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Oncoplastic Volume Displacement Techniques for Breast Conserving Surgery in Patients with Breast Cancer

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Breast Cancer

Breast cancer is the most common cancer in women, responsible for over 10% of new cancer cases annually and is the second leading cause of cancer death among women worldwide. The breast, consisting of 15-20 lobes and fat that determines size and shape, produces milk in response to hormones. Breast cancer often develops silently (Sathish Kumar, 2018), and is frequently detected through routine screenings or symptoms such as lumps, shape changes, or nipple discharge. Diagnosis requires physical exams, mammography, and biopsy, with early detection significantly improving survival. The cancer can spread via lymphatic and blood systems, leading to metastasis and a poor prognosis, underscoring the need for screening programs (Mahvi, et al. 2018).

Oncoplastic Breast Surgery

Oncoplastic surgery (OPS), introduced in the 1994 by Audretch, emphasizes aesthetic outcomes and quality of life after breast cancer surgery without compromising oncological safety (Bertozzi, et al. 2017). OPS allows for wider cancer resections compared to lumpectomy, improving breast contour and avoiding mastectomy. Studies show OPS offers equivalent or better local recurrence and disease-free survival rates compared to standard breast-conserving surgery (Kopkash and Clark 2018). OPS can even be performed in patients with tumors ≥5 cm, traditionally treated with mastectomy, with the support of a multidisciplinary team (Blankensteijn, et al. 2019).

Indications

OPS expands breast-conserving surgery for larger tumors, especially in patients at risk for breast deformity where mastectomy is not desired. Contraindications include multicentric disease, inflammatory cancer, and prior breast radiation (Patel, et al. 2019). Patients with high tumor-to-breast ratios (>20%), macromastia, or those desiring breast reduction or correction of asymmetry are also candidates (Losken, et al. 2017). A classification system correlates the amount of breast excision with appropriate surgical techniques (Table 1) (Chatterjee, et al. 2019).

Table (1): Classification of oncoplastic surgery (Scomacao, et al. 2020)

Level 1—volume displacement	< 20% of breast tissue is removed
Level 2—volume displacement	20–50% of breast tissue is removed
Volume replacement	> 50% of breast tissue is removed

Volume Replacement Procedure

The volume replacement procedure restores lost breast tissue using techniques such as latissimus dorsi (LD) flaps, maintaining breast shape and size while providing a balanced cosmetic result, especially for small-to-medium-sized

breasts. This approach avoids contralateral surgery and preserves native skin to enhance aesthetics (Colwell, 2023). This method minimizes scarring by avoiding unnecessary skin excision (Fig. 5) (Maselli, Mella, & Guo, 2019). The LD mini-flap technique was later developed to further improve cosmetic outcomes (Fig. 6) (Jatoi, et al. 2020b).

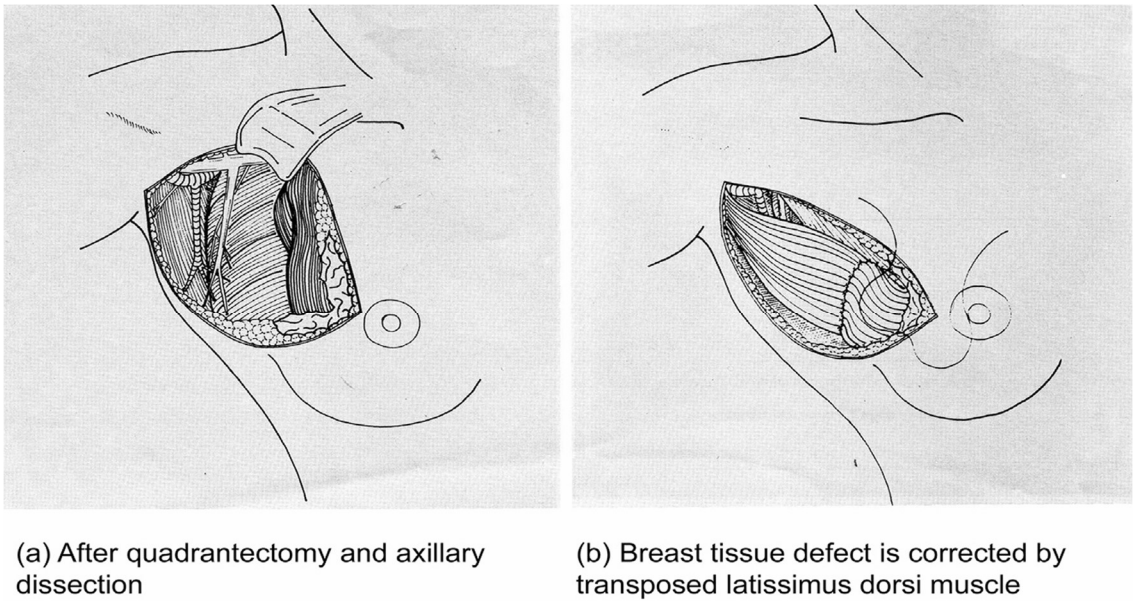

Fig (5): Breast conserving reconstruction with immediate transposition of latissimus dorsi muscle (Noguchi, et al. 2016).

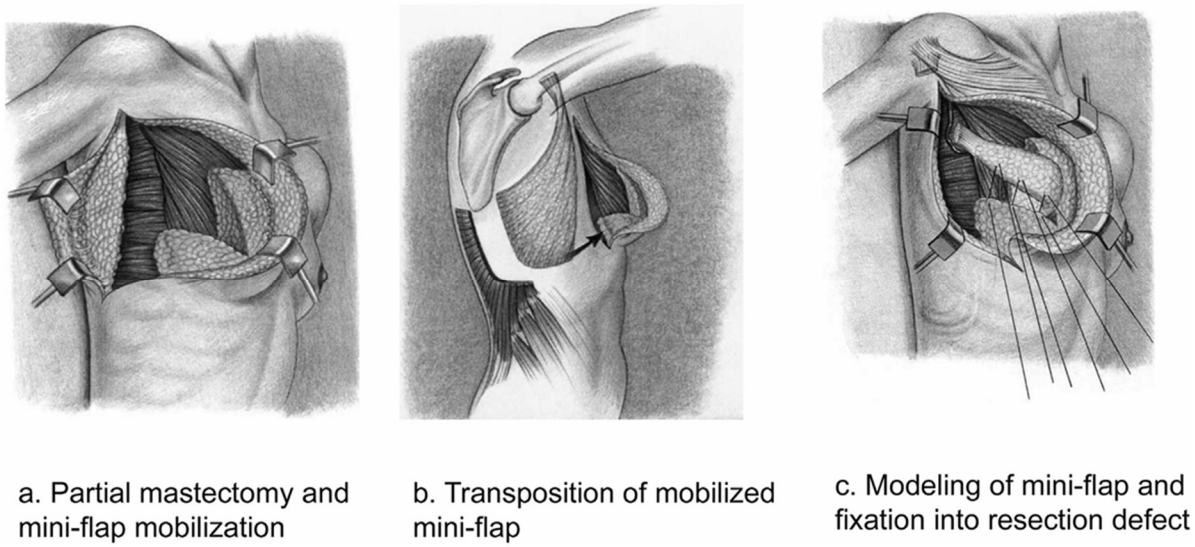

Fig. (6): Breast conserving reconstruction with latissimus dorsi mini-flap (12).

These procedures offer radiolucent flaps, avoiding interference with mammograms, but may involve longer operation times and complications, including post-radiation atrophy (Roy et al., 2021; Metz et al., 2022). Refinements include harvesting more tissue and using fat transfer to restore volume (Braudy, 2023). Various flaps, including thoracodorsal artery perforator (TDAP) and intercostal artery perforator (ICAP) flaps, have been explored for their rotation arc and minimal donor site morbidity (Table 2)) (Mangialardi, et al., Raposio, 2021). Despite newer techniques, the LD flap remains widely used and highly rated for patient satisfaction (Lee et al., 2022).

Table (3): Surgical procedures for breast-conserving reconstruction (Noguchi et al., 2016).

Volume replacement	Volume displacement
• Myosubcutaneous LD flap: Uses muscle and subcutaneous tissue for volume replacement. • Myocutaneous LD flap: Includes skin, usable at any site. • Lateral thoracodorsal flap: Utilizes tissue from the lateral thoracodorsal area for outer quadrant. • Lateral adipose tissue flap: Replaces volume in upper outer quadrant. • Thoracoepigastric flap: Reconstructs lower pole. • Inframammary adipofascial flap: Uses lower pole tissue, accessed via inframammary incision. • Intercostal artery perforator flap: Utilizes intercostal vessels for lower outer quadrant. • Thoracodorsal artery perforator flap: Utilizes thoracodorsal vessels for lower outer quadrant.	• Inferior pedicle: Moves tissue for upper pole reconstruction. • Round block: Displaces tissue for upper pole. • Lateral mammoplasty: Shifts tissue for upper quadrant. • J mammoplasty: Moves tissue for lower outer quadrant. • V-mammoplasty: Shifts tissue for lower inner quadrant. • Superior pedicle: Moves tissue for lower pole. • Batwing technique: Shifts tissue for upper inner quadrant.

Volume Displacement Procedure

Volume displacement procedures were developed for specific tumor locations, such as lower pole cancer (Fig. 7). The inverted-T mammoplasty technique involves deepithelialization around the nipple-areola complex (NAC), wide undermining of breast tissue, and en bloc tumor removal with a large margin of normal tissue. After resection, the breast is reshaped by reapproximating medial tissue and recentralizing the NAC. This technique can be adapted for other tumor sites, but may not suit all locations (van la Parra et al., 2019).

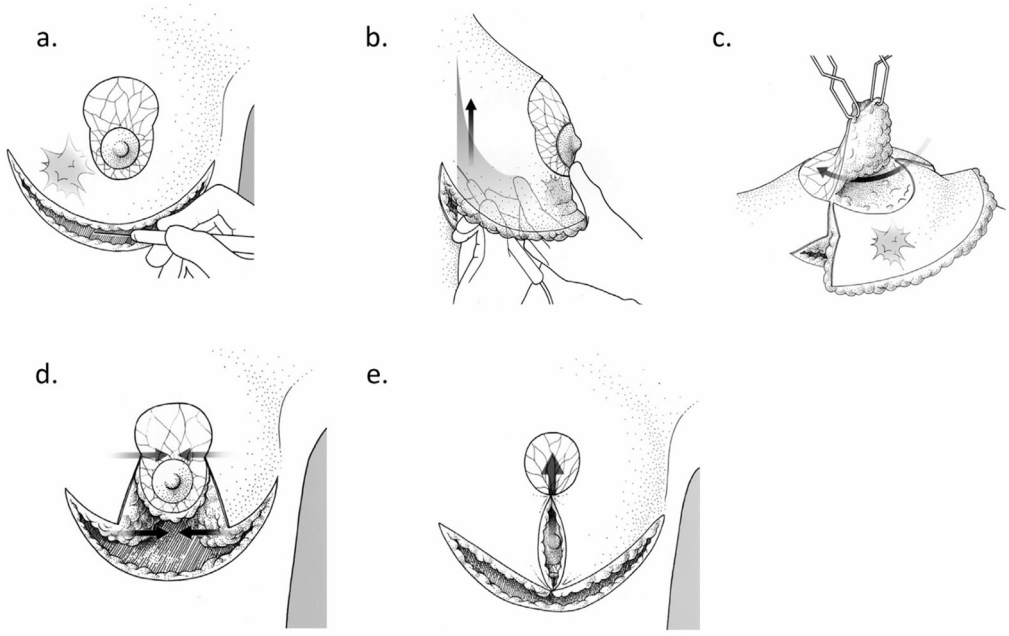

Fig (7): Superior pedicle mammoplasty (Noguchi et al., 2016).

For non-lower pole tumors, various mammoplasty techniques like inferior pedicle or J mammoplasty are used to avoid extensive undermining while reshaping the breast (MM et al., 2019). Volume displacement is generally limited to patients with a D cup size or larger, as it requires sufficient remaining tissue for effective reconstruction (Nowroozilarki, 2020). If cosmetic outcomes are inadequate, volume replacement may be necessary, which can lead to donor site complications but avoids the issues associated with contralateral surgery (Barry et al., 2023). It is now advised to delay contralateral surgery until after radiation therapy to minimize scar visibility (Jasra et al., 2018).

Volume Displacement Techniques

Volume displacement techniques encompass a range of methods aimed at utilizing remaining breast tissue to fill defects caused by tumor excision, resulting in reshaped breasts through advancement, rotation, or transposition of tissue, often decreasing overall breast volume (Kaufman, 2019).

Simple breast tissue mobilization can enhance cosmetic outcomes after the removal of small tissue volumes, though extensive mobilization risks blood supply disruption, leading to complications like necrosis or sepsis (Kaufman, 2019). For larger defects, such as those involving the nipple-areola complex, local tissue flaps, like the advancement rotation flap by Grisotti, are necessary to adequately fill the void (MESBAHI & YEMC, 2019).

Volume displacement techniques utilize remaining breast tissue to fill defects post-tumor excision, notably through dermato-glandular flaps based on inferior pedicles, which replace the nipple-areola complex and allow for immediate areola formation (Jin et al., 2021). The round block technique involves de-epithelializing a "corona" around the nipple-areola complex and excising the tumor, allowing for effective defect closure. Therapeutic mammoplasty integrates tumor excision with reduction mammoplasty, mainly for patients with large breasts and tumors in areas suitable for conventional mammoplasty, achieving over 80% patient satisfaction at 5 years and local recurrence rates under 10% (Shehata et al., 2021; Thiessen et al., 2018).

Modifications in pedicle techniques allow for closure of defects in conserved breast tissue, with complex procedures yielding good to excellent results in two-thirds of cases (Chu et al., 2021). The batwing and hemi-batwing techniques target tumors in the upper outer quadrants, facilitating excision with satisfactory cosmetic outcomes (Garg, 2023; Wignarajah et al., 2023).

Aesthetic and Functional Outcomes

Oncoplastic surgery (OPS) enhances cosmetic results and patient satisfaction by preserving breast anatomy and reducing dissection-related complications, unlike mastectomy, which can lead to higher complication rates and post-mastectomy pain syndrome (Wang et al., 2018). OPS maintains breast and nipple-areolar complex (NAC) innervation, improving sensory outcomes and overall satisfaction (Cornelissen et al., 2018). Techniques include volume displacement (e.g., tissue rearrangement) and volume replacement (e.g., fat grafting, regional flaps) tailored to tumor size and location (Table 4).

Table (4): Surgical options based on breast size and tissue excision (Scomacao et al., 2020).

	Small breast volume (A/B cup) without ptosis	Medium breast volume (C cup) with/without ptosis	Large breast volume (D cup or larger) andptosis
< 20% resection	Lumpectomy alone Tissue rearrangement Fat grafting	Tissue rearrangement Fat grafting Mastopexy	Tissue rearrangement Oncoplastic reduction
20–50% resection	Tissue rearrangement Fat grafting Mastopexy	Mastopexy Oncoplastic reduction	Oncoplastic reduction Volume replacement techniques

> 50% resection	Mastopexy Volume replacement techniques	Mastopexy Volume replacement techniques	Mastopexy Oncoplastic reduction Volume replacement techniques

Simple excisions exceeding 5-15% of breast volume without OPS correlate with decreased patient satisfaction (Losken et al., 2017). Oncoplastic reduction can alleviate shoulder and back pain and enhance aesthetic outcomes while minimizing cancer risk and improving radiation delivery (Macmillan & McCulley, 2016). Successful OPS depends on multidisciplinary planning, patient selection, and surgeon experience (Patel et al., 2019). Volume replacement techniques are necessary for larger resections (>50% of the breast) and may involve delayed fat grafting for optimal vascularization (Losken et al., 2017).

Complications

Studies comparing oncoplastic surgery (OPS) and breast-conserving surgery (BCS) generally report no significant differences in surgical complications, with most being minor and not requiring reoperations. A comparison by Carter et al. (2016) involving 9,861 patients found that wound-related complications were higher in OPS than BCS, although rates of hematoma and surgical site infections were similar. Notably, OPS demonstrated significantly lower rates of wound complications, infections, and hematomas compared to mastectomy with immediate reconstruction (Mx + IR). In patients with obesity and macromastia, oncoplastic reduction often resulted in fewer complications than mastectomy and reconstruction. Fat necrosis, a delayed complication, occurred in 4.6% of BCS cases and 16% of BCS with pedicled fat flap, possibly mimicking local recurrence and increasing patient anxiety (Nakada et al., 2019). Radiation negatively affects tissue vascularity, heightening fat necrosis risk, making careful intraoperative tissue perfusion critical to minimize complications.

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