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Oncoplastic breast-conserving surgery

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Introduction

Whilst simple wide local excision for small breast cancers is a routine operation, for anything slightly larger, many surgeons find it difficult to achieve good cosmetic outcomes, often preferring to perform a mastectomy rather than a cosmetically unacceptable breast-conserving operation. Sometimes this practice extends to bilateral mastectomy, which may be an easier way of achieving symmetry and of obtaining a good overall cosmetic result compared to unilateral reconstruction. However, oncoplastic breast-conserving surgery offers a better alternative, involving much less intervention, better cosmesis and quality of life, and less risk of complications.

What about oncological outcomes?

The randomised trials of breast-conserving surgery (BCS) versus mastectomy conducted in the 1980s are still relied on by many as the best evidence of safety of BCS and these are often quoted as showing that survival is equivalent for these two surgical options but that local recurrence is higher for BCS. And yet, modern treatment of breast cancer has increasingly little in common with that of 30–40 years ago. In particular, the advances in systemic therapy, neoadjuvant therapy, preoperative investigation and case selection have transformed our perspective on treatment algorithms and as a result, local recurrence after BCS is now a rare event.

More recent observational studies have shown better survival for breast-conserving therapy. In a study from the Netherlands Cancer Registry, which included all patients diagnosed with cancer from 1989 forward, and compared 10-year overall survival rates for 37 207 patients after either breast-conserving therapy or mastectomy, women with lumpectomy and radiation did better regardless of stage at diagnosis, with 20% increased overall survival compared to mastectomy. In addition, observational studies on BCS after neoadjuvant therapy for cancers previously thought to be too large for breast conservation show that the local recurrence in this group is lower than the group selected for mastectomy[1,2] (for further discussion see Chapter 7).

Selection bias and radiotherapy administration are likely to partly explain these results. However, this merely reflects that in modern practice there is much to influence the selection of the most appropriate treatment for the patient. A mastectomy is recommended for certain indications such as extensive disease, genetic predisposition and failure of a patient with a large cancer to respond to neoadjuvant therapy. If these factors are not present, then the choice between mastectomy and breast conservation is not an equal one; it favours breast conservation.

However, there is little to be achieved by performing a breast-conserving operation that results in a poor aesthetic outcome. Extending the option of breast conservation, with its benefits, to all women who do not need a mastectomy requires a skill set in the techniques of oncoplastic BCS.

Oncoplastic BCS also aims to achieve clear margins of excision at one operation. It does this by allowing larger excisions to be taken with

no cosmetic penalty. This contrasts with simple techniques of BCS that rely on small excisions as the main strategy to achieve minimal impact on cosmesis. Such surgery results in a second therapeutic operation rate of 20–25%. The rate is higher (30%) for DCIS.[3,4] Oncoplastic surgery aims to reduce this to less than 10%.[5]

Selection of cases for oncoplastic breast-conserving surgery

It can easily be argued that all breast surgery should be sympathetic to oncoplastic principles. For oncoplastic BCS specifically, there are some women who are likely to benefit more than others, such as:[6]

- Those with large tumour:breast ratios
  - >5–10% superiorly, medially or inferiorly
  - >10–20% laterally
- Those who are at risk of margin involvement
  - DCIS – with or without invasive disease
  - Invasive lobular cancer
  - Women of young age
  - Large tumour size
- Those who are at high risk of a poor outcome with mastectomy and reconstruction because of:
  - Need for radiotherapy after mastectomy
  - Large body mass index (BMI)
  - Need for axillary node clearance
  - No good or acceptable reconstructive option.

Causes of deformity after breast-conserving surgery

All surgery to the breast parenchyma causes scarring and, to some extent, fat necrosis, which occurs when fat and parenchymal tissue is traumatised or loses adequate blood supply and results in scarring and contraction. Most deformity in BCS is caused by collapse and contraction of the excision cavity and/or inappropriate skin removal and/or poor scar placement or orientation. Radiotherapy, by inducing fibrosis, usually compounds the effects of surgery, and a radiotherapy boost will compound this further. A contracting excision defect will have different effects on cosmesis in different breasts and in different locations within the breast. This will also vary by the size of the defect, mobility and quality of surrounding parenchymal tissue, and elasticity of the skin. Hence an inferior pole excision risks collapse and scarring of the lower pole, pulling down of the nipple and a classic 'polybeak' deformity. Likewise, a superior cavity will pull the nipple upwards and a lateral cavity will pull it laterally. Incision scars tend to contract along their length and can accentuate these deformities if not orientated correctly. Hence, a transverse scar placed inferiorly, below the nipple will result in further contraction of the lower pole of the breast and more 'beaking' of the nipple, and transverse lateral scars will tend to cause more lateral nipple deviation.

The high-risk areas prone to deformity are those that do not have adequate local tissue to compensate for a collapsing cavity without significant local effect. The breast has considerably more mobility and volume in the lateral half of the breast compared to the medial half. It is for this reason lateral tumour excisions are better tolerated. By contrast, superior and medial locations often have little mobility and are high-risk areas for deformity even if only 5–10% of the breast is removed.[7] Central and inferior excisions are also high-risk for deformity because of significant nipple–areolar complex (NAC) deformity or the dynamics of the polybeak deformity in lower pole tumours.

Other factors are size of the excision in relation to the size of the breast and the quality of the breast tissue. Very glandular, elastic breast tissue will not collapse easily, and is very tolerant of mobilisation, while very fatty breast tissue is more prone to fat necrosis and scarring and is not suitable for mobilisation. Glandular density can be evaluated both clinically and radiographically. Although mammographic evaluation gives a strong indication of what quality of tissue is likely to be found at surgery, clinical assessment both pre- and intraoperatively is essential. Breast density predicts the amount of fat in the breast and determines the ability to perform extensive breast undermining and reshaping without complications, and when it should be avoided. Mammographic breast density can be classified into four categories based on the Breast Imaging Reporting and Data System (BI-RADS). The four categories comprise: (1) fatty; (2) scattered fibroglandular; (3) heterogeneously dense; or (4) extremely dense breast tissue.[8] These categories loosely translate into surgically relevant categories. A dense glandular breast (BI-RADS 3/4) is more forgiving and can be mobilised easily with undermining and advancement of breast tissue into the excision cavity without risk of necrosis. Some oncoplastic techniques described in Asian women, for instance, are only possible because of the dense nature of such breasts. Low-density breast tissue with a major fatty component (BI-RADS 1/2) has a much higher risk of fat necrosis if extensive undermining is performed. Undermining such a breast from both the skin and pectoralis fascia can result in large volume fat necrosis with resulting deformity.

Oncoplastic techniques in breast-conserving surgery

There are both simple and complex oncoplastic techniques. Which to use will depend principally on patient factors and the degree to which a surgeon is comfortable with the technical skills required. As a range of options exists, the adage that 'the best technique is the one the surgeon is best at', probably does hold true and the advantages of oncoplastic surgery will be lost if the technical parts of the operation are not executed well. Surgeons should therefore be aware of the options available, offer those within their ability, learn techniques that can extend their practice, and recognise indications to refer to those with more expertise or work in conjunction with surgeons that offer additional skills.

Broadly, oncoplastic procedures can be divided into those that require basic tissue handling skills and follow a simple template, and those that are more creative and require expertise in cosmetic surgery techniques and flaps. Both approaches can significantly extend the role and outcome of BCS and surgeons do not need to be able to perform all, but should aspire to be competent in as many techniques as possible. In a similar vein, oncoplastic techniques are often referred to as Level I or II procedures, as has been championed by Clough.[9] Level I procedures have been described as those that allow up to 20% of breast volume to be excised, especially in the lateral breast. Level II covers more complex mammaplasty procedures, and within this category we would also include volume-replacement techniques.

In practice, there are a spectrum of techniques that can be employed and there is an overlap in the indications. For instance, is an upper pole tumour in a moderate breast with slight ptosis better treated with simple skin undermining, a round block rotation or a therapeutic mammaplasty? Of course, the answer depends on breast morphology, parenchymal type, patient preference and surgical expertise. In different surgeons' hands it may be any of the above options. The philosophy of 'keeping it simple' in terms of applying simple or Level I techniques to the majority (85–90%) of cancers is appealing and makes sense. However, a more technically demanding procedure may often be less disruptive, and incur a much smaller risk of fat necrosis, deformity or requirement for further surgery. Whatever is offered, the procedure should be low risk, and performed (patient factors permitting) as a day case procedure.

Important principles of oncoplastic BCS include the following:

- Maintain breast form and shape – sometimes keeping a normal-looking breast on the cancer side may be at the expense of overall symmetry.
- Perform the simplest procedure that gives an acceptable result.
- Only perform techniques within your own skill set.
- Do not compromise on the wide local excision to facilitate better cosmesis.
- Choose safety over perfect cosmesis – for some women a safer procedure that means accepting a small deformity, asymmetry or less than perfect appearance is still a much better option than the alternatives.
- Aim for all necessary surgery to be completed at one operation (including symmetrisation if required).

Volume displacement or replacement?

Confining surgery to within the breast is usually easier. It limits all scars to the breast and avoids donor site problems. As such, volume displacement should usually be considered as the default choice. Volume replacement surgery is predominantly indicated in the smaller non-ptotic breast.

Volume displacement

In escalating degree of technical complexity, volume displacement procedures can be classified as follows:

- simple parenchymal advancement into a defect;
- round block;
- round block with nipple centralisation (tennis racket);
- therapeutic mastopexy;
- therapeutic reduction mammaplasty.

Within these categories there are many variations. Simple parenchymal advancement is usually appropriate for small cancers and the main oncoplastic consideration is the site and orientation of the incision. Round block techniques are usually used as simplified alternatives to a mastopexy or mammaplasty and represent a very safe and useful approach for surgeons less familiar with the techniques of the latter. The indications and techniques of each are described in more detail below.

Volume replacement

In escalating degree of technical complexity, volume displacement procedures can be classified as follows:

- lateral intercostal artery perforator (LICAP)/ lateral thoracic artery perforator (LTAP) flap;
- latissimus dorsi (LD) miniflap;
- thoracodorsal artery perforator (TAP) flap;
- free flap.

Within these categories there are many variations. Each of these techniques has an indication. However, the emphasis of volume replacement should be to minimise the risk of donor site problems and, ideally, not compromise an option that may be useful as a method of total breast reconstruction should this be required. Again, the indications and techniques of each are described in more detail below. Immediate lipofilling or lipomodelling is an evolving technique in the volume replacement category (see Chapter 7).

Timing of oncoplastic breast surgery

In general, it is far better to avoid deformity rather than try to correct later. Oncoplastic procedures should therefore be planned and performed at the same time as the primary breast cancer surgery. Exceptions to this may be in volume replacement techniques using thoracodorsal pedicles or possibly free flaps, when achieving certainty of clear margins may be sensible before committing to that option.

With regards to the timing of any contralateral symmetrising surgery that is planned, it is usually more appropriate to do the symmetrisation immediately. Delayed symmetrisation is not easier or more likely to achieve better symmetry and leaving patients asymmetrical even for a short time is not necessary.

Basic techniques in breast-conserving surgery

In most simple BCS cases, minimising the cavity size will maximise outcome. It is for this reason cancer excisions should be planned accurately with appropriate width of clear margins and avoidance of unnecessary tissue excision, whilst not compromising on excising what is necessary. Releasing the breast in the subcutaneous plane from the skin will increase parenchymal mobility and allow the tissue to 'fall' into the tumour cavity. The other option is to release parenchymal tissue from the chest wall. Ultimate freedom is created by doing both. However, parenchymal flaps released from both the skin and chest wall are at higher risk of fat necrosis, especially in the fatty breast. Although not always feasible, moving breast tissue is best done when it is left attached to either the chest wall or the skin (this can include de-epithelialised skin). However, excessive undermining will produce internal scarring and some fat necrosis and there comes a point at which more formal oncoplastic techniques become indicated.

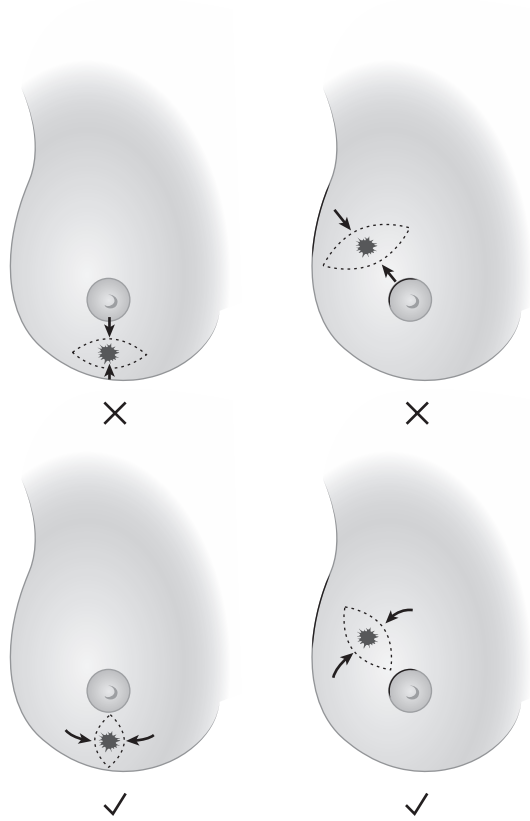

Figure 8.1 • Concept of radial parenchymal closure around the NAC. The dotted lines represent incisions in the parenchyma and the arrows the direction of parenchymal closures.

As a principle, it is important to encourage the tumour cavity to collapse in a planned orientation to minimise deformity. Usually the cavity should be designed to collapse in a radial direction around the NAC (**Fig. 8.1**). For example, in the inferior pole the cavity should collapse in a vertical orientation and a 9 o'clock tumour in a horizontal direction. This principle will minimise NAC movement and any skin or parenchymal undermining should be done to encourage this.

Round block and tennis racket techniques

The round block mammaplasty was originally described by Benelli.[9] The procedure starts by making two concentric periareolar incisions, followed by de-epithelialisation of the intervening skin. The outer edge of de-epithelialised skin is incised and the entire skin envelope can then be undermined to allow access to the tumour. The NAC remains vascularised through its posterior glandular base. Resection of the lesion from the

subcutaneous tissue down to the pectoralis fascia is performed. The breast flaps are then mobilised off the pectoralis fascia and advanced towards each other to eliminate the excision defect. The outer skin incision is then purse-stringed and the two skin incisions then approximated, resulting in a circumareolar scar.

Clough describes six steps for level I oncoplastic surgery that begin with the skin incision (1) followed by undermining of the skin (2) and NAC (3).[10] After completion of undermining, a full-thickness glandular excision incorporating the cancer and a surrounding rim of normal breast tissue is performed from subcutaneous fat down to pectoralis fascia (4). The glandular defect is subsequently closed, following specimen X-ray to demonstrate complete radiological excision, with tissue re-approximation (5). If required, an area in the shape of a crescent bordering the areola is de-epithelialised to reposition the NAC (6). If this is not performed the NAC often displaces towards the site of excision. (See **Figs 8.2** and **8.3**.)

Incisions

An oncoplastic approach includes choosing an appropriate scar position and orientation. Good principles of scar healing include placing them where possible along the lines of skin tension (see Chapter 7 on breast-conserving surgery) and minimising tension of closure. Shorter scars are not always less visible or a particularly good strategy to achieve good cosmesis and many oncoplastic procedures produce long scars to achieve both tumour excision and breast reshaping.

Dynamic tension lines over the breast vary according to breast shape (particularly the degree of ptosis) and skin elasticity (usually related to age). In general, scars concentric to the NAC rarely follow tension lines other than in firm, non-glandular breasts. By contrast, tension lines are often orientated towards the NAC in the lateral and medial parts of the breast, and in the upper and lower part of the breast tension lines are usually transverse. Placing incisions in tension lines facilitates good healing and hence a good cosmetic appearance. However, in the lower pole of the breast, vertical incisions, which may be perpendicular to tension lines, heal very well because the dynamic forces on the resulting scar (weight of the breast) act along its length (**Fig. 8.4**).

Whilst poor incision placement can compound the forces that produce deformity after BCS, good incision placement will only aid cosmesis if the underlying breast excision is closed appropriately and this is usually in a radial direction around the NAC. It is often useful to place a tension line incision a little inferior to the tumour and close the defect above it. Thus, the incision is well supported by underlying tissue, rather than being affected by a healing and contracting cavity. The only reason to place an incision directly over a cancer is if skin is to be removed over it, which is only necessary if it is directly involved. Skin closure should be layered with everting deep dermal sutures, anticipating that the scar will tend to invert.

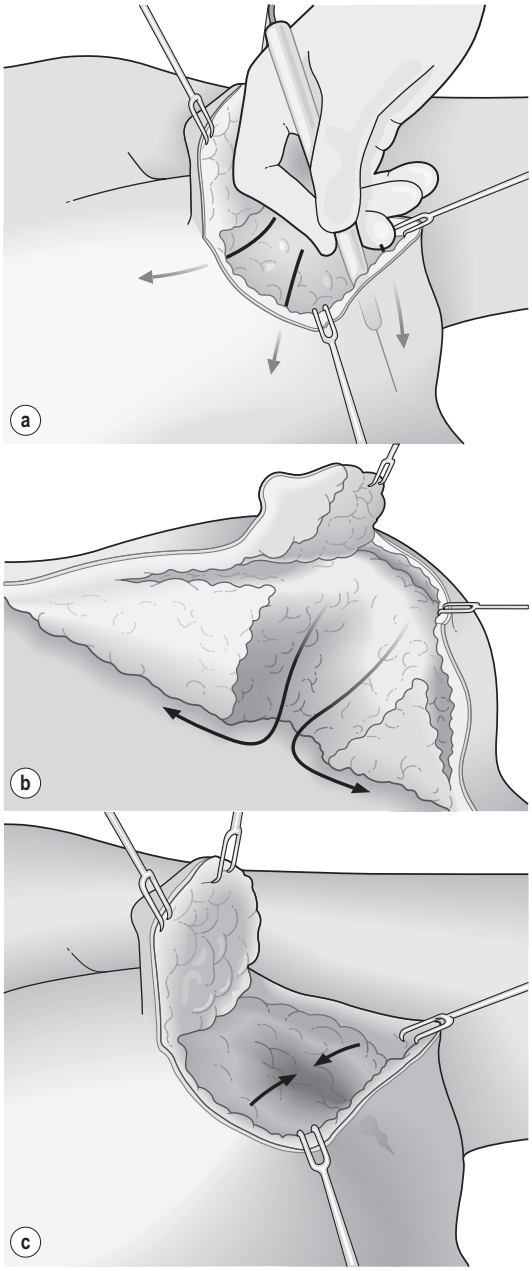

Figure 8.2 • Level I oncoplastic techniques: skin and NAC undermining (Clough). **(a)** Extensive skin undermining. **(b)** Wide excision from subcutaneous fat to muscle, then NAC undermining. **(c)** Glandular flap re-approximation.

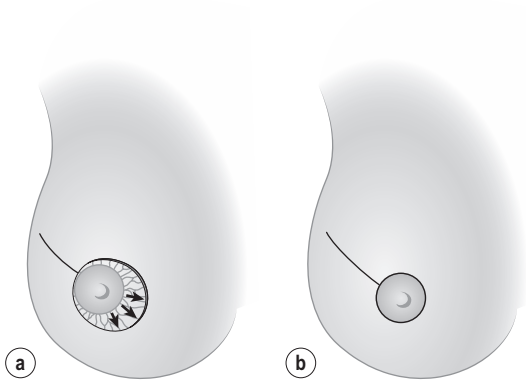

Figure 8.3 • Level I oncoplastic techniques (Clough). Centralisation of the NAC will offset some of the contraction towards the tumour cavity.

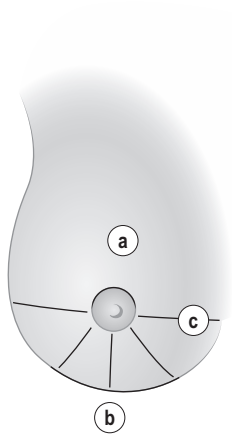

Figure 8.4 • Scars can be independent of the direction of parenchymal closure. Periareolar incisions **(a)** can access most of the breast but are better used for access to the upper half of the breast. Intramammary fold incisions **(b)** can be used for tumours close to these sites. **(c)** Radial incisions will cause less deformity.

Periareolar scars usually give good access to much of the upper half of the breast and are the standard approach in round block techniques. Again, there is a balance between excessive undermining and using a simple tension line incision just below the tumour or a different oncoplastic approach.

Direct oncoplastic excisions with centralisation of NAC

Direct excisions (en bloc skin and wide local excision) are helpful in that they minimise undermining and mobilisation of breast tissue. As such, they require less expertise in mammaplasty surgery. For surgeons without such knowledge these are lower-risk procedures and, to a degree, very

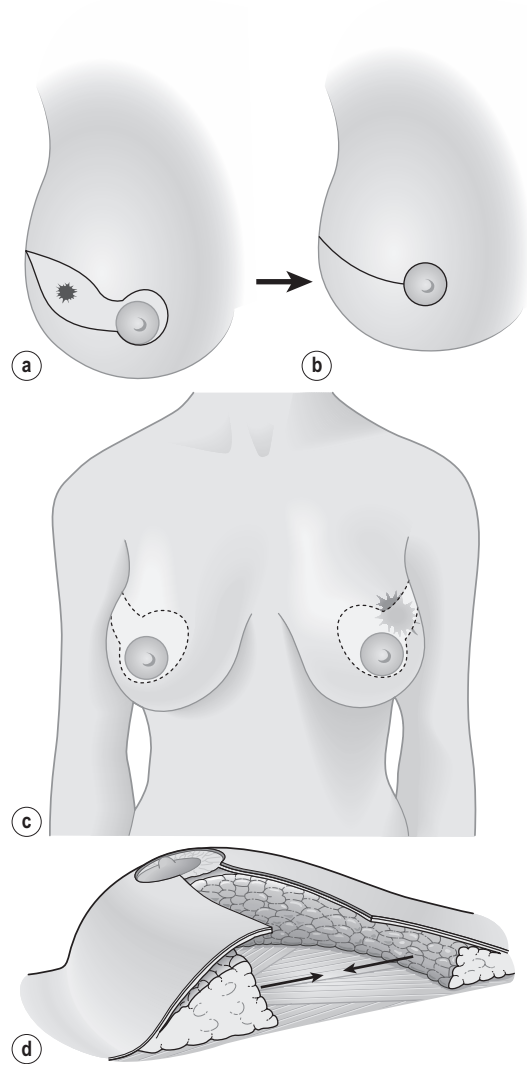

Figure 8.5 • **(a)** and **(b)** 'Tennis racket' mammaplasty **(c)** Tennis racket technique for upper outer quadrant cancer with symmetrising procedure **(d)** Mobilised breast tissue is brought together to close defect. Skin crease incisions work well in the upper outer quadrant.

reproducible. Sometimes referred to as 'tennis racket techniques', they allow closure of the tumour cavity radial to the nipple and centralisation of the NAC position (Fig. 8.5). As such, they achieve many of the oncoplastic principles of reducing the negative impact of BCS. The main reason for excision over the tumour is to simplify the technique, although occasionally it is oncologically indicated. After wide excision, the reshaping is performed by mobilising the glandular tissue either side of the defect into the cavity and suturing it together. The NAC is then centralised with de-epithelialisation to the required location. The disadvantage of this approach is that up to half of the volume of excision may be skin and

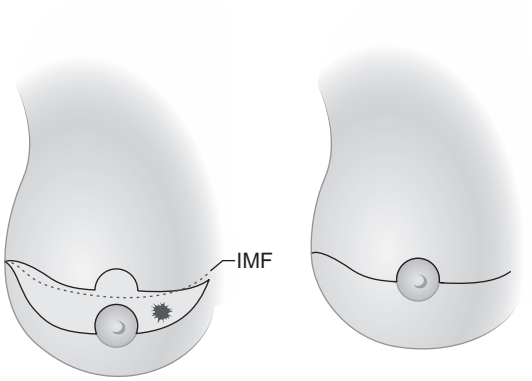

Figure 8.6 • Batwing mammaplasty. IMF, position of the inframammary fold.

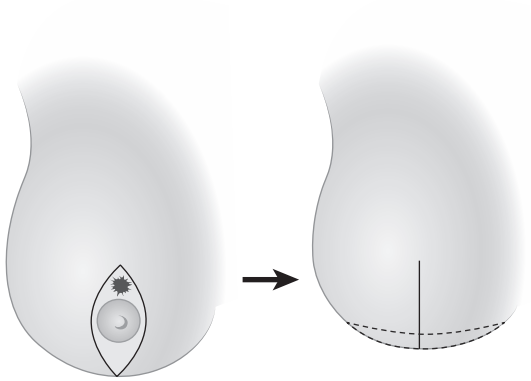

Figure 8.7 • Direct vertical ellipse removing the NAC may be combined with a lower wedge to convert to an inverted T incision. This limits the length of the vertical incision.

subcutaneous fat and this volume would not need to be excised if a remote scar is used. Alternatively, complete detachment of the retroareolar gland from the NAC enables the central part of the gland to be available for volume redistribution without compromise of NAC vascularity. Once the defect is eliminated, the NAC is placed in its optimal position, at the centre of the new breast mound. Such techniques are also helpful in all patients at higher risk of fat necrosis – smokers, diabetics, consideration in obese patients.

Another direct excision option is the 'batwing mammaplasty', as described by Silverstein[11] (see Fig. 8.6). This allows similar principles to be applied for tumours above the NAC or in a lateral or medial location. Although this can elevate the nipple it does not address the main issue in larger breasts with ptosis, namely the excess skin below the nipple and the large areola to inframammary fold distance.

Direct oncoplastic excisions with removal of NAC

Direct ellipses excisions

These can be orientated in transverse or vertical orientations depending upon cancer position and breast shape (Fig. 8.7). They include the NAC and are used in high-risk cases, tumours involving the NAC, and larger breasts in women who do not view keeping the NAC as important. They are very simple and safe forms of breast reduction. A horizontal ellipse will flatten the breast in comparison to a lower pole vertical ellipse, which will minimise any flattening and even can produce breast projection.

With larger breasts, a horizontal 'melon slice' ellipse allows considerable volume reduction as well as access to any part of the breast. The superior ellipse line should be at or just below the projected inframammary fold position. The upper ellipse should remove more skin and tissue laterally to reduce the lateral volume of the breast (Fig. 8.8). Alternatively, a Wise pattern reduction without an NAC pedicle can be performed and is a very safe and simple procedure. This inverted T 'wedge mammaplasty' is marked in a very similar manner to a standard mammaplasty (see below) (Fig. 8.9).

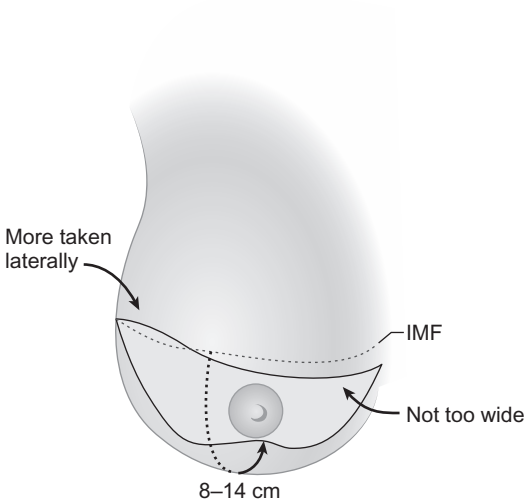

Figure 8.8 • Markings of the melon slice mammaplasty. IMF, position of the inframammary fold.

Therapeutic mammaplasty

A formal mammaplasty technique is useful in breasts that have some degree of ptosis, regardless of overall breast size.[12] The scars are usually placed in traditional Wise or vertical mammaplasty pattern. Modification to the scar design is feasible if skin overlying a cancer is required to be removed or to take into account existing scars.

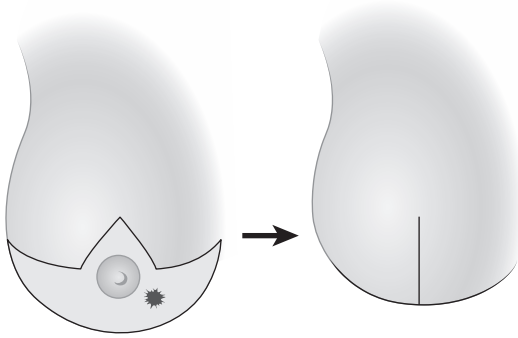

Figure 8.9 • Inverted 'T' wedge mammaplasty below removing the NAC.

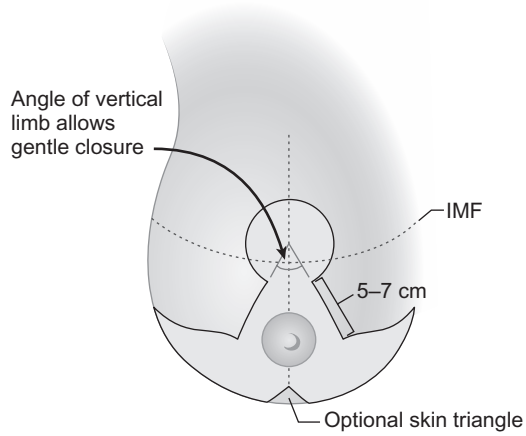

Figure 8.10 • Marking up principles for Wise pattern therapeutic reduction mammaplasty.

Therapeutic mammaplasty is usefully subdivided into:

- Therapeutic reduction mammaplasty – where an overall breast reduction is planned in combination with a wide local excision (usually using a Wise pattern).
- Therapeutic mastopexy – where usually the only volume removed is the wide local excision itself (usually using a vertical pattern).

Therapeutic reduction mammaplasty

A Wise pattern is usually indicated and gives more flexibility regarding access, pedicle options and volume reduction in the larger breast. It is vital that the markings for the mammaplasty are accurate and avoid tension on wound closure. The aim is to avoid fat necrosis and wound breakdown as these delay radiotherapy and other adjuvant treatments. It should be remembered that although the NAC is usually planned to sit at the level of the inframammary fold, siting it lower may enable shorter pedicles and make the procedure safer. Similarly, although the vertical markings are judged by the natural laxity of the breast, narrowing these slightly will reduced tension on the closure. If needed, leaving additional skin on the lower flap at the T-junction and making this a Y-junction rather than a simple T can further reduce risk (**Fig. 8.10**). Thus, although there are situations where a therapeutic reduction mammaplasty can be performed in an almost identical way to a cosmetic breast reduction, in breast cancer patients the procedure often needs to be modified to make it safe and, in so doing, the ideal cosmetic result may be a little compromised, whilst still achieving the objectives of cancer excision and volume reduction.

Therapeutic mastopexy

This commonly used procedure applies to any small/moderate-sized breast that has some degree of ptosis but does not require a large overall reduction. The scar pattern is identical to a standard vertical mastopexy but again, the planned nipple position is lowered and the width of the vertical incisions reduced in some patients to reduce risk. The procedure is essentially a breast lift that includes a wide local excision.

Techniques of therapeutic mammaplasty by site of cancer

There are a wide variety of ways in which a Wise pattern breast reduction and a vertical scar mastopexy can be modified to include a wide local excision of a breast cancer and the techniques described below are, in our opinion, some of the most reliable.

Inferior pole tumours

When a Wise pattern is used the tumour can lie in almost any inferior position and this allows easy access and cancer removal. Superior, medial or lateral pedicles can be used for the NAC (**Fig. 8.11a**). Although it is tempting to perform the procedure as an almost completely standard breast reduction, it is better to perform the (very) wide local excision initially and then complete the mammaplasty. This is because to excise the cancer completely more tissue in one area may need to be removed and so the subsequent resection of breast tissue as a part of the mammaplasty can be modified accordingly. Excisions related to the wide local excision can be orientated according to the site and position of the cancer.

A vertical skin pattern is used when the tumour is in the centre of the lower pole (**Fig. 8.11b**). A superior

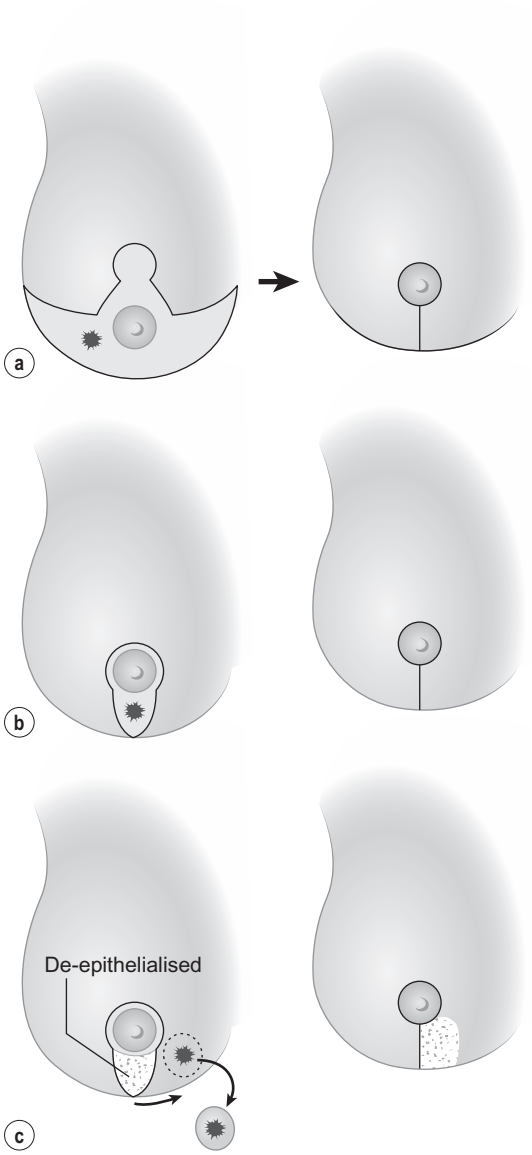

Figure 8.11 • **(a)** Standard Wise pattern mammaplasty. **(b)** Vertical pattern mammaplasty for inferior pole cancer. **(c)** Vertical pattern with dermoglandular advancement/rotation flap to fill the tumour defect.

or medial/lateral pedicle can be used for the NAC. When the tumour is off centre, the cancer excision can still be performed through vertical markings and the inferior central breast skin and underlying tissue can be de-epithelialised and advanced/rotated into the defect (**Fig. 8.11c**).

Medial and lateral tumours

Although surgery can be more difficult with medial situated tumours the principles are similar when using therapeutic reduction mammaplasty for both medial and lateral cancers. The access for tumour excision will be via the mammaplasty markings. Care should be taken when mobilising overlying skin flaps to preserve their vascularity and tension on skin closure should be avoided. Hydrodissection in the plane under the subcutaneous fat can help to ensure that the blood supply to the overlying skin is not damaged. The method of filling these defects is with a secondary parenchyma pedicle (usually inferomedial or inferolateral) or occasionally an extended NAC pedicle or a rotation parenchymal flap (**Fig. 8.12a, b**). If long pedicles are being considered to fill the defect, thought should be given to whether to use two shorter pedicles as the vascular supply to these is likely to be more predictable. Any secondary pedicle should ideally have de-epithelialised skin along its entire length to maximise safety.

In a therapeutic mastopexy, rotation of parenchymal tissue is usually the simplest and best option. Smaller breasts are very tolerant of this, particularly if they are not too fatty. For a lateral defect the breast is mobilised from the subcutaneous and pectoral fascia layers and rotated en masse into the defect. For medial defects, it is preferable to preserve breast tissue medial to the defect where possible and perform a partial breast rotation into the defect (**Fig. 8.13a, b**).

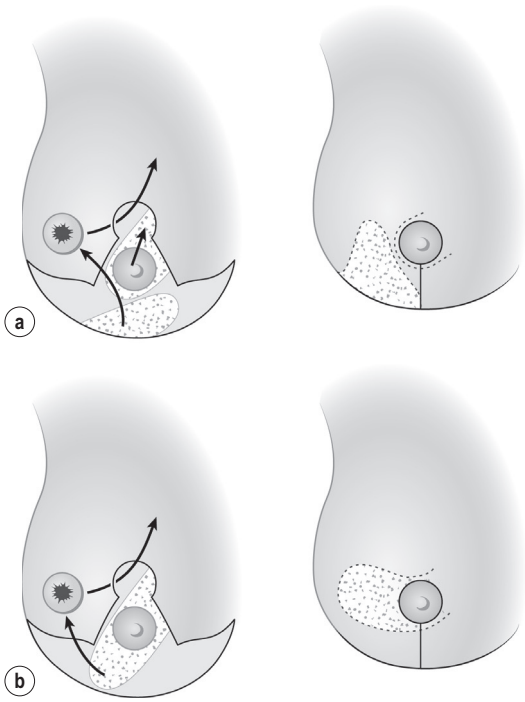

Figure 8.12 • **(a)** Secondary de-epithelialised pedicle to fill the tumour defect. **(b)** Extending the NAC pedicle to fill the tumour cavity.

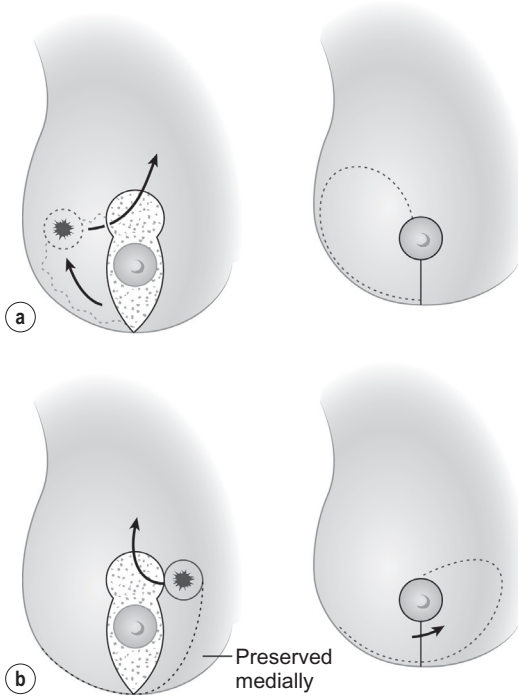

Figure 8.13 • Vertical pattern mammaplasty rotation/advancement of parenchymal tissue. **(a)** Rotation of parenchymal tissue into a lateral defect. **(b)** Preservation of tissue medial to a tumour cavity minimises disruption of the remaining breast.

Tumours in the upper pole of the breast

When performing a therapeutic reduction mammaplasty, a defect in the upper pole can usually be easily filled with an extended inferior NAC pedicle (**Fig. 8.14**). This pedicle can be made as big as required and can even include the whole central mound (Fig. 8.14a). The central mound technique can require a lot of skin dissection to free a large volume of breast and allow it to move. This larger and well-visualised amount of dissection is off-set in part by the use of a very safe a reliable pedicle.

It is often better to plan the new NAC position 1–2 cm lower in the breast containing the cancer than the non-cancer breast, as dissection in the upper pole followed by radiotherapy can result in some contraction and retraction towards the tumour site. An inferior pedicle does not have to carry the NAC and in some situations creating a small medial pedicle for the NAC allows the central tissue to be mobilised on an inferior second pedicle independently (Fig 8.14b).

Tumours involving the NAC

The main options here are vertical or inverted T wedges, as described above. In selected cases it is possible to use an inferior, medial, or lateral pedicle carrying inferior pole skin which can be advanced into the defect to both fill the defect and replace the NAC skin. A nipple reconstruction can be performed primarily on this. This shares some similarities with the Grisotti flap where inferior tissue is advanced–rotated into the defect, being carried on the lateral breast pillar or tissue.[13]

Volume replacement techniques

When the breast has little ptosis, has insufficient volume for displacement techniques or the patient does not wish to have a smaller breast or bilateral surgery, then volume replacement becomes an option. Volume replacement can use numerous techniques to fill defects in all areas of the breast. In practice, local perforator flaps are the most useful and have replaced previously used methods such as the LD miniflap.[14]

Intercostal and lateral thoracic artery perforator flaps

These are the primary default options in volume replacement, especially for laterally based tumours.[15] Intercostal perforators surround the breast base but it is those on the lateral and inferior aspects that are used for this clinical scenario (see Fig. 8.15 below). The advantage of these flaps is that they are available in all patients, and are to a degree an expendable flap as they do not use any significant flap pedicle such as the thoracodorsal pedicle. As such they can be considered for immediate volume replacement techniques and do not usually jeopardise total reconstruction options in the case of incomplete excision and positive margins. They can be raised in a range of sizes. The position of these perforators has been well documented but they are usually concentrated in the 4th to 6th intercostal spaces and are also present in the lateral lower aspect of the breast and along the inframammary fold.[16]

The lateral thoracic vessels also give off perforators as they run down the lateral aspect of the breast and these can be used to raise pedicled flaps or the vessels can augment the intercostal perforator-based flaps. Flaps based on the lateral intercostal perforators are generally limited to fill defects in the lateral half of the breast although they can be large enough to span the width of the breast, particularly in the upper half.[17]

Inferiorly based flaps reach anywhere in the lower half of the breast and can in selected cases reach the upper inner aspect of the breast.

These inferior flaps are based on anterior or medial intercostal perforators.

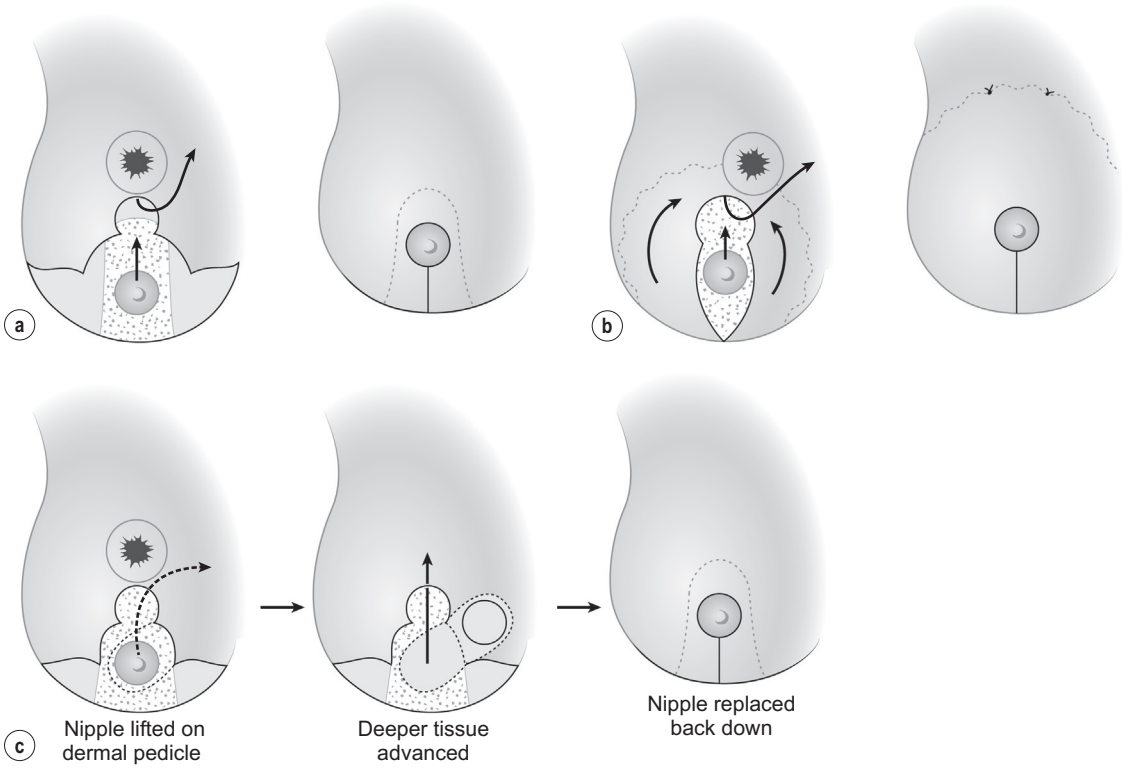

Figure 8.14 • **(a)** Wise pattern mammaplasty with an extended or bulky inferior pedicle to both carry the NAC and fill the tumour defect. **(b)** Vertical pattern mammaplasty with a central mound pedicle to carry the NAC and fill upper pole defects. **(c)** 'Trap door' or thin dermal pedicle to remove the NAC from the filling pedicle to allow free movement of the pedicle without displacement of the NAC.

Planning a LICAP or LTAP flap

This flap is based on the lateral intercostal perforators, the lateral thoracic artery perforators or a combination of the two. These are located using a hand-held 8-Mhz vascular Doppler probe and surface-marked on the skin. **Figure 8.15** shows the common areas to find the perforators. Only perforators within 2–3 cm of the lateral breast crease are of value to allow easy delivery of the flap into the breast. The planning of which perforators to use is a balance of where the tumour defect is positioned, the available perforators and the method of delivery of the flap. A flap can be delivered as a turnover flap (like turning a page on a book, **Fig. 8.16**) and is usually based on a line of perforators at the base of the flap. Alternatively, it can be rotated into a defect based usually on a single perforator (the flap is like the blade of a propeller turned around a fixed point where the perforator is located, **Fig. 8.17**). This is useful when a skin-bearing flap is required. The size of the flap is based on the requirements of the defect and the laxity of skin and subcutaneous tissue adjacent to the breast. Flaps are de-epithelialised as the subdermal plexus contributes to the vascularity of the flap. A pure subcutaneous flap does not have predictable vascularity. The dimensions and length of the flap need to be carefully assessed to allow enough reach to the defect, while not taking more tissue than is required and allowing for easy donor site closure.

The LTAP flap has the potential to be pedicled on the lateral thoracic vessels (**Fig. 8.18**). LTAP flaps are identifiable with a linear Doppler signal of the lateral thoracic vessels with enhancements for the actual perforators. However, although always present, the lateral thoracic vessels are more variable in their course and require to be confirmed at open surgery.

Flap dissection

The patient can be positioned on her back, her side or somewhere between depending upon the size of the flap to be raised. An incision based on the lateral curvature of the breast will usually allow access to the tumour bed and the axilla. Care is taken to try

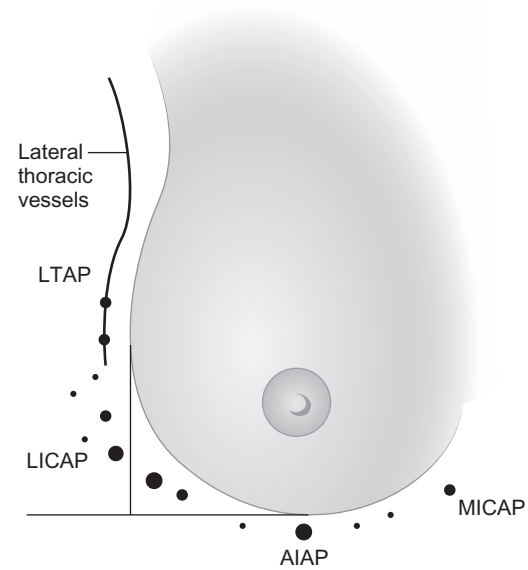

Figure 8.15 • Lateral and inferior perforators surrounding the breast: lateral thoracic artery perforators (LTAP), lateral intercostal artery perforators (LICAP), anterior intercostal artery perforators (AIAP), medial intercostal artery perforator (MICAP).

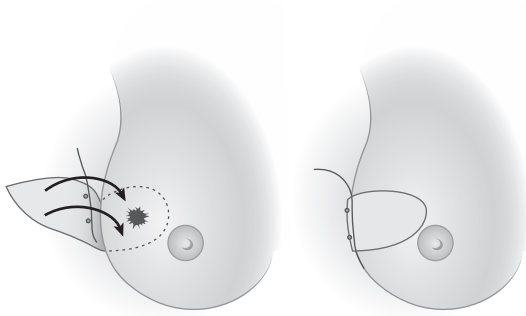

Figure 8.16 • LICAP/LTAP flap as a turnover flap into the defect based on a line or 'mesentery' of perforators.

to identify and preserve the lateral thoracic vessels in the first instance. Once the tumour excision is completed dissection can proceed laterally to identify the perforators. Once seen, the dissection can move to the lateral aspect of the flap and the flap is raised off the back towards the breast and selected perforators. Dissection continues either to the perforators or close to them, and stops at a level that allows full mobility of the flap into the required defect. The alternative, with experience, is to start dissection from the lateral aspect and dissect medially until the required perforators are seen and the flap is sufficiently mobilised. The skin can be

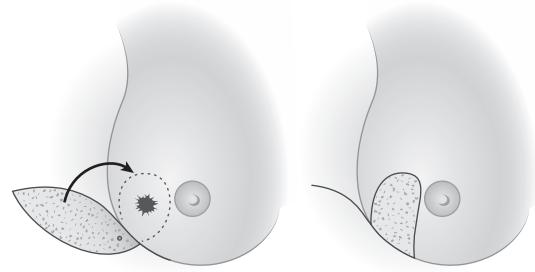

Figure 8.17 • LICAP flap based on a single perforator rotated into the lateral defect.

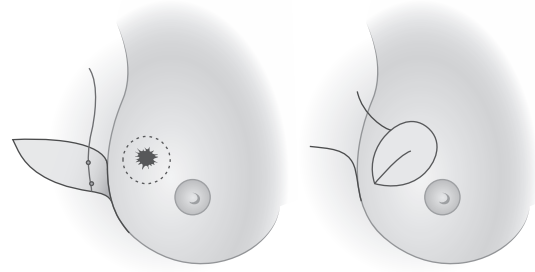

Figure 8.18 • LTAP flap pedicled into the defect.

de-epithelialised earlier at this stage or at the start. The flap is then delivered into the defect. Use of sutures to hold the flap employs the following principle: It is better to suture the flap at the edge of the breast to stop the flap falling out. Sutures within the breast can tether. The donor site is closed in two layers.

Anterior intercostal artery perforator flaps (AIAP) and medial intercostal artery perforator (MICAP) flaps

These flaps are based on the inferior aspect of the breast. They share similar planning in terms of Doppler identification. The flaps rely on the advancement of the upper abdominal tissue for closure of the defect. This mobility needs to allow closure without tension or there can be lowering of the crease.

The flap can be delivered as a single flap transposed into the defect based on a single or closely grouped perforators (**Fig. 8.19**). The alternative for more central defects is to raise the flap either side of the perforator and transpose both limbs (**Fig. 8.20**). For smaller flaps this has been described without identifying the perforators preoperatively.

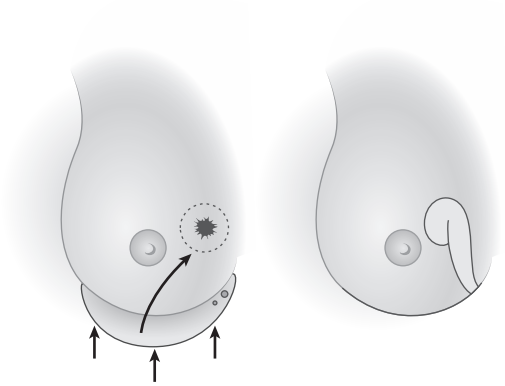

Figure 8.19 • MICAP flap rotated into the defect based on a single perforator.

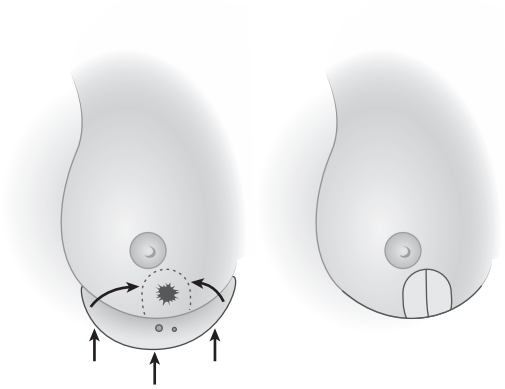

Figure 8.20 • AIAP flap transposed into the defect as a double-limbed flap based on a single/group perforator(s).

Thoracodorsal pedicle-based flaps

These flaps use the thoracodorsal pedicle which supplies the latissimus dorsi muscle and therefore will render the option of an LD flap no longer available for total breast reconstruction. As such, these flaps tend to be used for volume replacement as either a two-stage procedure or single-stage with intraoperative margin analysis to minimise the risks of involved margins and thus an incomplete excision. There are few indications for a TDAP flap in immediate volume replacement and their main role is in delayed correction of defects after radiotherapy.

Historically the LD flap (miniflap) has been the main flap used for volume replacement with breast-conserving surgery. It has the great advantage of good flap reach and being able to carry large volumes if required. It remains an option but it is uncommon to consider this in modern practice as there are better options. Therefore, the perforator flap alternatives, namely the intercostal artery perforators, lateral thoracic, or the thoracodorsal artery perforator flap, are a better option as they preserve an intact and functioning LD muscle with a smaller dissection and less donor site morbidity.

Thoracodorsal artery perforator (TAP) flap (Fig. 8.21)

The main perforator classically lies within 1–2 cm of the edge of the LD muscle, 10–12 cm below the posterior axillary fold.[18] It can be identified with the Doppler. The flap dimensions can be large but are planned with respect to the defect. Care needs to be taken to plan the reach of the flap taking into account pedicle length. The flap is usually raised from posterior to anterior to identify the planned perforator. Some surgeons prefer the opposite direction of dissection and to identify the perforator initially before dissecting the bulk of the flap. Once identified, the perforator is followed along its course, through the muscle down onto the anterior descending branch and this is then followed up to the main thoracodorsal pedicle. The associated nerves are spared. This dissection can be challenging and time-consuming without experience. The flap is then raised on the pedicle and transposed into the defect. This may require tunnelling of the tissue to allow inset.

Muscle-sparing modifications of the TAP flap create a simpler dissection while still preserving the vast majority of the LD muscle and its function.[19] The principle of planning is very similar except a vertical row of perforators can be included and this can allow the flap to be placed lower down in the

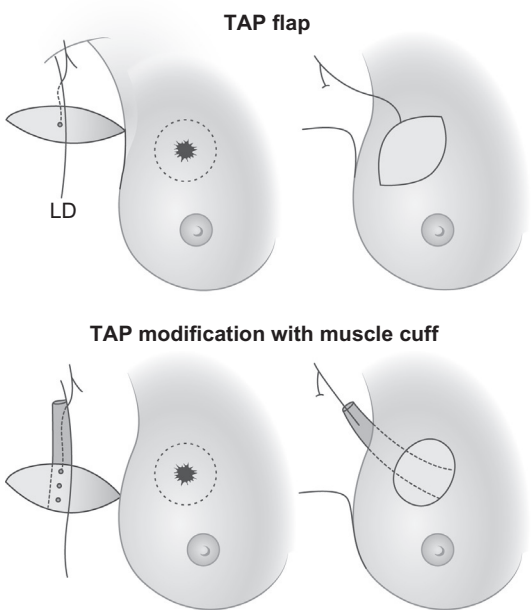

Figure 8.21 • TAP flaps and muscle cuff modification.

bra line, so increasing the potential flap reach. The dissection only requires approximate location of the perforators. A cuff of muscle is then taken around these perforators. This usually includes an anterior branch of the descending branch of the thoracodorsal artery, although the main descending branch can be included with a wider muscle strip if needed (the advantage of leaving the main descending branch is that the associated nerve with this vessel is easily preserved). The muscle cuff continues up until the true descending branch is identified, where the nerve is preserved. The dissection then continues as for the standard TAP flap.

Free flaps in breast-conserving surgery

These are not commonly performed but do provide an option for difficult medial defects. As with the principle of perforator flaps, smaller 'dispensable' free-flaps are preferable. Gracilis-based flaps are ideal.[20] This allows complete freedom to excise the tumour medially and reconstruct the breast without disrupting the remaining breast tissue. The transverse upper gracilis (TUG) flap is described for this option. It can be performed as a single or two-stage procedure and uses internal mammary vessels for the anastomosis.

Omental flaps

These have not gained world-wide use and are more commonly performed in the Far East where options for oncoplastic breast surgery for smaller breasts are limited.[21] In addition, the acceptability of scars may vary in different cultures. These flaps can be raised laparoscopically and delivered into the breast via the medial inframammary fold. They can be very helpful in selected cases. The volume can be large and obviously requires additional expertise in laparoscopic surgery to harvest the flap and the small risks that that carries.

Case examples

Case example 1

Skin crease incision for upper inner quadrant cancer. A simple incision giving good access placed in a dynamic skin tension crease, marked while standing (**Fig. 8.22**).

Case example 2

A vertical scar therapeutic mammaplasty for left DCIS in the upper pole. The defect was filled with an inferior pedicle carrying the NAC (**Fig. 8.23**).

Fig. 8.22 • Case example 1.

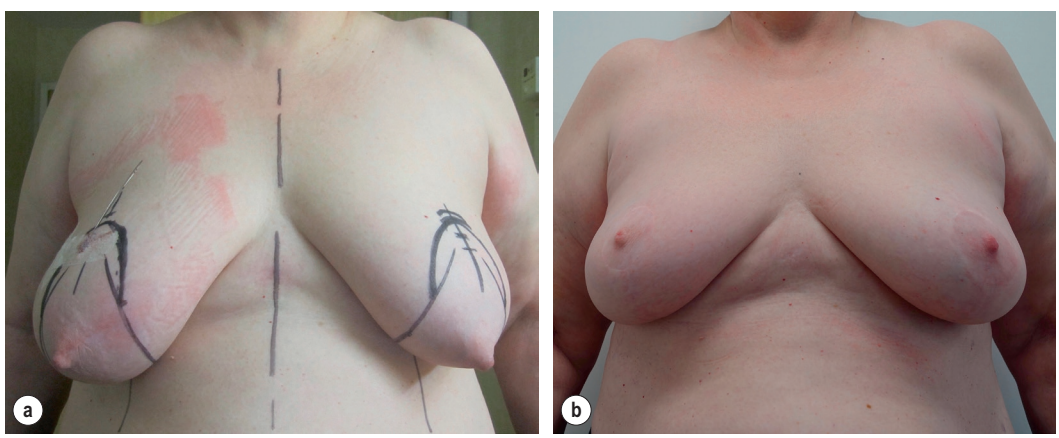

Fig. 8.23 • Case example 2.

Case example 3

A unilateral vertical scar therapeutic mammaplasty for a cancer in the upper inner quadrant. The NAC was preserved on a medial pedicle and the central and lateral breast tissue rotated clockwise into the defect (**Fig. 8.24**).

Case example 4

A LICAP flap for a lateral multifocal cancer. The flap was based on two perforators at the lateral curvature and turned over into the defect (**Fig. 8.25**).

Case example 5

The planning of an LTAP flap. The wide local excision and sentinel node are performed through the same scar and the flap is transposed into the defect. Breast tissue is preserved between the flap and the defect (**Fig. 8.26**).

Case example 6

The planning of a LICAP flap. The flap is turned over on the two identified LICAP perforators. The defect is as marked, with excision of all breast tissue to the base of the flap (**Fig. 8.27**).

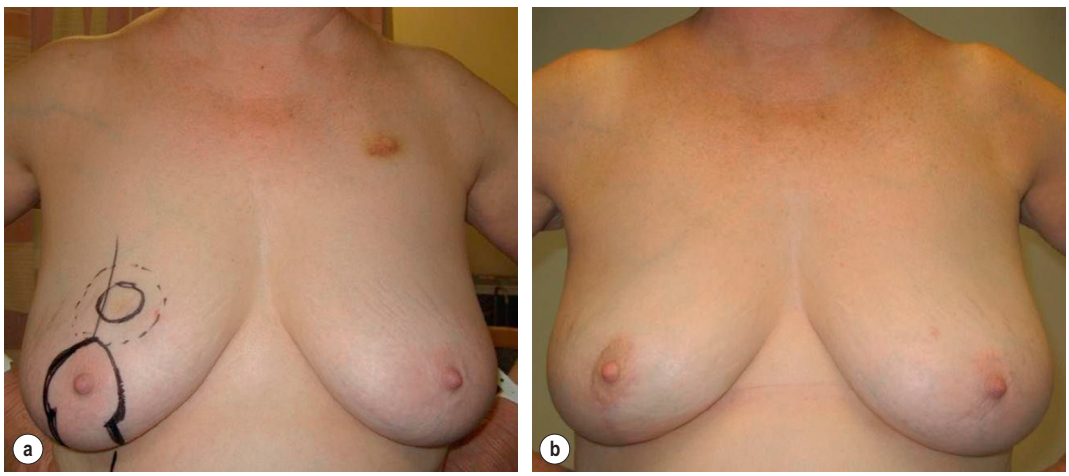

Fig. 8.24 • Case example 3.

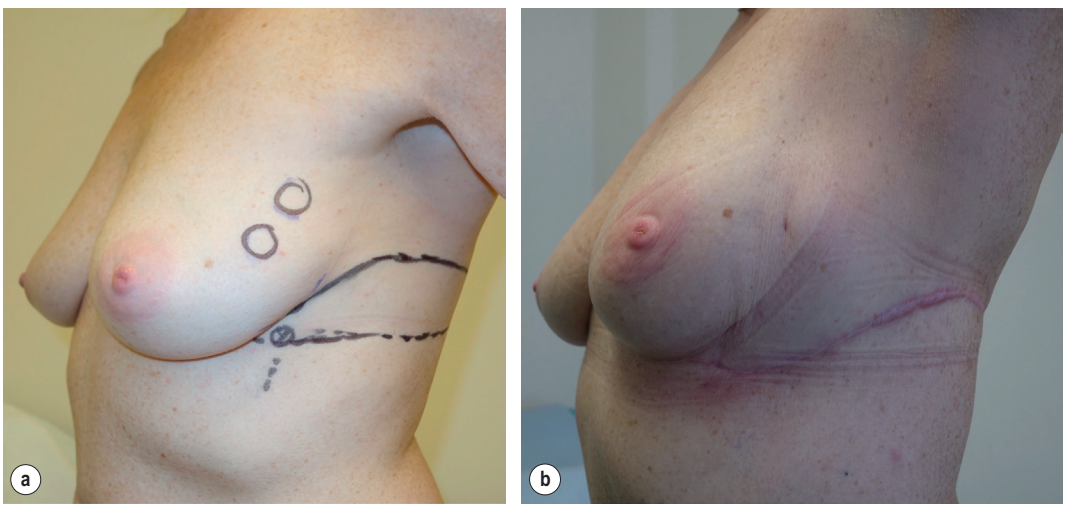

Fig. 8.25 • Case example 4.

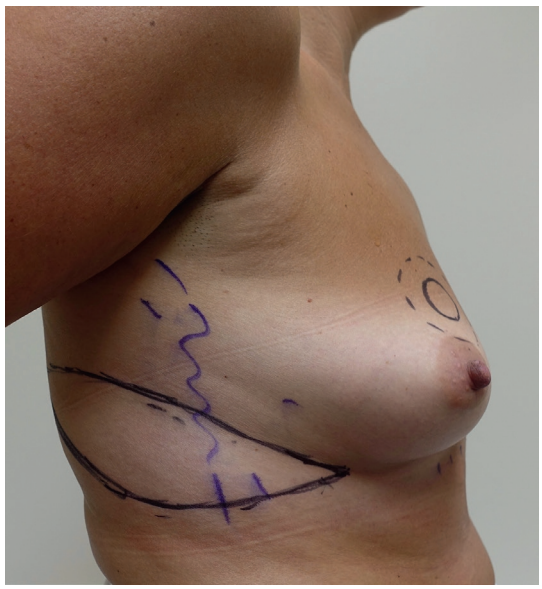

Fig. 8.26 • Case example 5.

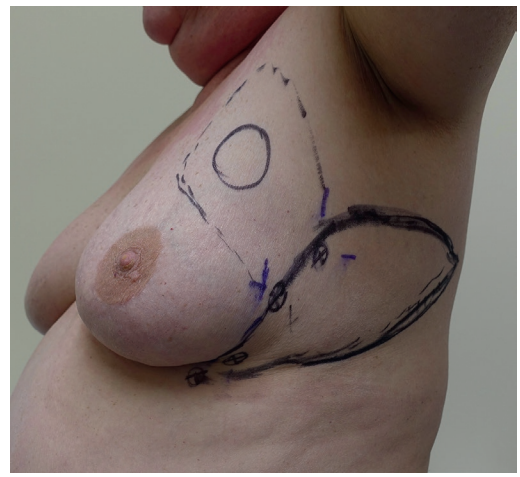

Fig. 8.27 • Case example 6.

Case example 7

The planning of a MICAP flap. The wide local excision is performed through the same scar as the flap, sentinel node biopsy via a separate scar. The flap is rotated on the medial intercostal perforator into the defect. The breast is split from behind between the defect and the inframammary fold to accommodate the long flap (**Fig. 8.28**).

Fig. 8.28 • Case example 7.

Key points

- Be aware of changes likely as the breast heals and that develop as a consequence of radiotherapy.
- Perform the simplest procedure that gives an acceptable result.
- Only perform techniques within your own skill set.
- Do not compromise on the oncological excision to facilitate better cosmesis.
- Choose safety over perfect cosmesis even if this means accepting a small deformity or asymmetry rather than risk significant deformity if flap or skin viability is compromised.
- Surgeons should be aware of options available, offer those within their ability and recognise that some patients are better referred to those with more expertise, or work in conjunction with surgeons that offer these additional skills.
- Volume displacement techniques should usually be considered as the default choice for extended breast conservation as they confine surgery to within the affected breast and are usually easier.
- Volume replacement techniques are largely used when the breast has little ptosis, has insufficient volume for displacement techniques or the patient does not wish to have a smaller breast or bilateral surgery.

Full references available at **http://expertconsult.inkling.com**

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