Breast reconstruction: options post-mastectomy

Breast cancer is the most common cancer affecting women in the UK. Breast reconstruction after resection of breast cancers increases patients' quality of life and psychosocial functioning. This article introduces this field and explores the options available to patients with breast cancer.

Breast cancer is the most common cancer affecting women, with 53 696 women diagnosed with invasive breast cancer in the UK alone in 2013 (Cancer Research UK, 2016). It has been estimated that one in eight women will be diagnosed with breast cancer during their lifetime. The majority of women require surgical excision of the primary tumour and the desired outcome is for breast-conserving surgery for these women. They may also require adjuvant chemo- and radiotherapy postoperatively, depending on the size, grade and tumour staging. Unfortunately, a number of women will require a mastectomy if the tumour is multifocal or multicentric within the breast tissue or if the breast tissue volume precludes breast conservation surgery. In this situation the women will be offered breast reconstruction surgery.

In 2009, National Institute for Health and Care Excellence guidelines were published on the diagnosis and treatment of early and locally advanced breast cancer (National Institute for Health and Care Excellence, 2009). They recommend that all patients undergoing mastectomy should be aware of the full range of options for immediate reconstruction (unless patient factors such as significant comorbidity or adjuvant therapy preclude this). The argument for immediate breast reconstruction post-mastectomy hinges on the benefits of only requiring one operation, with minimal loss of body image for the patient.

The National Institute for Health and Care Excellence guidelines echo the European Parliament resolution on breast cancer (2002/2279 (INI); European Parliament, 2003) which states that, wherever possible, breast reconstruction operations are performed using the patient's own tissue within the shortest possible time (Fentiman and Farhadi, 2011). Clinical studies have shown that immediate breast reconstruction is oncologically safe (Romics et al, 2012), does not delay initiation of adjuvant treatments (Chang et al, 2013) and is associated with better psychological outcomes (Wellisch et al, 1985). However, a Cochrane review on immediate *vs* delayed breast reconstruction did highlight the paucity of high level evidence on this topic (D'Souza et al, 2011).

Unfortunately, despite the National Institute for Health and Care Excellence recommendations, the current UK rates of immediate breast reconstruction are low. Only 21% of 15 479 patients undergoing mastectomy had an immediate reconstruction with a wide rate of regional variation from 9 to 43% reported (National Mastectomy and Reconstruction Audit, 2009). On a positive note, 90% of patients rated their care as excellent to very good within UK treatment centres. The use of a multidisciplinary team approach involving both breast and plastic surgeons early within the care pathway, with patient support from specialist nurses and peer groups, can increase the rate of immediate reconstructions up to 57% (unpublished local trust data, 2010). A multidisciplinary team approach also helps facilitate and meet patient expectations and allows a tailored approach to breast reconstruction. The advantages and disadvantages of each breast reconstruction option can be combined with individual characteristics to achieve the best results. Patients are assigned a breast reconstruction clinical nurse specialist at the initial consultation who will provide a contact reference and further support to patients throughout their care pathway. Written information on reconstructive options and patient support groups will also be provided at the initial consultation. The majority of patients are given time to process this information before a further outpatient appointment to confirm their choice for reconstruction and to address patient questions and concerns.

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Options for breast reconstruction

There are a variety of options for breast reconstruction which can range from simple implants to complex free flaps of tissue to replace the lost breast tissue. Historically, breast reconstruction has been in evolution since the 1900s (Champaneria et al, 2012). Current options can be broadly divided into prosthetic or autologous (patient-

Table 1. Techniques used in breast reconstruction in current UK practice

Type of reconstruction	Immediate *n* (%)	Delayed *n* (%)
Implant or expander	1246 (37)	281 (16)
Pedicle flap and implant or expander	735 (22)	438 (25)
Pedicle flap (autologous)	932 (27)	446 (26)
Free flap (autologous)	476 (14)	566 (33)
Total	3389	1731

From National Mastectomy and Breast Reconstruction Audit (2011)

derived) tissue. Prosthetic options include single stage implant reconstruction or a staged tissue expander then implant reconstruction. Autologous reconstructions involve harvesting tissue from one area of the body and transferring it to the mastectomy site. The flap of tissue may retain its original blood supply (pedicled flap) or be joined to a new blood supply at the recipient site (free flap) requiring microvascular anastomoses. Pedicled flaps include the latissimus dorsi and transverse rectus abdominis myocutaneous flaps. Free flaps include the free transverse rectus abdominis myocutaneous, deep inferior epigastric perforator, superior gluteal artery perforator, transverse myocutaneous gracilis and superficial inferior epigastric artery flaps. The National Mastectomy and Breast Reconstruction Audit (2011) provides a breakdown of the techniques used and their frequency in the UK between January 2008 and March 2009 (*Table 1*).

There are a number of clinical complications associated with breast reconstructions. With any surgical procedure there is disruption to local structures including lymphatics, nerves and vessels supplying the dermis. This in turn can lead to the complications of postoperative pain, changes in skin sensation, bruising, haematoma, seroma formation, infection, fat necrosis and scarring. Related to the mastectomy, a patient may develop skin flap necrosis if the blood supply to the remaining skin capsule is compromised, which is particularly evident in smokers (Chang et al, 2000), and delayed wound healing. Complications related to specific reconstruction options are detailed below. Aesthetic complications related to all reconstructions are the possibility for breast asymmetry, changes in breast texture, volume and shape. Patients may require revision surgery to improve the breast appearance or to treat complications should they arise. The risk of complications is related to the patient's comorbid status and the necessity for postoperative adjuvant therapies.

Prosthetic reconstruction

UK practice currently performs more prosthetic breast reconstructions than autologous options (*Table 1*). By far the most common form of reconstruction is either a single stage implant reconstruction or a two-staged tissue expander, followed by implant reconstruction (*Figure 1*).

Implants

The advent of silicone breast implants in the late 1960s allowed the option of implant-based reconstruction for women post-mastectomy (Puskas and Luebbers, 2012). The majority of implants consist of saline-based or silicone rubber-based silica nanocomposite. Implants can be chosen in a variety of volumes and shapes to best match the patient's original tissue. The implant is inserted under the pectoralis major muscle as a single stage operation. Implant reconstruction is a simple, short operation with no flap-associated morbidity (Cassileth et al, 2012). Complications with this approach include capsular contracture (formation of a fibrous tissue around the implant resulting in pain and loss of breast shape), infection and the need to replace implants. The poly implant prothèse (PIP) implant complications of implant rupture have meant that some women view the use of prosthetic devices less favourably than they did previously (O'Dowd, 2012).

Tissue expander or implant reconstruction

The majority of women have a two-stage prosthetic reconstruction which involves placement of an initial tissue expander. The expander can then be subsequently inflated in a clinic setting to the desired volume. A second stage operation is then performed to exchange the expander for a matched implant. Advantages of the expander technique are the ability to adjust the final volume and the opportunity to create ptosis with initial over-expansion. This technique involves two operations with the associated complications for implant placement. A major disadvantage to any

Figure 1. Prosthetic breast reconstruction with implants, showing the positioning of the implant beneath the chest wall muscle, pectoralis major.

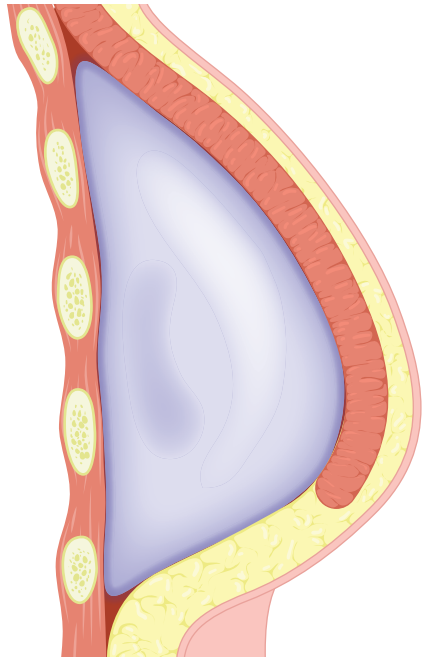
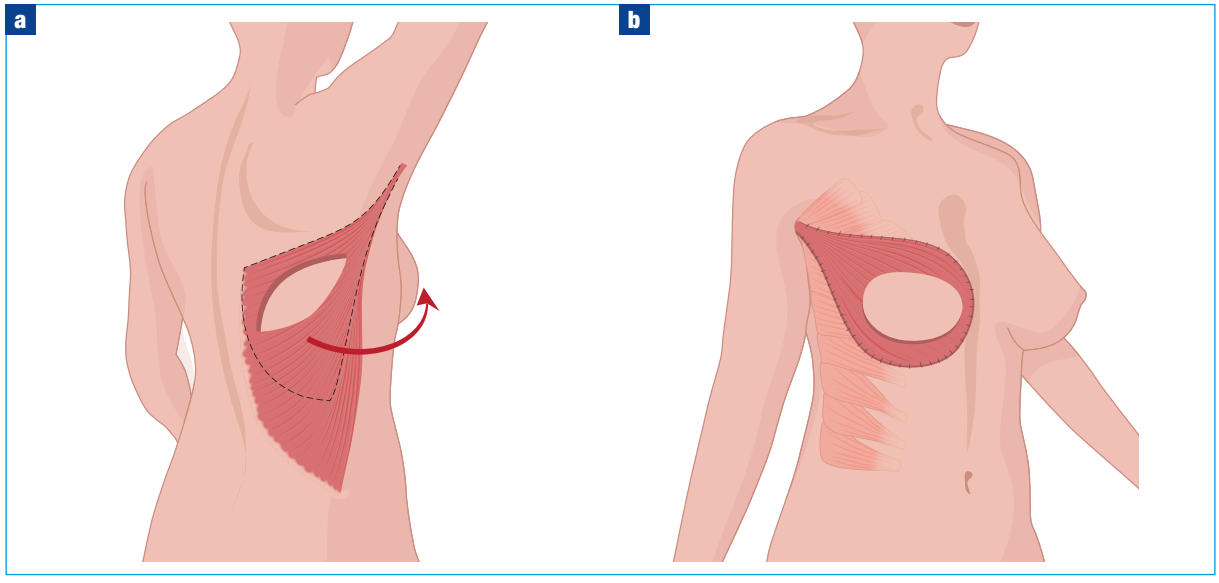


Figure 2. Latissimus dorsi reconstruction, illustrating **(a)** the position of the latissimus dorsi muscle used in breast reconstruction and **(b)** the movement of the pedicled flap onto the chest wall.



implant-based reconstruction technique is the increased risk of fibrosis after adjuvant radiotherapy. Fibrosis and contracture around the implant compromises the aesthetic outcome of the reconstruction and may necessitate further revision surgery.

Acellular dermal matrix

Acellular dermal matrix has been used as an adjuvant product in prosthetic reconstruction. It consists of processed dermis (human, porcine or bovine) which is used to provide soft tissue support and coverage for expander and implant breast reconstructions (Hester et al, 2012; Venturi et al, 2012). A meta-analysis on acellular dermal matrix in breast reconstruction concluded that the benefits of dermal matrix need to be weighed against reported increased complication rates such as seroma formation (Kim et al, 2012).

Autologous reconstruction

Autologous reconstructions are based upon the concept that a patient's own tissue is most likely to mimic breast tissue lost during mastectomy. Most commonly abdominal tissue is used as the texture and consistency of the subcutaneous tissue matches well to breast tissue; however, tissue may be harvested from other sites depending on patient factors. In addition, the skin harvested will age with the patient creating natural ptosis and a good aesthetic outcome. Autologous reconstructions are durable and can withstand adjuvant radiotherapy. The abdominal flap harvest is similar to an abdominoplasty procedure offering patients the simultaneous advantage of a 'tummy tuck' which remains an attractive option for the postmenopausal woman. Free flaps are anastomosed to vessels at the recipient site, most commonly the internal mammary artery and vein. Free flaps can have vascular complications postoperatively if the donor or recipient vessels are compromised and may result in flap necrosis and failure of the reconstruction.

Commonly performed autologous breast reconstructions

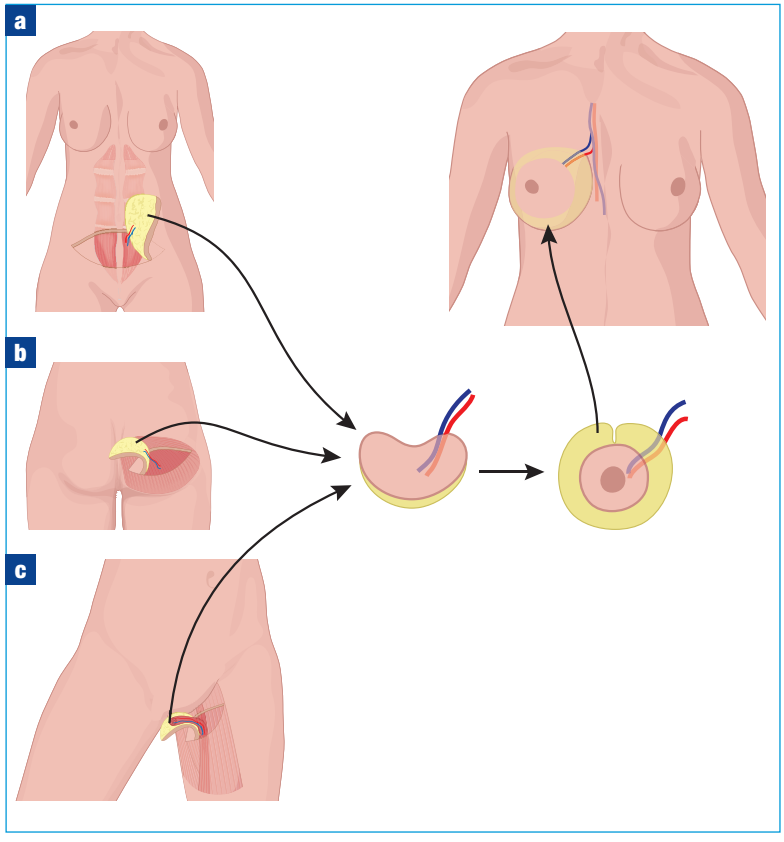
Latissimus dorsi flap

The flap is raised from the large muscle of the back and is tunnelled through the axilla to the pectoral region (*Figure 2*). The flap remains on a vascular pedicle, the thoracodorsal pedicle, which is robust, with low flap necrosis and failure rates (Bonomi et al, 2012). Latissimus dorsi flaps are often used to cover subpectoral implants if a greater breast volume is desired compared with latissimus dorsi alone. Complications are related to the donor site and include a large back scar, seroma formation and shoulder dysfunction. Patients report higher levels of satisfaction with their reconstruction for latissimus dorsi flap covered implants *vs* implant alone, 84% satisfaction at 18 months post surgery *vs* 72% (National Mastectomy and Breast Reconstuction Audit, 2011).

Deep inferior epigastric perforator flap

The deep inferior epigastric perforator flap has gained increasing popularity among plastic surgeons as the abdominal perforator flap of choice for immediate breast reconstructions (*Figure 3a*). The flap is based upon the perforating vessels of the abdominal tissue and so avoids the need to dissect fascia and muscle (Granzow et al, 2006) therefore reducing the risk of abdominal wall herniation and bulging. Raising the deep inferior epigastric perforator flap involves careful microdissection of the perforating branches to provide a suitable pedicle for anastomosis in the chest, often their course through the tissue is highly variable. In light of this, operating times are often in excess of 6 hours per flap and heavily rely on the skill of the surgeon. The flap requires a patient with a good amount of abdominal tissue and therefore is not suitable for patients with a low body mass index. Similarly, patients with very high body mass index, diabetes or who are heavy smokers

Figure 3. Options for free flap breast reconstruction. **a.** Deep inferior epigastric perforator. **b.** Superior gluteal artery perforator. **c.** Transverse upper gracilis.



have increased postoperative complications (Seidenstuecker et al, 2011). A small majority of patients have reported functional problems relating to the donor site in the most recent national audit, e.g. abdominal discomfort, bulging and tightness (10%, 12% and 13% respectively) although over 80% of women were satisfied with the appearance of their abdomen at 18 months (National Mastectomy and Breast Reconstruction Audit, 2011).

Less commonly performed autologous reconstructive options

Patients who would like an autologous reconstruction but who lack the required amounts of donor site tissue for a deep inferior epigastric perforator reconstruction or prefer to avoid latissimus dorsi donor site morbidity may be considered for alternative free flap techniques. The following is a short introduction to these less frequent reconstructions, which invariably would be performed in a specialist tertiary reconstructive centre.

Superior gluteal artery perforator flap

This flap is based upon superior gluteal artery perforating vessels which supply the overlying subcutaneous tissue and skin in the gluteal region (*Figure 3b*). Perforators are identified and dissected through the gluteus muscle and as such, a limited pedicle length can be achieved. Dissection is often time-consuming and challenging. The gluteal muscle is preserved and therefore donor site morbidity is low with minimal postoperative pain, although can be prone to seroma formation (LoTempio and Allen, 2010). The nature of the donor tissue is firm and provides a good texture and projection to reconstructed breasts (Werdin et al, 2010). The superior gluteal artery perforator flap is often reserved as a back-up flap for patients with a previous history of abdominal surgery, thin patients with little abdominal adiposity or patients who wish to avoid abdominal scarring

Superficial inferior epigastic artery perforator flap

This flap is similar to the deep inferior epigastric perforator flap as it is based upon an inferior epigastric perforator to supply the flap tissue. However, it does not involve muscle dissection and therefore is minimally traumatic to the abdominal wall (Selber et al, 2010). Variability in the anatomy and diameter of perforating vessels requires surgical expertise (Rozen et al, 2011).

Transverse rectus abdominis myocutaneous flap

The transverse rectus abdominis myocutaneous flap can be either a pedicled flap using the superior epigastic vessels or a free abdominal flap using inferior epigastric vessels (Hartampf et al, 1982; Grotting et al, 1989). The flap is based on the rectus abdominis muscle and its overlying skin and subcutaneous tissue. Harvesting the flap results in an iatrogenic weakness in the abdominal wall which is repaired using a synthetic mesh. Despite mesh repair, patients are at risk of abdominal wall herniation at this site (Serletti, 2006).

Transverse myocutaneous gracilis flap

Flap tissue is derived from the inner thigh and as such is a useful option for reconstruction in thinner patients. It was first described by Yousif et al in 1992 (*Figure 3c*). This free flap relies on the proximal pedicle of the gracilis muscle and consists of the whole gracilis muscle and an elliptical transverse cutaneous paddle. The average flap volume is 350 cc and suits small to moderately breasted women. The flap is relatively quick to raise because it has fairly constant anatomy and the donor site has minimal morbidity. The patient benefits from an additional thigh lift within the procedure. Transverse myocutaneous gracilis flaps are a useful reconstructive option and can be a robust salvage flap for previous flap failure. Disadvantages to this flap are the relatively short vascular pedicle, the small volume of tissue available and the skin colour discrepancy between breast and thigh (Schoeller et al, 2008).

Nipple reconstruction

A range of surgical techniques is available for nipple reconstruction, for example C-V flap, dome flap, quadra flap and arrow flap techniques. All aim to use a small section of skin to recreate a nipple using a single pedicled local flap. The results are variable with little evidence to recommend one technique over the other (Farhadi et al, 2006; Boccola et al, 2010). Complications include nipple necrosis and failure and more commonly loss of projection which is quoted at 30–40%. Moulded prosthetic nipples

KEY POINTS

- Breast reconstruction post mastectomy may be immediate or delayed.
- Reconstruction may involve prosthetic material or autologous tissue either as a pedicled or free tissue flap.
- Current UK statistics indicate a low proportion of women are offered immediate breast reconstruction as an option post-mastectomy, well below National Institute for Health and Clinical Excellence guidelines recommending that all women should be given this option.
- Different options for reconstruction need to be weighed against oncological and patient-specific characteristics to find the best procedure for the individual.

are available as an alternative to further surgery. The majority of women undergo nipple-areola tattooing to complete their reconstruction with good results.

Conclusions

There are a variety of options for breast reconstruction post-mastectomy. Immediate breast reconstruction is an attractive and oncologically safe procedure with recognized psychosocial benefits. There remains a need to increase patients' awareness and provide access to all reconstructive options within the UK. Specialist regional referral centres working in a multidisciplinary environment may help to provide women with a tailored immediate breast reconstruction service. **BJHM**

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