Oncoplastic and Reconstructive Surgery for Breast Cancer

22

Prabha Yadav and Dushyant Jaiswal

22.1 Introduction

Breast is the most revered symbol of the feminine. Before and long after their main function of lactation, they continue to serve as an important part of body image and sexuality. Cancer ablative surgery in the form of total removal (mastectomy) or partial removal (Breast Conservative Surgery, BCS) leads to a deformity with potential adverse impact on body image perception and psychosexual wellbeing, having an adverse impact on the quality of life [1, 2] Fig. 22.1. Reconstruction using plastic surgery principles is now safe, proven and well established. Oncoplastic Breast Surgery (OBS) is an approach where plastic surgery principles are used in synchrony with established oncological caveats to achieve good cosmetic outcomes [3–5]. Term OBS is generally used to refer to reconstructive surgery interventions done with BCS. Reconstruction after mastectomy, Whole Breast Reconstruction (WBR), can be accomplished using autologous tissue, synthetic implants or a combination of the two. The aim of all reconstructive endeavour is to achieve an outcome acceptable to the patient, aligned with her perception of size, symmetry, site and proportions. In absence of WBR or OBS, the breast deformities are a constant reminder of the disease long after oncological treatment has attained purpose. Reconstruction cannot free the patient of the disease but free their minds off these

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Fig. 22.1 (**a**, **b**, **c**, **d**): Deformity after mastectomy and breast conservative surgery without reconstruction

reminders. It per se doesn't affect the disease biology and should not interfere with timely delivery of chemotherapy and radiation therapy [6]. Follow-up for cancer recurrence is not hindered by reconstruction in the era of modern imaging modalities of mammography, CT scan and MRI.

Patient Autonomy in Reconstruction All forms of breast reconstruction are essentially cosmetic. The patient has a full right to choose a life with a deformed or an absent breast. An open and inclusive approach in decision making is highly recommended. All possible options of type of reconstruction, donor site and timing (primary or secondary) with advantages & disadvantages must be explained to the patient before a decision is made [7]. Even an option of an external prosthesis, a post-mastectomy brassiere, for camouflage must be offered to the patient.

The Opposite Breast An assessment of the opposite breast is the first and most important element in planning reconstruction. It serves as the baseline template which reconstruction tries to match. If the patient wishes to modulate the normal breast, the reconstructive end points change. A large and/or ptotic breast can be subjected to reduction or mastopexy procedure, a small breast can be augmented with an implant or a lipofilling procedure. The willingness of a patient to undergo a symmetrising procedure often eases the reconstructive effort and yields a better cosmetic and symmetrical result.

22.2 Whole Breast Reconstruction: Implant Based

Implant based reconstructions after mastectomy (they are not usually used an option after BCS) offer the absolute advantage of not needing any additional donor site scars or morbidity. They are an option when patient doesn't have any suitable donor site with abundant skin and fat or doesn't wish an additional scar on her body. In western nations they also have a short-term cost advantage [8].

Breast implants and expanders are made of medical grade silicone. The shell is of silicone, core is empty in 'Saline implants' and again of silicone in 'Silicone implants". Surfaces are round as textured implants now withdrawn due to association with BIA-ALCL [9]. 'Implants' are of a fixed size. 'Expanders' can be increased or decreased in size, accessed by a 'port' on the device or remote and connected to it Fig. 22.2.

Implant Pocket The implant or expander needs space, a 'pocket', to fit in. The pocket needs to be robust in morphology and vascularity to cover and isolate it from the environment. The pocket options are,

(a) Subcutaneous: The device is placed just below the mastectomy flaps
(b) Submuscular: The device is placed below the pectoralis major muscle totally covered; no surface is in contact with the under surface of skin.
(c) Dual plane: the upper part of implant is submuscular, lower part subcutaneous [10].

The lower half of the subcutaneous implant coverage can be augmented or buttressed by, acellular dermal matrix (ADM), de epithelised dermal flap remnant from a wise pattern skin reduction, serratus anterior or LD muscle flap or a rectus fascia turnover flap.

The quality of the skin flaps, thickness and vascularity, after mastectomy are one of the most important determinants of outcome of any reconstruction [11]. If the pocket is suspect, reconstruction can be delayed to observe (temporary expander placement), pocket changed or augmented (muscle or fascial flap or ADM). Sometimes the pocket is outright deficient in skin and the defect needs to be plugged with an autologous tissue flap, Latissimus Dorsi flap is the most common choice.

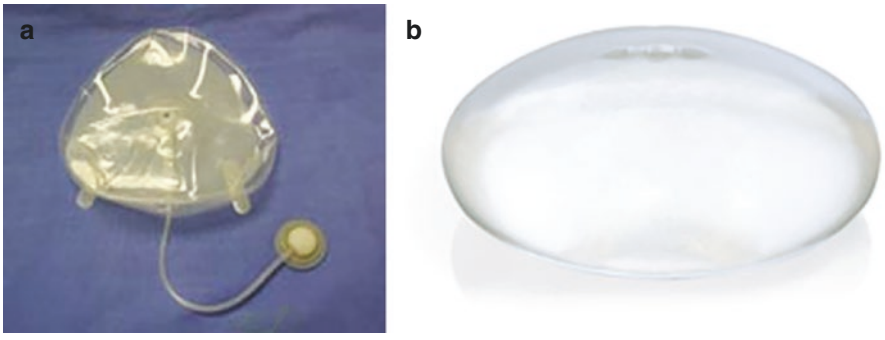

Fig. 22.2 (**a**) Expander with remote port for breast. (**b**) Silicone breast implant

Need for Expander Commonly arises in two situations.

(a) *Secondary reconstruction*—The mastectomy has been done prior and skin pocket is contracted like a flat sheet compared to a hemisphere of a normal breast before mastectomy. Tissue expansion reverses this process to enable an implant placement.
(b) *Primary reconstruction* with postoperative radiation requirement—In this scenario the chest needs to be flat for ease of radiation delivery and expanded later to accommodate the implant.

Long Term Complications The implant is inert, however, it being a foreign material, doesn't integrate with the body in a biological way. Biofilm formation happens, starting the process of infection, exposure and extrusion. Capsular contracture is a major concern in nearly 25–30% of patients [12]. Most complications with implants are insidious and unravel over long term. This often gives a false sense of comfort about the safety of implant-based reconstruction, and necessitates adequate long-term follow-up of these patients.

Additional Concerns Implants come with an element of fear of the unknown. The PIP controversy happened where a manufacturer used industrial grade silicone instead of medical grade, prompting implant removal or exchange in thousands of women in Europe [13]. The recent concerns with BIA—ALCL (Breast Implant Associated—Anaplastic Large Cell Lymphoma) also places a seed of doubt. The Incidence of BIA-ALCL is extremely low as of now and associated with only textured implants [14]. These concerns also come with the fear of something yet unknown cropping up in the future.

Indian Perspective Young patients often present with advanced primary necessitating skin excision and subsequently a LD flap when an implant is planned after mastectomy Fig. 22.3. Tissue expander is often needed prior to an implant. In addi-

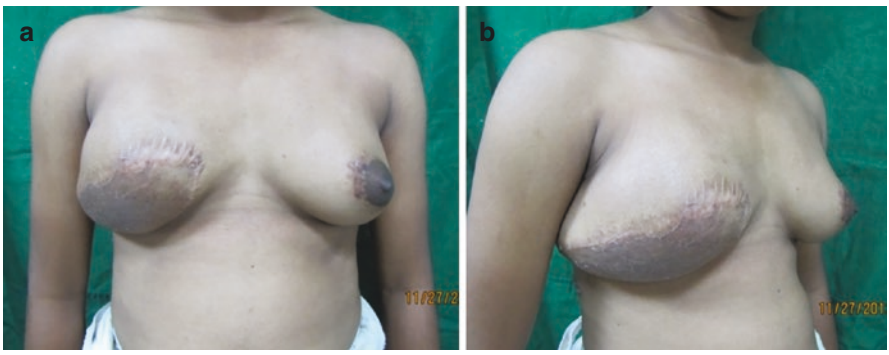

Fig. 22.3 (**a**, **b**): Follow up of breast reconstruction with LD flap & expander, followed by insertion of an implant after completion of radiotherapy. Note the scar stretching and skin changes in the LD skin island due to radiation

tion, the nodal burden, usually necessitates postoperative radiation which prolongs the whole process till a result is achieved and also pulls the cosmetic results a notch lower in long term. The repeated follow up (for tissue expansion) and multiple visits to operating room (expander to implant change) push up the costs and present additional logistics issues. The availability of a spectrum of implants and expander to choose from is also an issue, especially in non-metro cities and towns.

22.3 Whole Breast Reconstruction with Autologous Tissue

Autologous reconstruction implies patients own tissues are used to reconstruct the 'neo faux breast' from her donor sites, most commonly abdomen and less frequently back, thighs, buttocks or flanks. This tissue could be varying combinations of skin, fat and muscle in the form of a pedicle flap, a free flap or lipofilling of suctioned fat. These tissues integrate with the body in breast location (unlike an implant / expander), feel, behave and age as they would in the native donor site (even gaining and losing weight as they would at the native site). Autologous reconstruction can have some short-term complications or failure with flaps but the incidence is very low (1–2%). Long-term complications with successful autologous reconstruction are extremely low [15]. They are all associated with a donor site cost; scar and its sequalae, rarely morbidity due to muscle loss or weakness, herniation and cosmetic deformity of the donor site. With the current state of autologous reconstruction, microvascular surgery, range of donor site options and predictability with modern imaging techniques, it is a very safe, robust and reliable option to choose.

Decision to choose autologous tissue for WBR should be preceded by a thorough examination of the possible donor sites and opposite breast Fig. 22.4. Patient's willingness to symmetrise the opposite breast, should be taken into account. Clinical examination gives an approximate idea of options of donor sites, which have required amount of fat and skin needed to reconstruct the breast without significant morbidity. These technically feasible options, matched to the comfort level of the surgeon, need to be discussed with the patient before a final decision is made. The autologous free flap options need the blood vessels of the flap to be anastomosed to a donor set of vessels, requiring microvascular expertise, longer operative time and more cost. The donor sites which can be utilised in order of most common to rarer ones are described below Fig. 22.5.

22.3.1 Abdomen-Pedicle TRAM to the DIEP Flap

Lower abdomen skin and fat offer the closest match to the breast morphologically. It can look and feel almost like the normal breast tissue. In addition, it gives a donor site gain rather than morbidity in form of a 'cosmetic abdominoplasty' or a free "tummy tuck". When available, it is the first choice as a donor site.

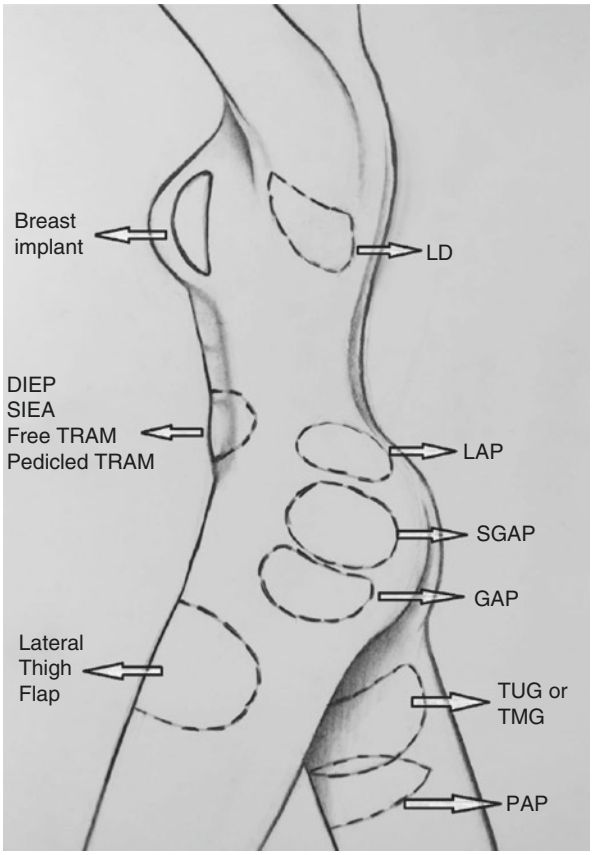

Fig. 22.4 Possible flap donor sites for Autologous whole breast reconstruction

Pertinent Anatomy The Rectus Abdominis (R.A.) muscle has a codominant blood supply from the Superior Epigastric Artery (SEA, continuation of the Internal Mammary Artery) and Deep Inferior Epigastric Artery Fig. 22.6. These two vessels anastomose with each other in the rectus abdominis muscle. The dominant supply of the lower abdominal pannus is the deep inferior epigastric artery & vein (DIEA&V), via the perforators traversing the RA muscle and rectus sheath. Innervation of the RA muscle is from anterior rami of thoracic 6–12 spinal nerves, which begin as intercostal nerves, in a segmental manner entering the muscle laterally.

Pedicled TRAM Flap This was first performed (on suggestion of a patient!), standardised and popularised by Carl Hartrampff [16]. This pedicle flap utilises the

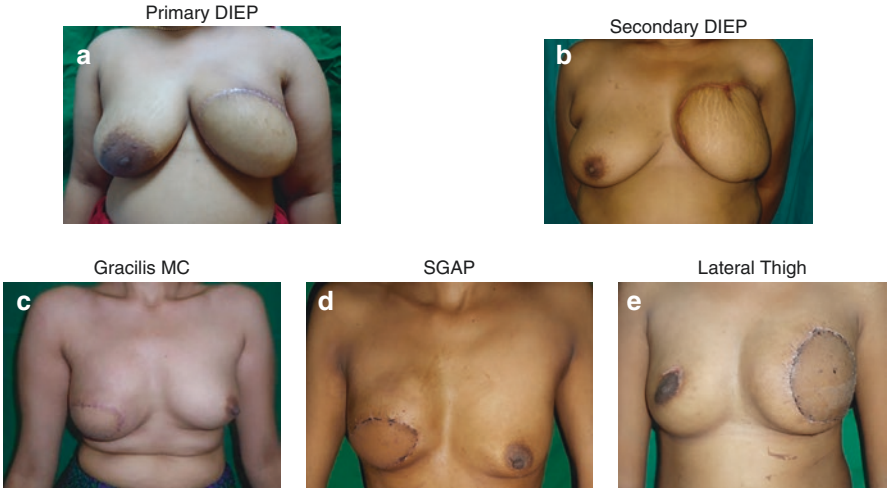

Fig. 22.5 Autologous reconstruction—different paths to same destination, (**a**) primary Deep inferior epigastric perforator (DIEP flap), (**b**) Secondary DIEP flap, (**c**) Gracilis myocutaneous flap, (**d**) Superior Gluteal artery perforator flap (SGAP), (**e**) Lateral thigh flap

lower abdominal pannus based on the SEA communicating with the DIEA, within the RA muscle. Many variations in skin island design, mode of inset of the flap, use of bilateral flaps and delay techniques have been described.

This flap can produce excellent results in selected cases Fig. 22.7. It is but plagued by a high rate of partial flap necrosis and fat necrosis in the late postoperative period. The reason for this is the unpredictable nature of communications between the SEA and DIEA, sometimes few, rarely absent and occasionally the choke vessels are present but don't open up. This problem is compounded in obese, smokers and patients with comorbidities where the peripheral circulation is compromised [17, 18].

The other problem is donor site morbidity due to loss of the RA muscles and rectus sheath, resulting in abdominal wall weakness, bulges, hernia and backache due to muscle imbalance.

Free TRAM and Free DIEP Flap The ischemic complications drove the change to use the, lower abdomen pannus based on the dominant DIEA/V, harvested with the corresponding RA muscle and rectus sheath called Free TRAM flap (first described by Holmstrom) [18]. This transfer is as a free flap with need for microvascular tech-

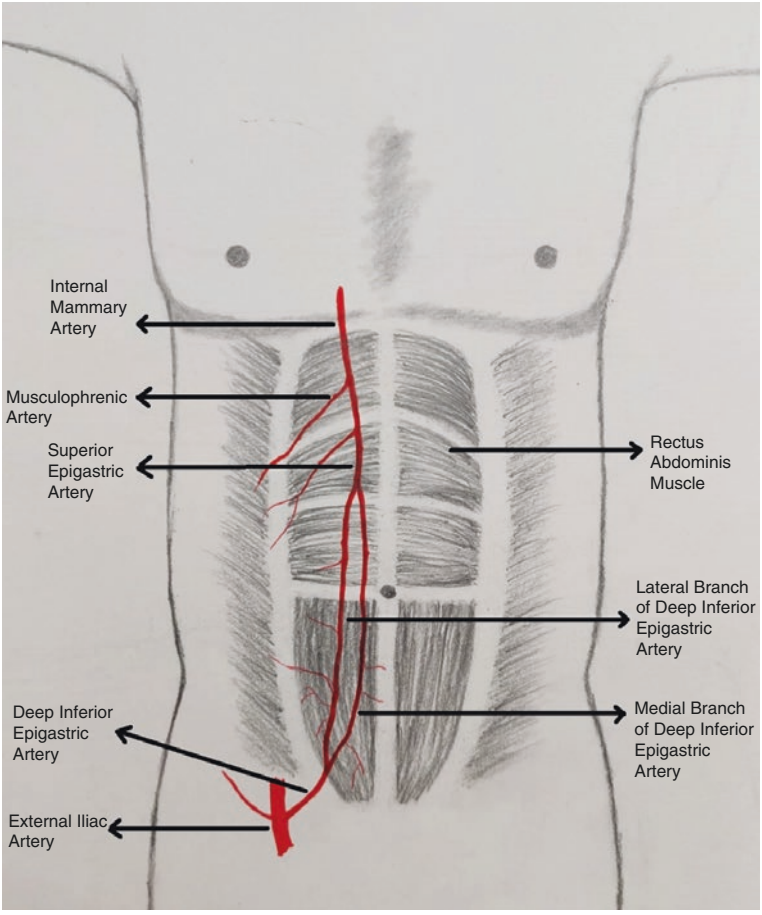

Fig. 22.6 Pertinent anatomy of flaps from the abdomen

nique to anastomose the DIEA/V to a donor pedicle of Thoracodorsal or Internal mammary vessels. Free TRAM flap took care of the ischemic problems of Pedicle TRAM but the donor morbidity remained an issue.

The *Free DIEP flap* is the current 'gold standard' of autologous breast reconstruction against which all other are compared [19] Figs. 22.8, 22.9 and 22.10. It utilises the lower abdominal pannus with the DIEA/V vessels based on a single or few perforators only sparing the Rectus muscle, its innervation and rectus sheath completely. This in principle reduces the morbidity. It was first described for a different indication by Isao Koshima, by Robert Allen for breast reconstruction and popularised by the early work of Phillip Blondeel [18, 20]. CT Angiogram or MR

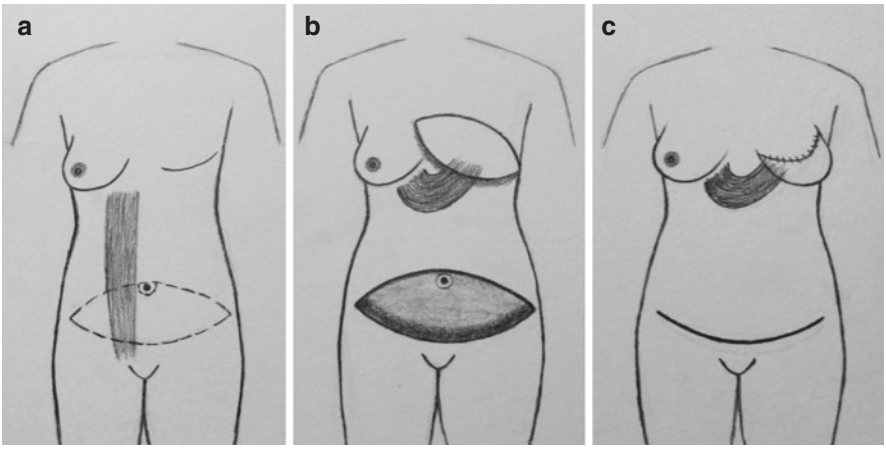

Fig. 22.7 Pedicled TRAM flap for breast reconstruction. (**a**) Defect and the flap marking. (**b**) Harvested pedicle for TRAM and donor defect. (**c**) Post operative views

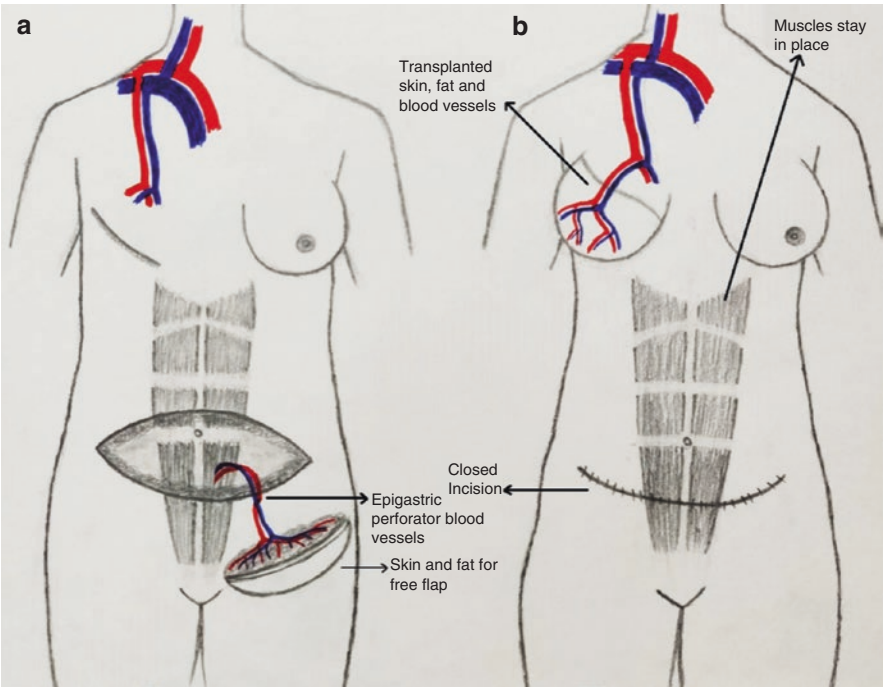

Fig. 22.8 DIEP flap for Whole Breast Reconstruction. (**a**) Defect after mastectomy and harvested flap showing perforator and pedicle (**b**) transplanted DIEP flap for breast reconstruction; rectus sheath primarily closed

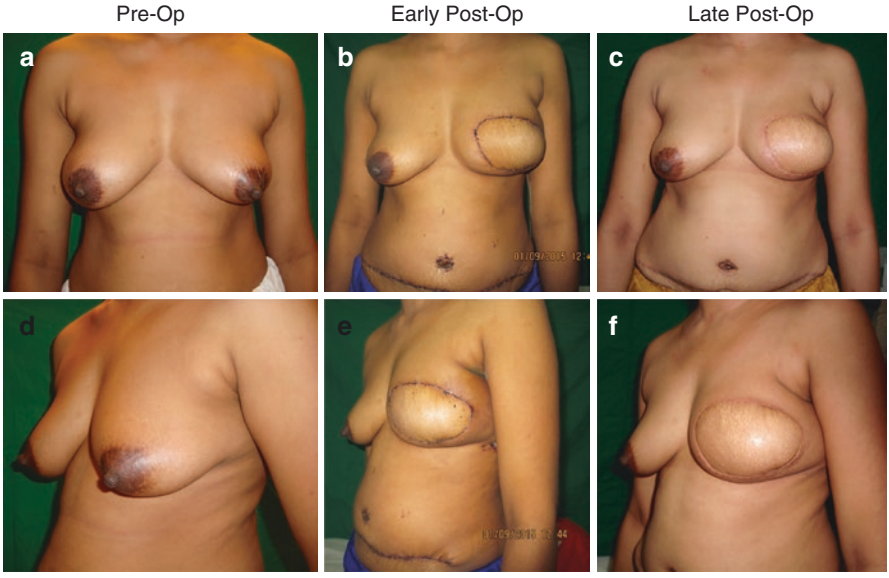

Fig. 22.9 (**a** & **d**) Preoperative, (**b** & **e**) early postoperative and (**c** & **f**) late postoperative post radiation images of patient in Fig. 22.9, front and semi lateral views

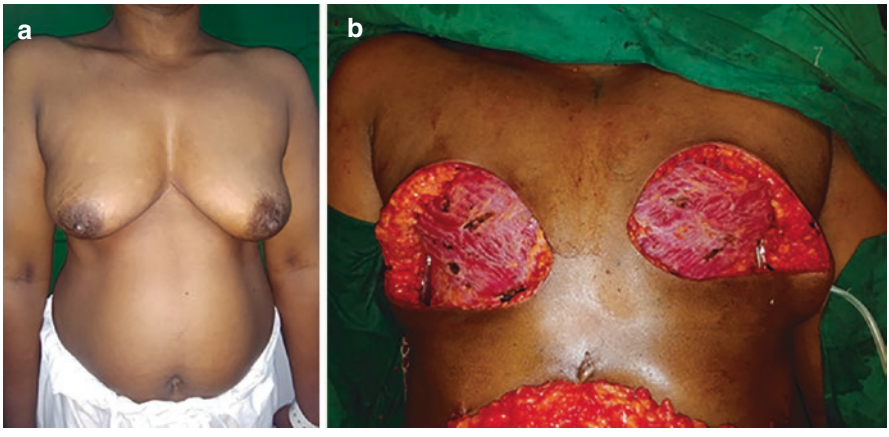

Fig. 22.10 Bilateral mastectomy with Bilateral DIEP flap (clockwise), (**a**) Preoperative, (**b**) Bilateral mastectomy with skin defects, (**c**) Bilateral DIEP flap marking, (**d**) The two harvested flaps, (**e**) Under surface of both flaps showing one perforator each with pedicle, (**f**) At completion of surgery with flap inset and abdominoplasty (**g**, **h** and **i**) Follow up after completion of radiation

Fig. 22.10 (continued)

Fig. 22.10 (continued)

Angiogram, to identify the most suitable perforator or their combinations (size, arborisation, communications, likely area perfused and their course through muscle), represent the next major step in evolution [21, 22].

Previous surgery with any scars or nulliparity is not an absolute contraindication to use of abdomen. Imaging can identify and assure about the intact vascular basis of the flap [23].

22.3.2 Back- Latissimus Dorsi Myocutaneous Flap

LD flap can be used to reconstruct the whole breast in selected cases Fig. 22.11. The morphology, texture and feel of the back fat is close to the breast, though not as good as abdominal tissue [18]. Patients with small to moderate size breast, with a wide trunk and adequate fat in the back are ideal candidates. (See section on OBS for anatomy details).

The LD flap skin island can be larger than needed from anterior axillary line till the midline. The LD muscle atrophies significantly after transfer and should be discounted when assessing the volume of the flap needed. The flap should be seen as a skin and fat harvest with muscle being just the carrier. This ensures good long-term volume retention. Extra fat can be harvested beyond the skin island. This version of the flap is popularly called the '*Extended LD flap'*. This harvest should be restricted to the deep layer of the fat between the superficial fascia and the muscle [24]. This deep fat layer is perfused by minor perforators from the pedicle. The fat above this fascia is perfused dermis down, and is likely to necrose if harvested and likely to result in donor site complications. Persistent seroma is usually the sequala of this excess harvest. The donor site complications of dehiscence and skin necrosis are often the result of overenthusiastic fat harvest. The donor site availability and complications with excessive harvest, limit the utility and indications of LD flap for WBR.

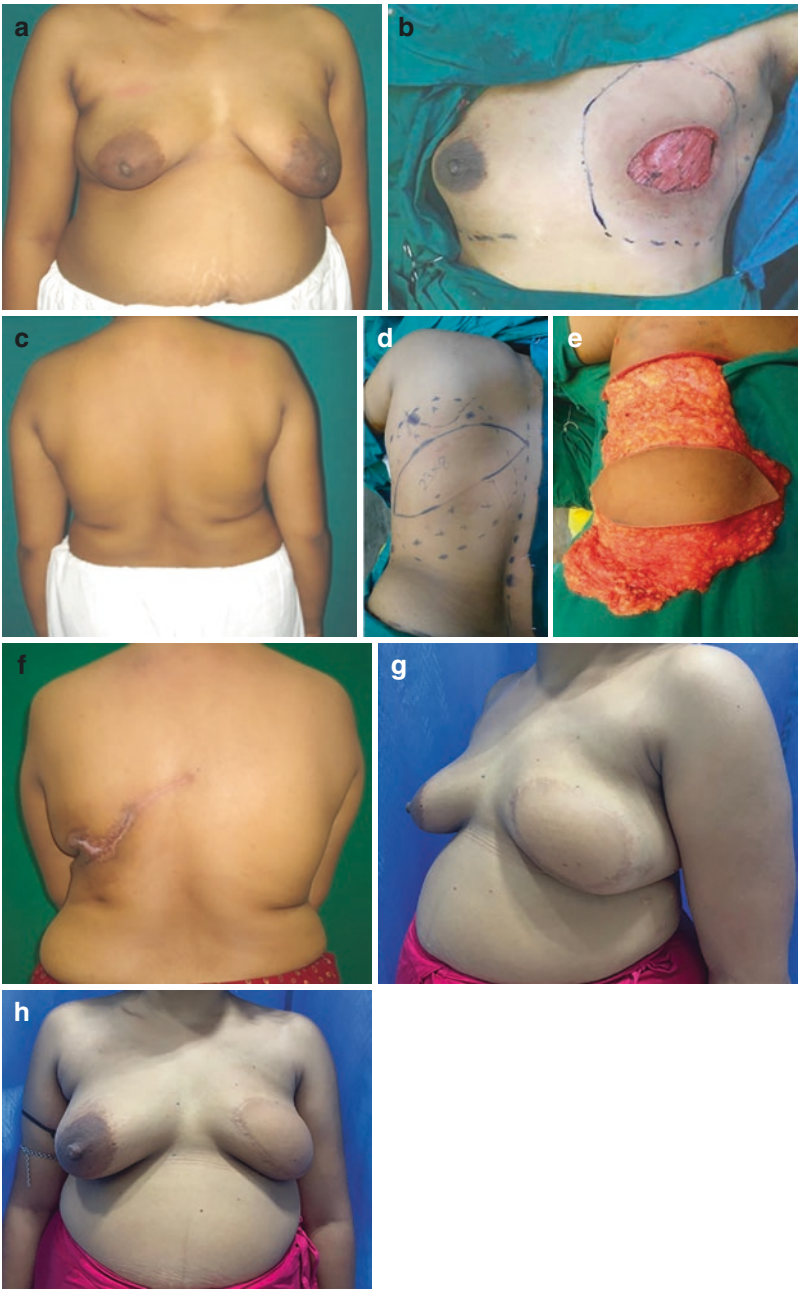

Fig. 22.11 Whole breast reconstruction with Extended LD flap, (**a**) Preoperative Left breast IDC, (**b**) Mastectomy defect, (**c**) Preoperative abundant fat in back, (**d**) Flap marking, (**e**) Harvested flap with extended fat harvest, (**f**, **g**, **h**) 2 year postoperative, note scarring of the donor site following delayed healing due to skin necrosis and dehiscence

22.3.3 Alternative Free Flaps for WBR

They come into picture if the abdomen has been used for a flap, violated by abdominoplasty or liposuction or doesn't have adequate fat. A pear-shaped body habitus lends itself well to flaps from lower part of the body. These flaps generally have a low skin to fat/volume ratio and are best suited when skin envelope is preserved and the requirement is small to moderate. The fat texture is firmer and skin thicker compared to breast tissue or abdominal tissue. These flaps are often technically challenging to harvest and anastomose.

The upper medial thigh tissue above the Gracilis muscle, is used as a free flap based on the medial circumflex femoral vessels called the *Transverse Upper Gracilis myocutaneous* flap (TUG) [25, 26]. The medial to posterior upper and midthigh tissue can be also based on the perforators of profunda femoris (Deep femoral) vessels as the *Profunda Artery Perforator flap* (PAP) [27]. The lateral upper thigh tissue can be harvested based on the transverse branch of the Lateral circumflex femoral vessels as the *Lateral thigh flap or TFL perforator flap* [28]. The buttock skin and fat can be harvested based on perforators originating from Superior or Inferior gluteal vessels as *Superior or Inferior Gluteal Artery Perforator flaps (SGAP & IGAP)* [29]. The posterior flank tissue above the iliac crest can be harvested based on the lumbar perforating vessels as *Lumber Artery Perforator flap (LAP)* [30].

22.4 Oncoplastic Breast Surgery

The term Oncoplastic Breast Surgery (OBS) refers to an approach where plastic surgery principles are used in synchrony with oncological principles to achieve a good cosmetic outcome after breast conservative surgery. The term is conventionally used for plastic surgery after BCS. The choice of incisions for resection of the primary tumour to cosmetically acceptable locations such as peri areolar, radial or in IMF can be the first step in an oncoplastic approach. The two main approaches to OBS are described below.

22.5 Volume Displacement Techniques

These are procedures when no tissue is added to the breast but remoulding and reshaping of the remnant breast tissue is done based on principles of rotation flap, mastopexy or reduction mammoplasty template or its modification as per the defect size and location.

22.5.1 Disc Rotation or Donut Mastopexy

Ideal indication for this is a small defect in a moderately sized breast, other than the retroareolar area.

The breast parenchymal tissue is mobilised from both sides, rotated and advanced into the defect and sutured [31]. Biplanar mobilization of breast tissue leading to lack of dermal contact with parenchyma and mobilisation from the chest wall, predisposes these flaps to ischemia and fat necrosis. It is the most common 'oncoplasty' procedure but often not well understood and poorly applied.

A variant of this flap is a rotation flap of the lower pole of the breast for lower inner quadrant defects Fig. 22.12. Here the flap is dermo glandular, hence of robust vascularity and safe.

The Grissoti flap is also a rotation flap modification for central quadrant tumours, with a retained skin island to create the neo areola Fig. 22.13.

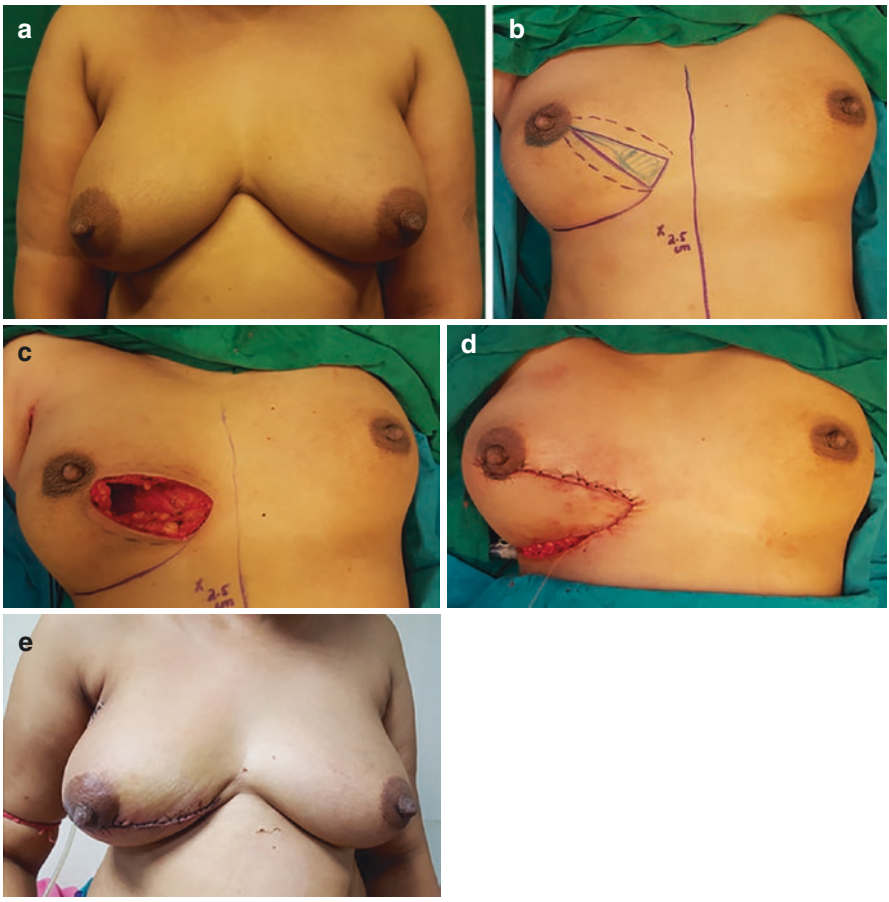

Fig. 22.12 Rotation flap for lower inner quadrant defect, (**a**) Preoperative, (**b**) Marking of skin and gland excision, (**c**) defect after BCS, (**d**) Rotation flap with incision in inframammary fold, (**e**) Early postoperative. Case courtesy, Dr. Shalaka Joshi Professor, Breast Services, Tata Memorial Centre, Mumbai

Fig. 22.13 Grisotti flap for central defect, (**a**) flap marking note the epithelial island at the leading edge, (**b**) NAC central quadrant defect with elevated flap, (**c**) Flap sutured in place with donor site closed, (**d** and **e**). Follow Up Case courtesy, Dr. Shalaka Joshi Professor, Breast Services, Tata Memorial Centre, Mumbai

22.5.2 Mastopexy and Reduction Mammoplasty Templates

Mastopexy is a procedure where the breast ptosis and shape are modified with minimal or no reduction in volume. *Reduction mammoplasty* is a mastopexy with significant reduction in the volume of the breast.

These two surgeries are not distinct entities but represent a continuum with the same three basic principles:

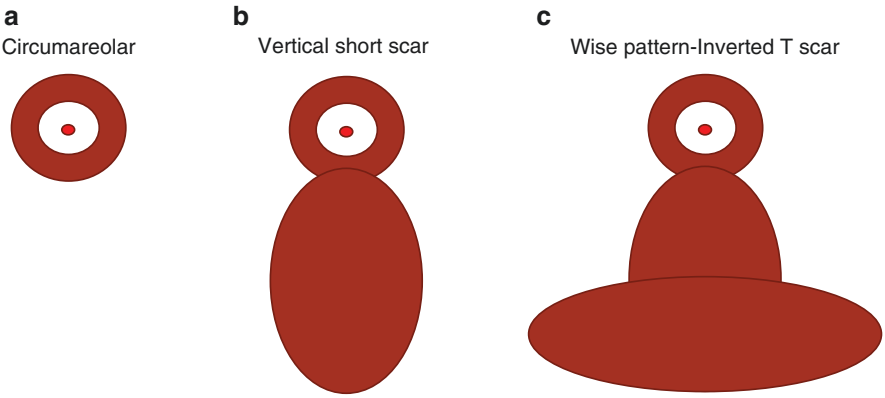

Fig. 22.14 Basic skin resection and access pattern's for OBS, (**a**) Cicumareolar skin incision can be extended to skin excision also, (**b**) Vertical short scar, combination of circumareolar and vertical ellipse, (**c**) Wise pattern skin excision, combination of a vertical short scar pattern and horizontal ellipse in inferior part of breast

1. *Skin resection pattern selection*—this could be needed for access or reduction of the skin envelope Fig. 22.14. Depending on the size of breast, access needed and amount of tissue to be resected, choice could be made from
   (a) *Peri areolar*
   (b) *Vertical short scar* (combination of peri areolar and vertical ellipse inferiorly)
   (c) *Wise pattern* (combination of peri areolar, vertical ellipse inferiorly and horizontal ellipse at IMF)

   However, often skin resection patterns may have to be modified depending upon the incisions planned for primary resection.
2. *Nipple Areola modulation*—the NAC complex can be resized, re-located and needs to be retained. The NAC can be used as a free graft or retained on vascularised dermo glandular pedicles most commonly superomedial or inferior or rarely a glandular central pedicle Fig. 22.15.
3. *Parenchyma resection*—needed for resizing the breast, this could follow the skin resection pattern or differ from it slightly.

   In all these procedures, what is left behind of the breast tissue is more important than how much and from where is it removed. Numerous combinations of pedicles and skin resection patterns have been historically described.

   These procedures lend themselves beautifully to OBS Figs. 22.16 and 22.17. Each of the above procedures needs excision of some breast parenchyma. When BCS is done and resection falls in one of these templates' excision, nothing more needs to be done. In other cases, which is more often the case, the skin resection patterns and parenchyma resections can be modulated. The breast tissue which would otherwise be removed can be utilised for filling the BCS cavities as dermo glandular flaps based on named or visible perforators or supply based on dermal and subdermal plexus.

   The radical rearrangement of breast tissue can make the planning radiotherapy difficult, especially when boost needs to be delivered. All OBS procedures

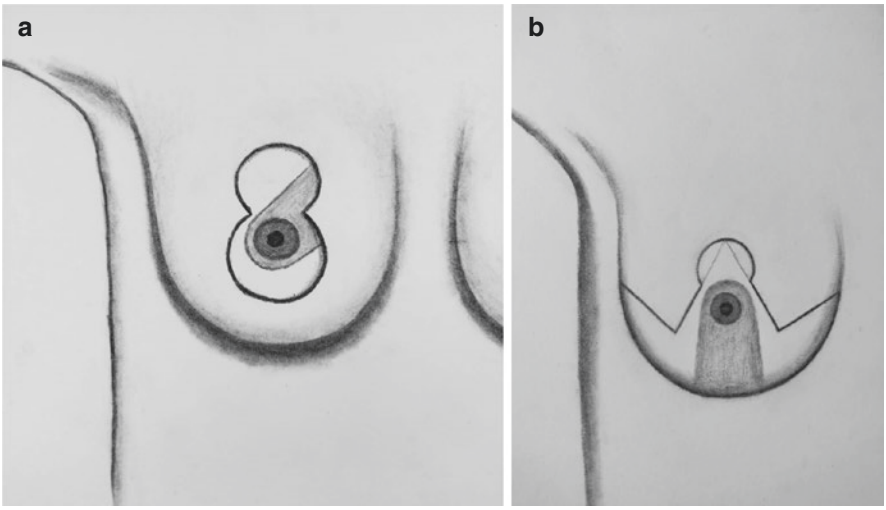

Fig. 22.15 Most common dermoglandular pedicle options to preserve NAC in breast reduction based OBS, both combine well with a wise pattern skin resection. (**a**) Superomedial pedicle, (**b**) Inferior pedicle

should be documented and photographed for ease of communication with the radiation oncologist. Surgical clips should be appropriately applied for cavity delineation to help in delivery of radiation boost which significantly impacts local recurrence rates. Inability to boost the primary cavity and need of mastectomy for local recurrence is detrimental to the primary goal of aesthesis and breast conservation.

22.6 Volume Replacement Techniques

These are procedures where tissues from outside the breast are bought into it by way of local, perforator, regional pedicle, or rarely free flaps. They are indicated when the defect is large compared to the remnant breast, usually in a small to moderate sized breast, when only breast reshaping would not serve the purpose and additional tissue is required for adequate cosmesis.

22.6.1 Latissimus Dorsi Myocutaneous Flap

It is the workhorse and most often done flap for breast restoration in partial breast reconstruction or volume replacement techniques in OBS Fig. 22.18. The safety of LD flap is well proven in early as well as locally advanced breast cancer with respect to oncological outcomes.

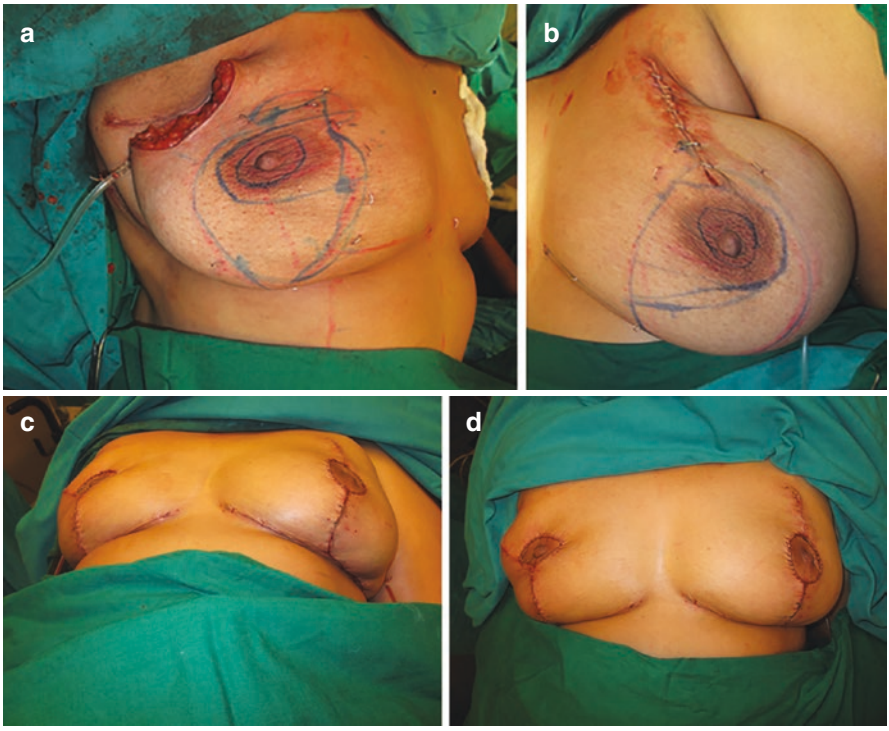

Fig. 22.16 Bilateral IDC breast treated with BCS on both sides, (**a**) R- modified Wise pattern skin resection with superomedial dermoglandular pedicle for NAC, (**b**) L- Wise Pattern skin resection with primary closure superiorly and medial dermoglandular pedicle for NAC, (**c** and **d**) At completion of surgery

Fig. 22.17 (**a**, **b** and **c**) Preoperative, (**d**, **e** and **f**) Follow up at one year after radiation therapy of case in figure

LD is a large muscle on the back just below the subcutaneous tissue. The flap is based on the Thoracodorsal artery and vein, branches of the subscapular vessels. The vessel divides into a descending and transverse branch within the substance of the muscle and gives numerous perforator branches to the overlying fat, some of the larger ones reaching the dermis and supplying the skin. Any skin island located on

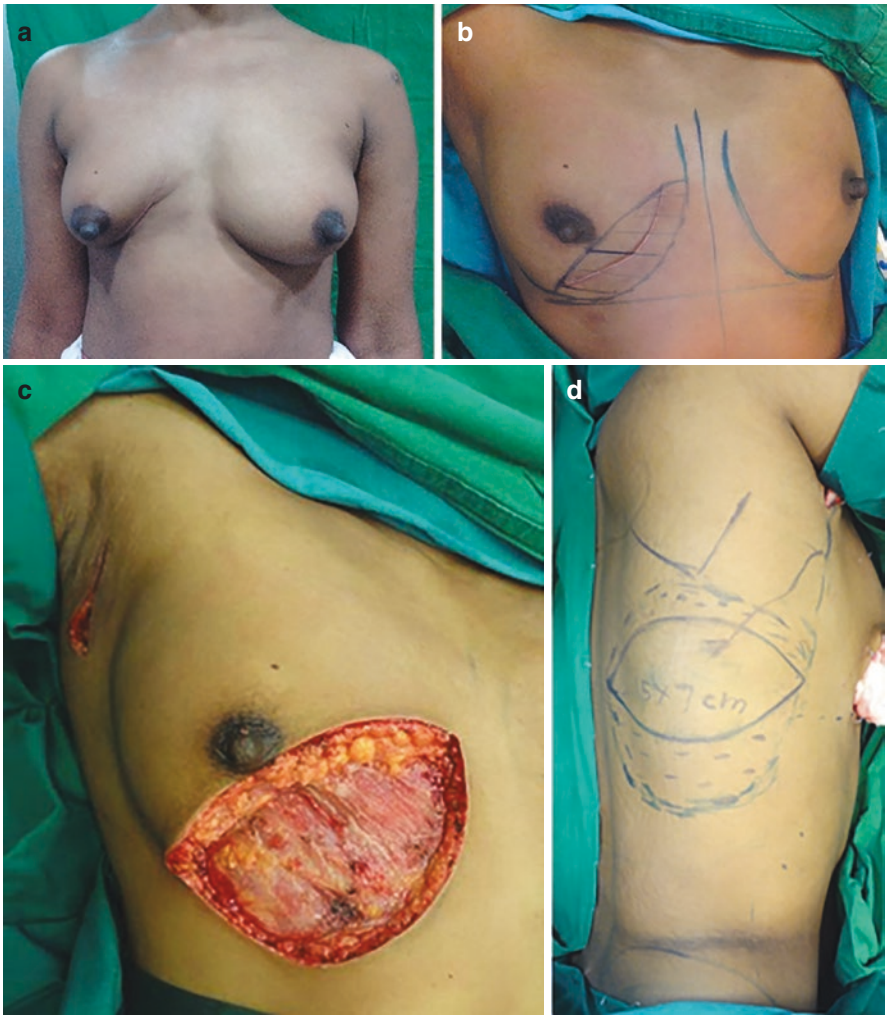

Fig. 22.18 LD myocutaneous flap for partial breast defect, (**a**) Deformed breast after excision, (**b**) Further scar revision required for margins, (**c**) Defect in lower inner quadrant, (**d**) Marking of the LD flap with intended fat harvest, (**e**) Harvested flap, (**f**) Flap rotated anteriroly into the defect, (**g**) LD flap skin island sutured in to defect, (**h**) Follow up

Fig. 22.18 (continued)

the muscle can be presumed to be safe vascularity wise, especially on the proximal two third of the muscle.

The transverse skin island at the level of the inframammary fold is the most used and gives the most concealed scar in Indian clothing. Only as much flap as needed should be harvested to limit donor site morbidity, most common being pain, persistent seroma formation and rarely dehiscence of suture line.

Fig. 22.19 LD flap reaches anywhere in the breast, (**a**) Inner quadrant, (**b**) Central quadrant, (**c**) Total flap deepithelised and buried for outer and central quadrant

The LD flap can reliably reach any quadrant of the breast safely Fig. 22.19. Cutting the tendinous insertion of LD into the humerus and ligating serratus muscle and chest wall branches gives extra length of the pedicle, allowing further reach and greater liberties in inset and contouring.

The vascular anatomy and innervation allow certain muscle preserving approaches. Segmental LD flap can be harvested based on one of the branches, preserving the innervation of the remnant muscle.

TDAP (Thoracodorsal Artery Perforator) Flap Can be harvested where the entire LD muscle and its innervation is spared, harvesting only the skin and fat as per requirement [32] Fig. 22.20. The vascularity of the remaining LD muscle is maintained by secondary segmental pedicles i.e., paraspinal and intercostal perforators. This offers a thinner flap of robust vascularity, amenable to contouring in all three dimensions with the muscle preserved and functional, reach is variable but the flap generally feasible for outer and central quadrant defects. It can also be used as a dermo-glandular turnover flap for peripheral outer quadrant defects with no skin requirement.

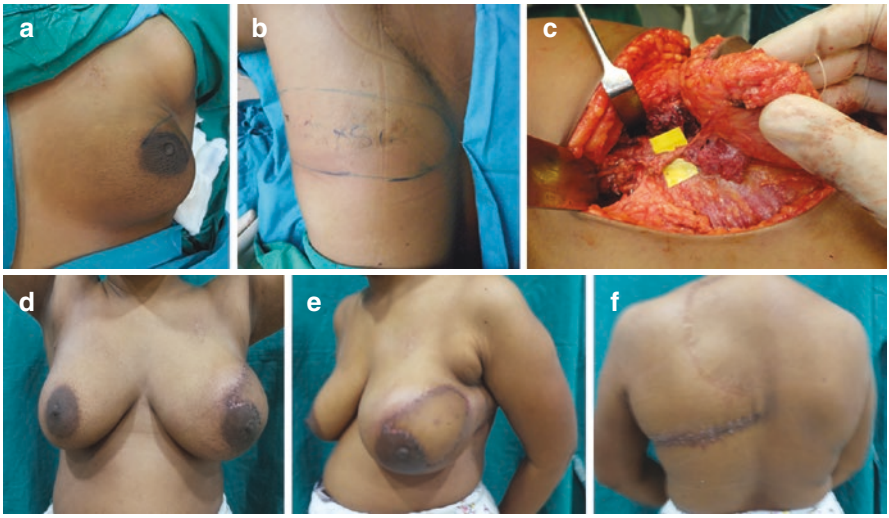

Fig. 22.20 TDAP flap for UOQ defect in a case of previous spinal surgery requiring LD muscle function for using crutches, (**a**) Recurrent IDC with scar, (**b**) Flap planned guided by the doppler signal, (**c**) Perforator dissected sparing the nerves, (**d**) Healed donor site, (**e** and **f**) Follow up

22.6.2 Other Perforator-Based Flaps: SEAP/LTAP/AICAP/LICAP

Some local perforator flaps are now popular [33]. Most of used variants of these are not true islanded perforator flaps but dermo glandular or glandular turnover, VY advancement or transposition flaps based on the supply of the perforators. The ones generally suitable for outer upper and outer lower quadrant are TDAP, LICAP (Lateral Intercostal Artery Perforator flap) and LTAP (Lateral Thoracic Artery Perforator flap), for lower inner quadrant SEAP (Superior Epigastric Artery Perforator flap) and AICAP (Anterior Intercostal Artery Perforator flap) for lower central and outer quadrant defects Figs. 22.21, 22.22 and 22.23. Most of these flaps do well when performed for defects at the edge of the breast mound, no skin replacement and only filler is needed. However, use of magnification becomes necessary while harvesting these true islanded perforator-based flaps and an initial learning curve may be steep.

22.7 Just Cover Needed

At least 30% patients in India present with locally advanced tumours where large skin resection is indicated. In some patients after mastectomy, primary closure of skin is not possible. A robust skin cover is still desired to ensure timely delivery of radiotherapy with a stable wound peri RT. In these patients, following options can be utilised depending on the donor site expendability and microvascular expertise available.

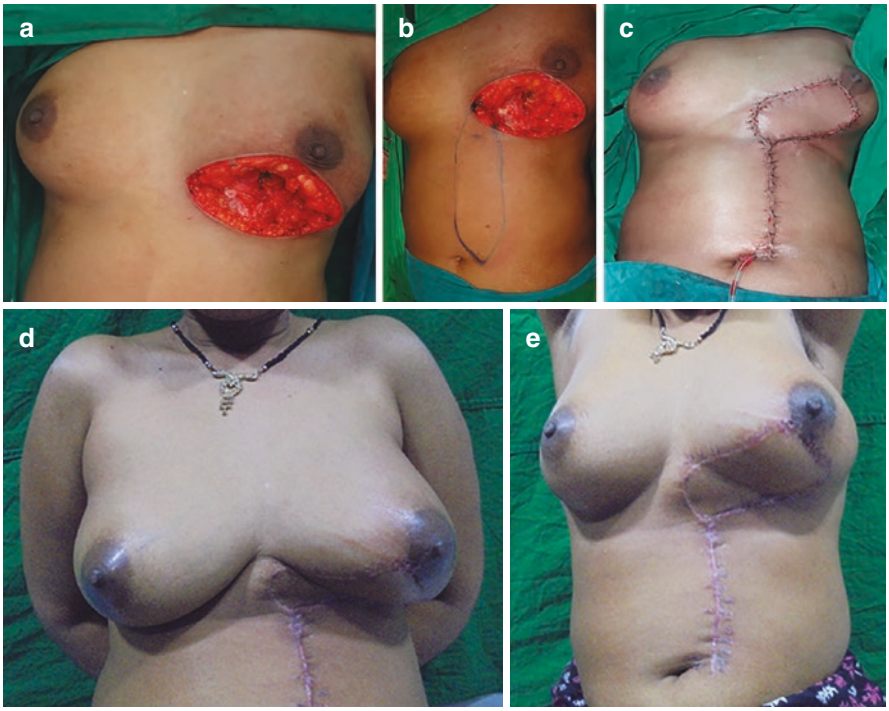

Fig. 22.21 SEAP flap, (**a**) Lower inner quadrant defect with injured LD pedicle (clock wise), (**b**) Flap planned around a robust audio Doppler signal and perforator visualisation from the defect, (**c**) flap harvested, inset with donor site primary closure, (**d** and **e**) Follow up after radiation

1. Latissimus Dorsi flap with a skin island. When a large skin island is needed the donor site might not close primarily and skin graft to the back might be needed Fig. 22.24. Large skin grafts to the back are troublesome to manage postoperatively. Only LD muscle with skin graft can also be utilised in rare cases where post-mastectomy radiation therapy is not indicated.
2. Free Anterolateral Thigh (ALT) flap offers an excellent donor site when large amounts of tissue are needed, up to half the circumference of the thigh can be harvested in the full length.
3. Pedicle TRAM, VRAM or free DIEP can also be utilised to cover these defects, especially when abdomen is not very thick but very pliable, allowing easy donor site closure.

22.8 Nipple-Areola Reconstruction

There is a plethora of local flap designs described for the reconstruction of the nipple. Most of them suffer from loss of volume with time especially when reconstruction is done from breast tissue or abdominal skin of the flap with low dermis content.

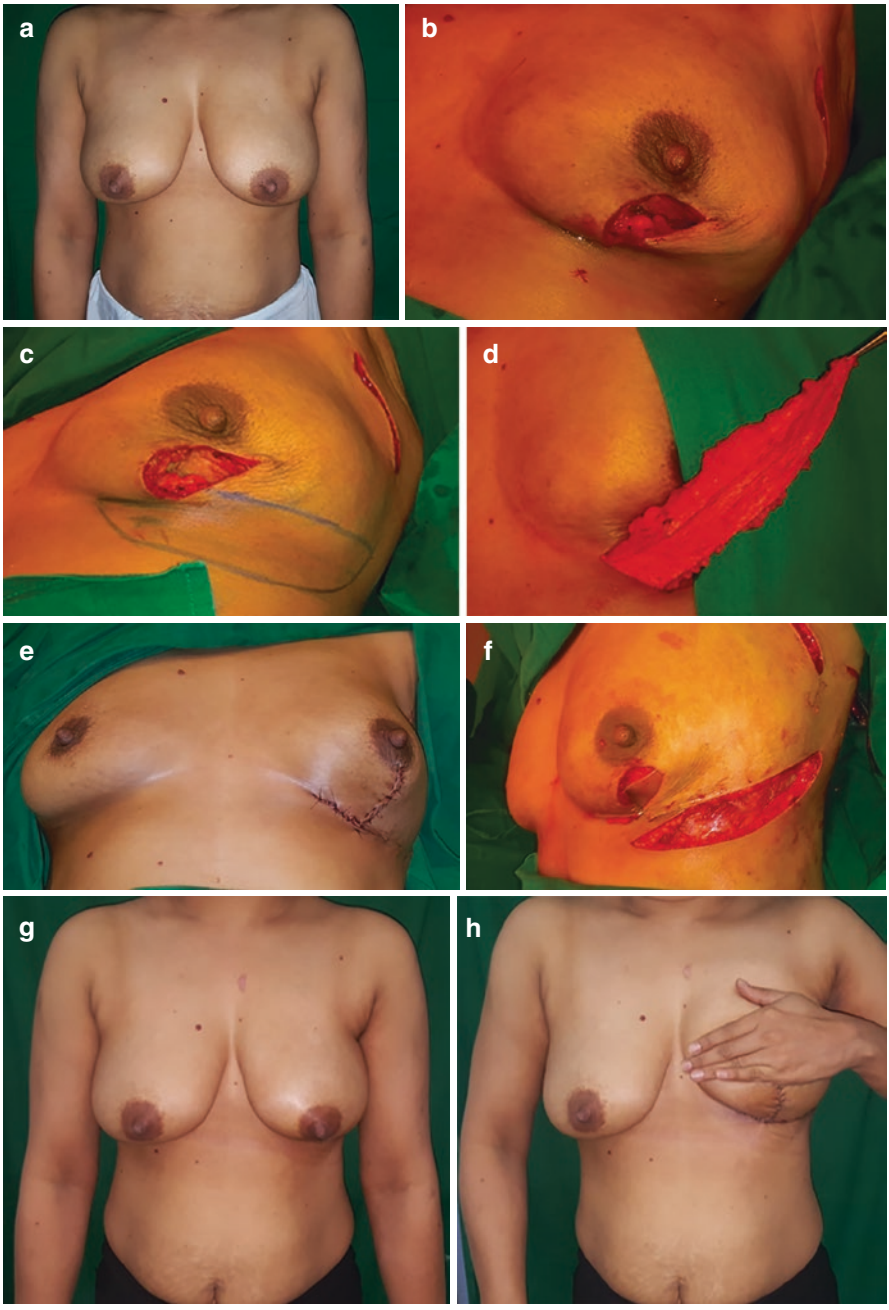

Fig. 22.22 AICAP flap (Anterior Intercostal artery perforator flap) (**a**) Preoperative, (**b**) Defect in lower central quadrant, (**c**) flap marked around doppler signal, (**d**) flap elevated and deepithelised, (**e**) flap moved in place, (**f**) flap sutured in place and skin closure, (**g** and **h**) post operative

Fig. 22.23 Transposition flap for outer quadrant defect, (**a**) Outer quadrant defect with flap marking, (**b**) Transposition flap elevated and rotated, (**c**) Flap sutured in position and donor site closed, (**d** and **e**) Follow up images front and lateral views. Case courtesy, Dr. Shalaka Joshi Professor, Breast Services, Tata Memorial Centre, Mumbai

Even with use of dermis or cartilage fillers with flaps for nipple volume, long term results are not encouraging. LD flap with thick dorsal skin with higher dermal thickness does better in terms volume retention of the nipple. Authors recommend a simple modified C-V flap design to reconstruct the nipple [34] Fig. 22.25.

Nipple reconstruction can also be done by a nipple sharing procedure. Part of the opposite nipple, if large enough, is harvested in full thickness and grafted on the breast mound.

Fig. 22.24 LD Myocutaneous flap for chest wall coverage (clockwise), (**a**) Recurrent carcinoma breast after surgery and radiation, (**b**) Skin defect after excision, (**c**) LD myocutaneous flap after inset

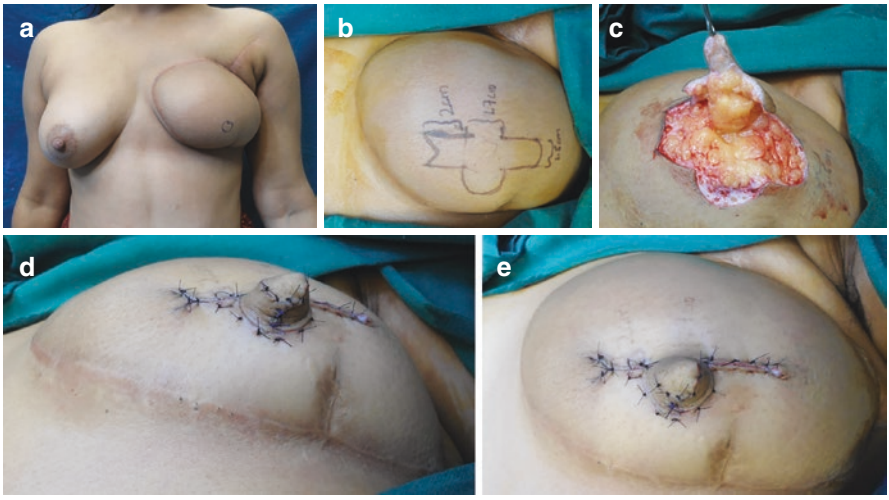

Fig. 22.25 Nipple reconstruction with CV flap (clock wise), (**a**) Nipple marking in standing position, (**b**) Markings of the CV flap, (**c**) Elevated flap, note fat in the centre of the flap, (**d** and **e**) the three flaps, two wings and lid sutured in position

Areola reconstruction can be done with grafting of opposite areola if a symmetrising procedure is done on the opposite side or grafting skin of darker matching complexion from medial thigh or the labia. Tattooing of the areola produces excellent results in good hands, even an illusion of nipple can be created by good expert tattoo artist. Some patients opt for an artistic tattoo instead of NAC to camouflage the deficit!

22.9 Radiation and Breast Reconstruction

Radiotherapy is an integral part of Breast Conservative Therapy (BCT). With mastectomy too, radiation is often required depending on tumour size, skin involvement and nodal status. Radiation affects the reconstructed and the conserved part of the breast. The changes might range from minimal skin colour and texture changes to extremes of volume loss, a stony hard breast, wound dehiscence, and very rarely, osteoradionecrosis of ribs. The severity of manifestations is dependent on the vascularity of the conserved and reconstructed element of breast, radiotherapy dosage and technique employed and individual patient susceptibility. The skin can get hyperpigmented, develop a leathery texture and contract to a variable degree. The parenchyma and fat of breast can have ischemic changes rarely progressing to necrosis manifesting as discharging sinuses, abscess, or firm to stony texture of 'fat necrosis'. Any shortcoming in the vascularity of the fat and parenchyma of reconstructed and conserved breast often confounds and amplifies the ill effects of radiation. From a decision-making point of view, flap or procedure choices must be made which are based on robust vascularity, 'highly unlikely to have a problem' taking precedence over 'might just work'. Modern methods of radiotherapy delivery and hypo fractionated regimens combined with predictability in reconstruction aided by a preoperative imaging and a wide array of donor sites have resulted in freeing reconstructive choices from the fear of radiation to a large extent.

Secondary breast reconstruction in a radiated field can also be safely done. The extra skin requirement and radiated vessels sometimes pose a technical challenge but are rarely a deterrent. Once a reconstruction has been successfully done the results are stable and predictable over the long term, as there is no further radiation.

Breast implant-based reconstruction and radiation have a way more troubled relationship. Robust envelopes of breast skin, muscle or a flap need to be preserved or reconstructed to protect the implants. The long-term complications especially capsular contracture is much higher.

22.10 Indian Perspective on Breast Reconstruction

In the authors' experience, breast reconstruction in India has some peculiar challenges. Breast cancer has now surpassed cancer of the cervix and oral cavity squamous cell carcinoma to be the most common cancer of India [35]. Because of the middle heavy population pyramid of the country, majority of the patients presenting with breast cancer are in late 40s or early 50s unlike the West where the median age at presentation is 60. The younger patients are more likely to present with advanced

and aggressive disease necessitating mastectomy. Offering them reconstruction can substantially improve their quality of life. Reconstructive surgeons need to keep up with the pace of increasing number of breast cancer patients in urban India.

The idea that breast can be reconstructed after removal is met with surprise by few patients. The awareness about reconstruction is still low, but in the era of internet, google searches, multiple social media, and digital platforms this deficiency should be bridged in the future. The primary surgeons too often presume patients non inclination to reconstruction.

The decision of reconstruction is often taken by or is influenced by the spouse or other family members. Some patients leave the ball in the cancer or reconstructive surgeons' court. The authors recommend counselling until the patient voluntarily takes an informed decision regarding reconstruction. An unmotivated patient with unfortunate complication is a very adverse situation to be in!

In the authors experience, our patients do choose reconstruction and a symmetrising procedure too, when offered early, counselled appropriately, given some time to decide and communication is concordant between the cancer and reconstructive surgeon. They also respond best when they can interact with long term follow up cases who have undergone a similar procedure. The acceptance for autologous reconstruction and scars is also high. Cost is often the deciding factor. Surprisingly in India autologous reconstruction is often cheaper in the long term than implant-based reconstruction.

22.11 Conclusion

Breast reconstruction and oncoplastic breast surgery in the current era are desired and safe. The earliest attempts at breast reconstruction included transferring a thigh lipoma to the chest! We have evolved to a point where implants can substitute for breast tissue or tissue from a range of donor sites in the body can be harvested with minimal donor site morbidity and transferred with predictability using microvascular skills. The future might be in lipofilling or bioprinted breasts! [36]. The reconstructive surgery skill set availability, interaction and cooperation between the reconstructive and cancer surgeon are vital in delivering reconstructive services to patients. Every woman undergoing surgery for breast cancer has a right to be offered the best possible reconstruction options available and the free will to choose or refuse it. Its duty of the doctors involved to facilitate this.

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