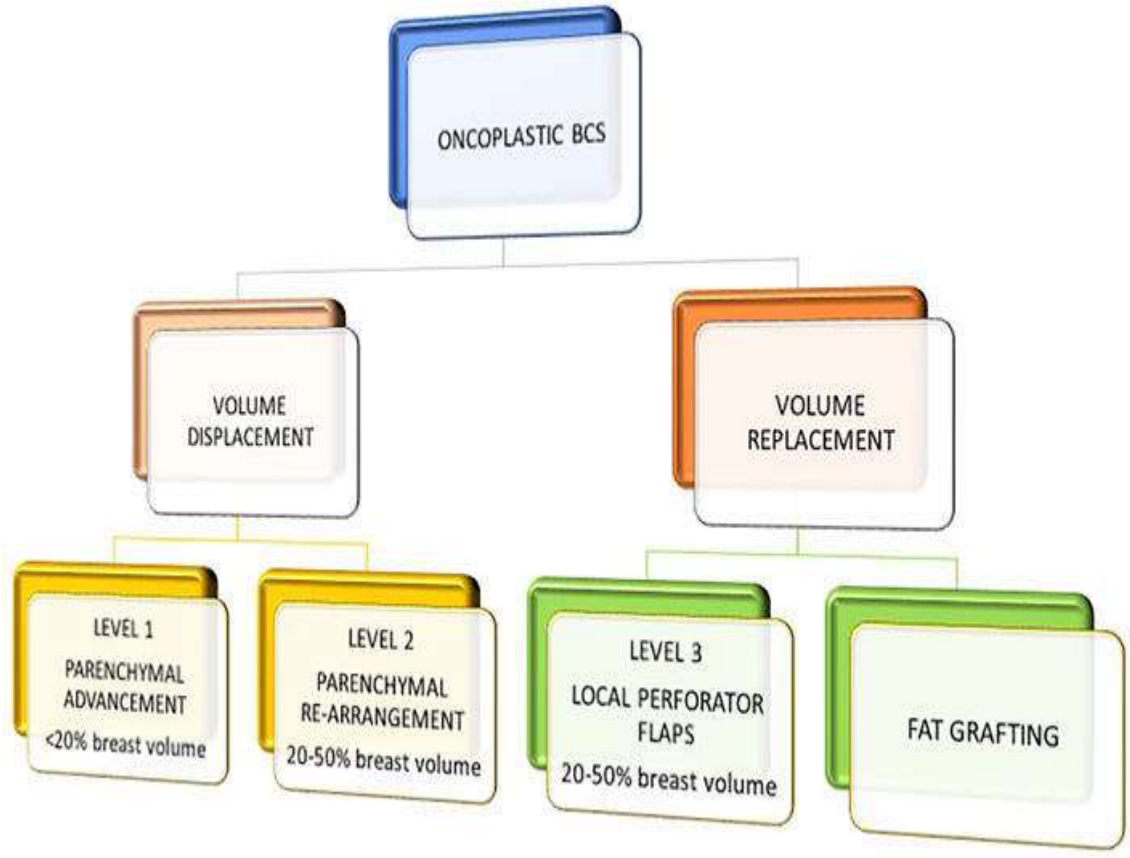

Figure 2: shows various OPBS techniques [45].

Indications and Safety

OPBS is oncologically safe and cosmetically superior. Trials confirm BCS and mastectomy yield equivalent survival and recurrence rates. OPBS is beneficial for younger women, ductal carcinoma in situ, or invasive lobular cancer, where resection adequacy is critical [46].

Cosmetic outcomes decline when >10% of breast volume is excised, highlighting OPBS's role in preserving aesthetics (76). Clough et al. classify OPBS into:

Level I: <20% volume removed

Level II: >20% volume removed—suitable for larger tumors or breasts [46].

Tumors up to 5 cm are suitable for OPBS; tumor size alone shouldn't exclude BCS. RD Macmillan outlines core principles, including prioritizing safety, gentle tissue handling, and single-stage completion with symmetry [47].

Volume Displacement: Techniques and Variants

Typically used when 20–50% of the breast is resected, often through a Wise-pattern incision with contralateral symmetrization. Vascularized pedicles (e.g., inferior, superomedial) fill defects without compromising perfusion [48].

Displacement is further divided into:

Level I: Simple advancement

Level II: Complex rearrangement using flaps Peterko [45].Variability across atlases reflects lack of standardization, but offers flexibility Peterko [45].

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Level I: Parenchymal Advancement

Used for resections <20%. It involves minimal tissue mobilization, preserving NAC vascularity and minimizing distortion [49]. Common incisions include periareolar, crescentic, and inframammary fold, tailored to tumor location. Round block technique enables extensive undermining while maintaining NAC attachment [50].

Level II: Parenchymal Rearrangement

Used for resections of 20–50%. Suitable for patients with ptosis or macromastia, it includes reduction mastopexy and NAC repositioning. The Wise-pattern is common, using pedicles (e.g., inferior, superomedial) for support and reshaping, but requires care at the T-junction [51] (Fig 3, 4).

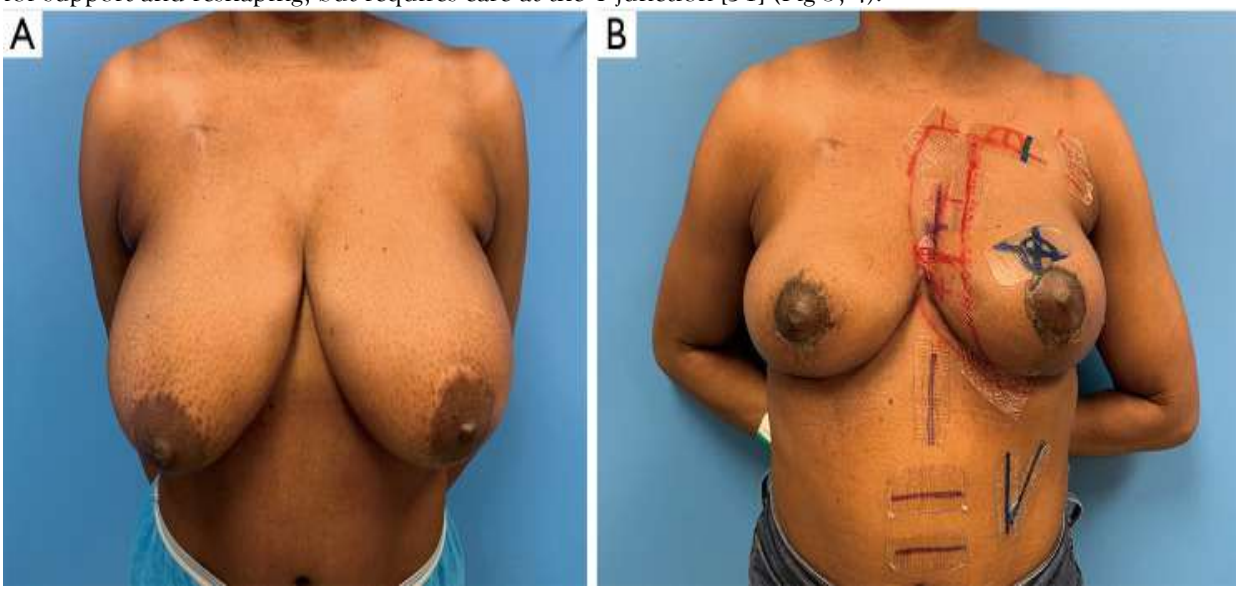

Figure 3 shows postoperative outcomes with Wise pattern [52].
Circumvertical techniques avoid T-junctions and offer better wound healing.

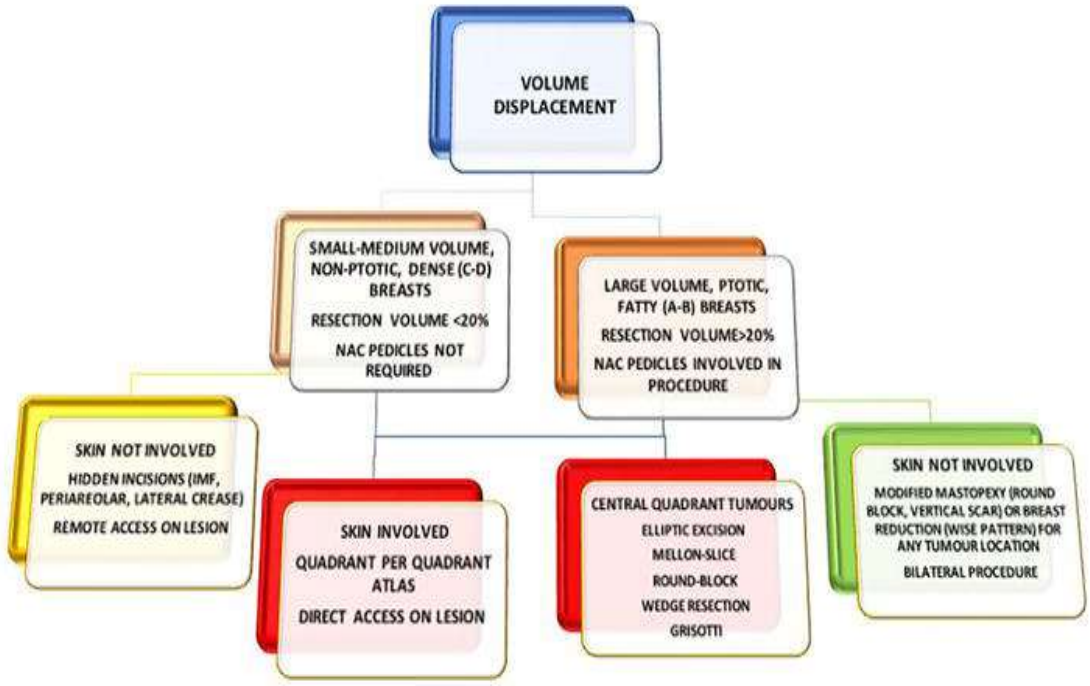

Figure 4 depicts levels 1 and 2 VD techniques [53].

Level III: Volume Replacement with Local Flaps

Ideal when >20% of small breast volume is excised or symmetry surgery is to be avoided. Perforator-based flaps (MICAP, LICAP, LTAP, TDAP) are used. Donor site morbidity and technical demand require proper training and patient selection [54] (Fig 5).

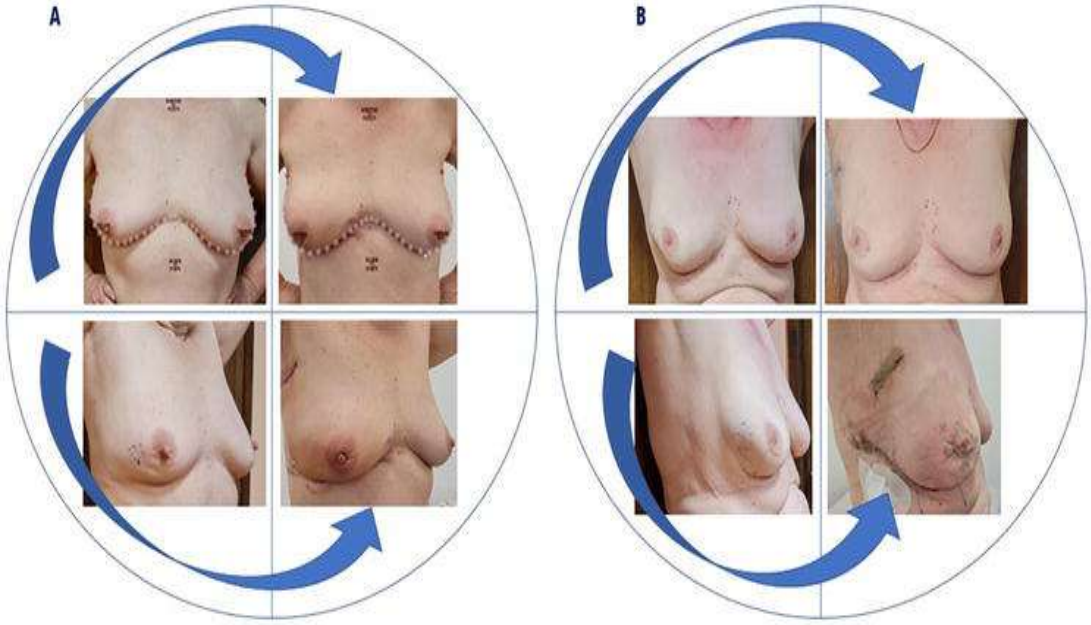

Figure 5 shows flap locations [55].

Indications

OPS suits women with macromastia, ptosis (grade II–III), or tumors in challenging zones (medial/lower quadrants). Contraindications are similar to mastectomy, including prior chest radiation and inflammatory cancer [45].

Preoperative Markings

Markings are done standing, aiming for symmetry, ideal nipple height (19–23 cm from sternal notch), and pedicle base (10 cm for inferior) based on tumor size and location. Triangle-based designs standardize planning [54] (Fig 6).

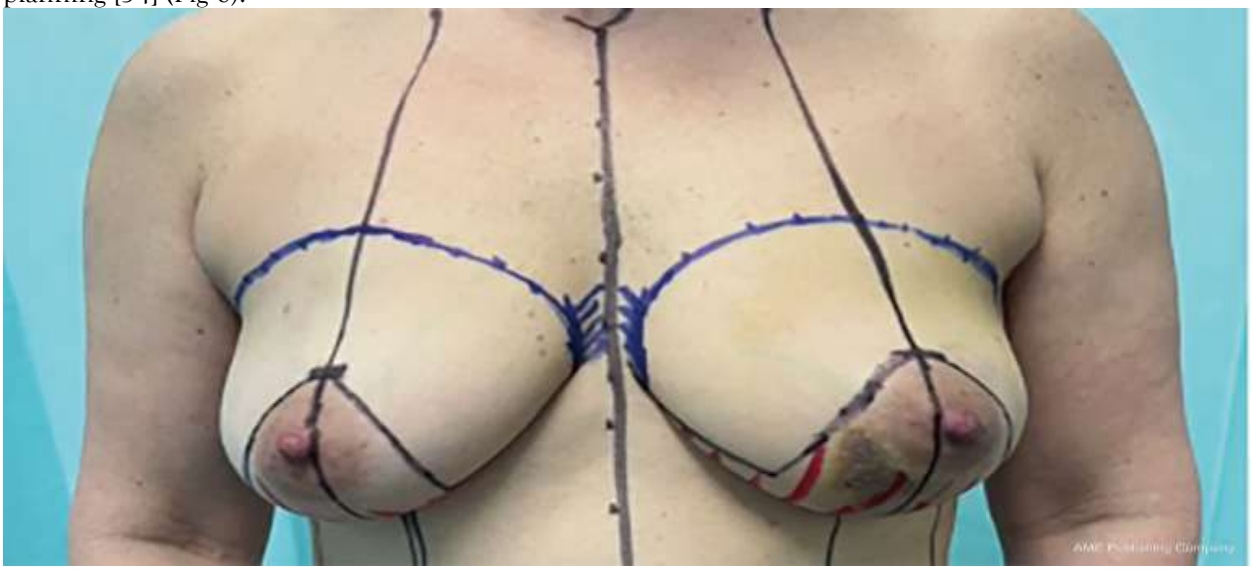

Figure 6 illustrates marking layout [56].

Advantages of OPBS

OPBS allows wide resections, avoids contralateral surgery in some cases, and maintains natural appearance [57]. It is also applicable in benign cases needing deformity correction [58].

Complications

Common:

Fat necrosis (5%), seroma (8–10%), delayed healing (esp. smokers), asymmetry, NAC malposition, sensory loss [59].

Rare:

Nipple necrosis (0.5%), skin necrosis, deformity from radiation, especially in low-density breasts. Combining with intraoperative radiotherapy increases fat necrosis risk.

Slim patients with small breasts are at higher risk for deformity and NAC issues [60].

Other complications include hematoma, infection, altered sensation, wound dehiscence, and poor cosmetic results [60].

Oncologic and Cosmetic Outcomes

OPBS is equivalent to mastectomy in oncologic safety if clear margins and radiotherapy are ensured. A 2020 review showed 95% overall survival and 90% disease-free survival, matching BCS/mastectomy outcomes [61]. It enables larger excisions while preserving aesthetics, especially in large tumor-to-breast ratios. A meta-analysis of 31 studies showed better or equal outcomes compared to standard BCS [62]. It improves radiotherapy tolerance in macromastia and corrects post-RT deformities. Age alone shouldn't exclude OPBS; patient evaluation is key .

Indications for oncoplastic breast-conserving surgery include patients with macromastia or those requiring excision of more than 20% of breast volume. It is particularly beneficial for tumors located in cosmetically sensitive areas such as the medial, central, or inferior quadrants of the breast [63]. OPBS is also indicated in cases requiring salvage surgery after failed conservative procedures, in patients with extensive ductal carcinoma in situ (DCIS) or invasive lobular carcinoma, and in those showing an incomplete response to neoadjuvant chemotherapy [64].

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