Recent trends in breast reconstruction

Dick M Rainsbury

The rising popularity of breast reconstruction is closely linked to patient expectation, improved techniques and a better understanding of the risks and benefits of reconstructive procedures. Innovative new approaches can conceal the scars of mastectomy and extend the role of breast-conserving surgery, leading to improved outcomes.

Attitudes toward breast reconstruction (BR) have changed dramatically. A few years ago, BR was viewed by many as unsafe or unnecessary (Handel et al, 1990), and was the privilege of a small minority who were prepared to join a long waiting list. Today BR is becoming integrated into the overall management of the breast cancer patient, backed up by the increasing availability of a variety of different procedures.

BR has progressed from the first use of simple silicone implants in 1963, to myocutaneous flaps in 1977 and tissue expanders in 1982. Improvements in technology have led to many modifications of these basic techniques, resulting in much greater patient choice.

Increasing numbers of women are becoming aware of these choices. Up to 70% will choose to have reconstruction when it is freely available (Bremner Smith et al, 1997), but this level of demand is currently unmet in most of the Western world. Less than 10% of women undergo BR in the UK and Australia, and the provision of services varies in different parts of the same country.

A shortage of trained reconstructive breast surgeons is a major factor underlying the current imbalance between the demand for BR and the supply of reconstructive services. Training is a vital issue, but the purpose of this article is to consider modern reconstruction in light of the following key factors, which should be considered when discussing BR with patients:

- The risks and benefits of BR
- Patient suitability
- Timing of reconstruction
- Choice of technique
- Additional procedures
- Recent innovations.

Mr Dick M Rainsbury
is Breast Tutor at the Royal College of Surgeons of England and Consultant Surgeon in the Breast Unit, Royal Hampshire County Hospital, Winchester, Hants SO22 5DG

THE RISKS AND BENEFITS OF BREAST RECONSTRUCTION

Any patient considering BR will face a number of doubts and uncertainties about the procedure that need to be addressed. The main areas of concern identified by patients and by surgeons are summarized in *Table 1*. Patients can be reassured that BR at the time of mastectomy neither adds to the risks of mastectomy (Vinton et al, 1990), nor delays the initiation of adjuvant treatment (Yule et al, 1996). Moreover, BR does not stimulate local recurrence or delay its detection (Patel et al, 1993; Slavin et al, 1994).

Concerns about the long-term safety of silicone implants have changed reconstructive practice in the USA although mature studies have failed to confirm any link between silicone and systemic diseases (The Independent Review Group, 1998). In the UK, patients undergoing implant-based reconstruction should be informed that these devices are 'long term' rather than 'permanent', and may need to be exchanged if they rupture or if they give rise to local discomfort and distortion. Most women chose BR for clear-cut physical reasons — to feel more normal, to avoid wearing an external prosthesis, and to maintain their femininity (Bremner Smith et al, 1997).

TABLE 1.
Factors limiting breast reconstruction

Patient factors*	Fear of more surgery
	Fear of complications
	Fear of oncological effects
Surgeon factors	Lack of time
	Lack of training
	Lack of interest

*Adapted from Handel et al (1990)

The benefits of BR are closely linked to the careful selection of appropriate patients and appropriate techniques. Poorly performed BR using an inappropriate technique in an uncertain patient is unlikely to result in a satisfactory outcome. By contrast, well-informed, well-motivated patients experience clear psychological and physical benefits following BR (Dean et al, 1983; Schain et al, 1985), but better selection criteria are badly needed. The financial benefits of immediate reconstruction are substantial (Elkovitz et al, 1993). Costs of duplicated consultations, operations and follow-ups are avoided — as are lengthy periods of convalescence leading to time off work.

PATIENT SUITABILITY

Although it is possible to reconstruct most patients who request BR, the following factors determine the suitability of BR in individual patients:

- Motivation
- Medical factors
- Tumour factors.

Motivation

The offer of reconstruction needs to be backed up by clearly understandable, comprehensive information and advice. Patients welcome the opportunity to meet others who have been through the same experience. Poor motivation or uncertainty are important contraindications to BR, especially when planned at the time of mastectomy.

Medical factors

A number of medical factors increase the risks of BR. Hypertension, diabetes, smoking, and collagen vascular disease reduce capillary blood flow to donor flaps and native skin, leading to poor perfusion, flap loss and skin necrosis. Radiotherapy has similar effects and reduces tissue elasticity. Pre- or postoperative radiotherapy increases the risk of capsule formation when implants or expanders are used, and alternative methods may be more suitable when radiotherapy is planned.

Tumour factors

BR is normally avoided in patients with locally advanced (T4) tumours because of the relatively high risk of local recurrence in the reconstructed breast, which may be very difficult to treat. Moreover, it may be inappropriate to perform major surgery in a group of patients with a limited life expectancy. In other groups, immediate BR (IBR) does not compromise the use of adjuvant treatment (Yule et al, 1996), and for those with extensive in-situ disease, IBR offers a welcome alternative to mastectomy alone.

TIMING OF RECONSTRUCTION

Reconstruction at the time of mastectomy makes a lot of sense. On one hand the patient is spared the psychological trauma of breast loss, and the pain and anxiety of a further procedure. Moreover, delayed reconstruction is usually performed by a separate team of plastic surgeons working in a separate unit with the associated inconvenience and expense. Dissection of undisturbed tissues during IBR is more straightforward, and allows the surgeon to conserve more skin and limit scarring, leading to better cosmetic results (Kroll et al, 1995a). Approximately 40% of reconstructions in the USA are now performed at the time of mastectomy (Carlson et al, 1997), and similar uptakes are reported when immediate reconstruction is offered to UK patients (Dixon, 1995).

Organizing reconstruction at the time of mastectomy is not without its problems (*Table 2*). Patients have little time to acquire sufficient information and advice to make an informed decision and may have unrealistic expectations about the results. Few surgeons have the experience necessary to perform both mastectomy and reconstruction, and regular liaison between breast and plastic surgeons may be difficult to arrange. Although most procedures are lengthy (3–6 hours), they add little to overall hospital stay or convalescence when compared with mastectomy alone.

TABLE 2.
Immediate breast reconstruction

Advantages	Less surgery
	Less disability
	Less convalescence
	Better cosmesis
	Cheaper
Disadvantages	Decisions hurried
	Organization difficult
	Procedures lengthy
	Expertise scarce
	Patients more critical

CHOICE OF TECHNIQUE

Patients considering full BR can choose from three fundamentally different techniques:

- Implants or expanders
- 'Pedicled' myocutaneous flaps
- 'Free' myocutaneous flaps.

Each technique is not suitable in every patient requesting reconstruction. An explanation of the risks and benefits to the individual patient will help to inform decisions, avoiding the disappointment of a poor cosmetic result.

Implant and expander reconstruction

With this type of BR the breast mound is recreated by placing an implant or tissue expander under the muscles of the anterior chest wall or under the skin (*Figure 1*). A tissue expander is an adjustable implant containing a saline-filled chamber. The volume of this chamber can be varied through a remotely-sited subcutaneous injection port, which allows postoperative alterations to the size and shape of the reconstructed breast until symmetry is achieved.

The speed and apparent simplicity of this approach makes it an attractive option for patients and surgeons. Hospital stay and convalescence are short, and the technique is free from 'donor site' problems. Unfortunately complications are common, and results are variable (Slavin and Colen, 1990). Lifelike ptosis is difficult to achieve and if a 'capsule' of thick scar tissue forms around the expander, a firm and uncomfortable breast mound results. This problem is all too common after radiotherapy, when tissue expansion is contraindicated. Tissue expansion is best suited to patients with small non-ptotic breasts if chest wall irradiation is not part of their planned treatment.

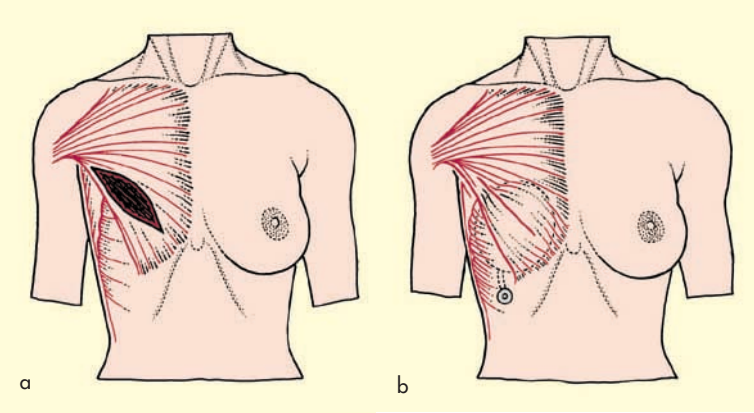

Figure 1. Breast reconstruction using a tissue expander. a. Creation of subpectoral pocket for expander. b. Expander adjusted to achieve symmetry.

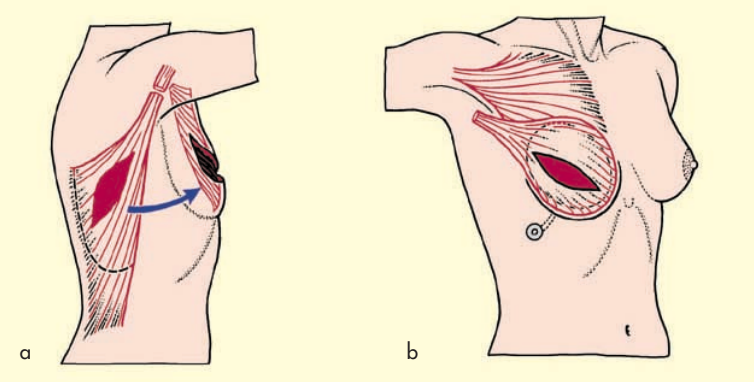

Figure 2. Latissimus dorsi breast reconstruction. a. Rotation of flap from donor site into breast pocket. b. Reconstruction with flap and tissue expander.

'Pedicled' myocutaneous flaps

This technique involves reconstructing the breast by transferring tissue (the 'flap') from a distant site (the 'donor' site) into the mastectomy defect. The flap remains attached to its native blood supply or 'pedicle', and is modelled to reproduce the shape and size of the remaining breast.

Latissimus dorsi (LD) and transverse rectus abdominus myocutaneous (TRAM)-flaps are in common use. LD flap reconstruction usually requires additional volume replacement with a tissue expander or an implant, and leaves a donor scar on the back. The flap has an extremely reliable blood supply, and produces a lifelike ptotic breast (*Figure 2*). TRAM-flaps produce the best aesthetic results without the need for additional volume replacement. The combination of BR and a 'tummy-tuck' make TRAM-flap reconstruction an increasingly popular technique (*Figure 3*), but complications include:

- Flap loss
- Donor site hernia
- Abdominal wall weakness.

'Free' myocutaneous flaps

Concerns about donor site morbidity following pedicled TRAM-flap BR have led to the recent development of 'free flap' techniques. In these procedures, the vascular pedicle of the flap (usually TRAM, LD or gluteus maximus) is divided and 'plugged in' to local vessels in the reconstruction site. This approach minimizes donor site disruption and subsequent morbidity (Kroll et al, 1995b), but is time consuming and requires a knowledge of microvascular techniques.

HOW TO CHOOSE

A number of factors must be discussed with patients who are choosing BR (*Table 3*). Expander reconstruction is most appropriate for those patients who want to avoid major surgery and are aware of the complications and limitations of the technique. At the other end of the spectrum, those patients who want the most lifelike breast, while avoiding implants and abdominal morbidity, may chose a 'free' TRAM-flap reconstruction. A third group of patients will be prepared to trade the risks and benefits of implant-based and TRAM-flap reconstruction for LD reconstruction, which combines some of the best features of both techniques and is relatively free from complications.

ADDITIONAL PROCEDURES

Many patients who opt for BR require further procedures, and need to be informed that BR is often a multistep process, which includes:

- Operations on the reconstructed breast
- Operations on the contralateral breast.

Ipsilateral procedures

The reconstructed breast may require revision to exchange an incorrectly sized or sited prosthesis, or to remove a capsule — which can form around the prosthesis. About 30% of women request nipple replacement. This can be provided either by the use of a 'stick on' silastic prosthesis or by autogenous nipple reconstruction using one of a variety of techniques. Following this, the reconstructed nipple can be pigmented or 'tattooed' to match the native nipple if required.

Contralateral procedures

Symmetrical BR is hard to achieve as it is difficult to reproduce the typical ptotic breast shape that is often encountered in patients undergoing reconstruction. Tissue expanders allow some adjustment to the reconstructed breast, but increasingly women are requesting adjustment to the opposite breast in order to restore symmetry, including:

- Mastopexy — a procedure to correct ptosis
- Reduction mammoplasty — mastopexy combined with volume reduction
- Augmentation — enlargement using an implant or expander.

These procedures should be discussed before reconstruction and deferred until the procedure is completed. Many UK patients are prepared to put up with some degree of asymmetry, particularly those who have already experienced the disfigurement of mastectomy.

RECENT INNOVATIONS

New approaches and new techniques are being introduced in a climate of increased specialization and expectation. Current developments include:

- 'Oncoplastic' surgery
- Skin-conserving mastectomy
- New implant designs.

Oncoplastic surgery

Oncoplastic surgery combines resection and reconstruction, often removing a whole quadrant of the breast. The distortion that normally follows extensive resections can be avoided by this approach, enabling a greater number of patients to choose breast conservation. Oncoplastic surgery may involve volume replacement, using a muscle flap (*Figure 4*) to reconstruct the defect (Noguchi et al, 1990; Raja et al, 1997). Alternatively, local glandular flaps can be mobilized and rotated into the resection defect to restore the shape of the breast (Grisotti, 1994). New endoscopic techniques are being developed that enable the surgeon to perform a number of these procedures through small concealed incisions (Rainsbury, 1997). These techniques are beginning to improve the quality of breast-conserving surgery by allowing wider clearance of tumours without cosmetic penalties (Raja et al, 1997).

Skin-conserving mastectomy

Skin-conserving mastectomy is becoming increasingly popular when used alongside IBR (Knowlton et al, 1992; Carlson et al, 1997). This procedure preserves as much of the intact skin envelope of the breast as possible, reducing the

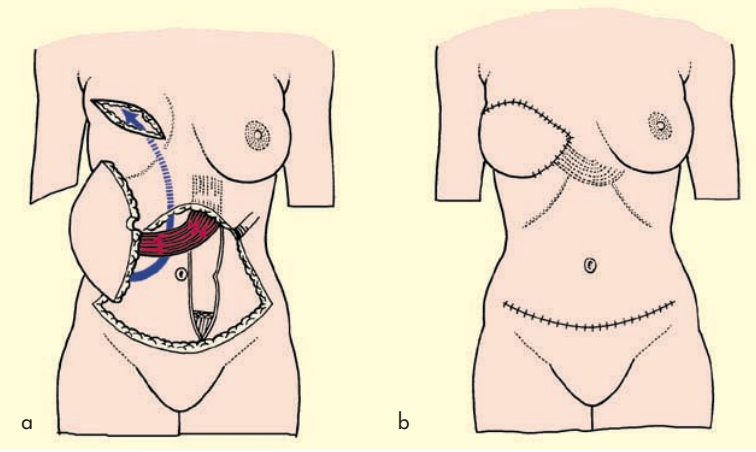

Figure 3. TRAM (transverse rectus abdominus myocutaneous)-flap breast reconstruction. a. Transfer of flap from lower abdomen. b. Reconstruction after 'modelling' of flap.

TABLE 3.
Comparison of techniques

	Expanders/implants	LD flaps	TRAM flaps	Free flaps
Speed	+++	++	++	+
Complexity	+	++	+++	+++
Rapid recovery	+++	++	+	+
Cost	+	++	+++	+++
Complications	+++	++	+++	+++
Good cosmesis	+	++	+++	+++

Grading scale: least=+; most=+++. LD=latissimus dorsi; TRAM=transverse rectus abdominus myocutaneous

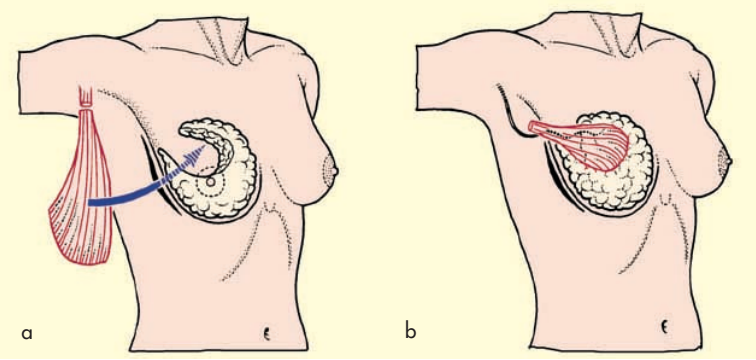

Figure 4. Breast-conserving 'oncoplastic' surgery. a. Partial mastectomy defect. b. Reconstruction with latissimus dorsi 'miniflap'.

amount of scarring and allowing the surgeon to reconstruct the breast within its normal skin pocket. The small central scar that remains can be turned into a nipple if desired, resulting in a 'scarless' reconstruction (*Figure 5*).

The outstanding cosmetic results achievable with this approach make it particularly suitable for younger patients, and for high-risk women requesting prophylactic mastectomy. Mastectomy can reduce the risk of breast cancer by at least 90% in these patients (Hartmann et al, 1999), and preservation of the whole skin envelope helps to achieve symmetry, avoiding the need for contralateral surgery in most cases (Carlson et al, 1997).

New implants

The recent adverse publicity surrounding silicone implants has led to modifications in their surface, content, shape and design, providing much greater patient choice. Capsule formation can be reduced by the use of implants with a textured surface (Coleman et al, 1991). More cohesive silicone gels help to reduce silicone 'bleed' — the slow seepage of silicone through the outer shell. Data on the long-term reliability of a number of new 'fillers', including saline, polyvinylpyrrolidine and triglycerides, are eagerly awaited.

The great individual variation in breast shape and size is now being addressed by the recent availability of 'anatomically-shaped' implants and expanders. These prostheses create a more natural-looking breast, with a broad base and lower pole projection.

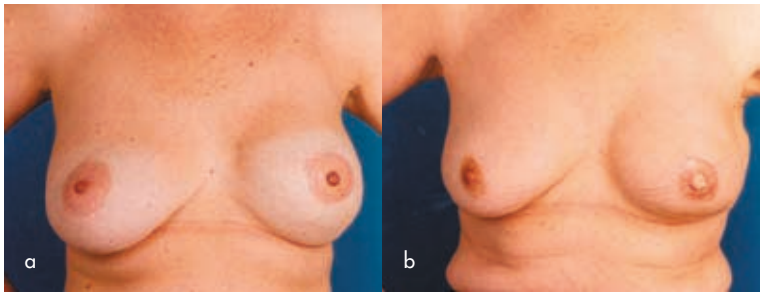

Figure 5. Skin-conserving mastectomy and immediate reconstruction. The small central scar can be concealed by (a) a silastic nipple prosthesis, or (b) nipple reconstruction based on the scar.

KEY POINTS

- Breast reconstruction is becoming increasingly popular in the UK.
- The benefits of breast reconstruction outweigh the risks in carefully selected patients.
- Patients must be helped to make information-based decisions, avoiding reconstruction if uncertain.
- Reconstruction is often a multistep procedure, requiring careful planning and collaboration.
- New techniques can minimize scarring and reduce the need for mastectomy.

CONCLUSION

Breast reconstruction is becoming increasingly popular in the UK, with rising expectations backed up by a greater choice of procedures. Patients need comprehensive information and advice about the risks and benefits of different techniques, and the need for further surgery. Innovative new approaches are improving outcomes and increasing the scope of reconstructive surgery in the management of patients with breast cancer. HM

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