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Authors: Thierry Tondou, Wiebren A.A. Tjalma, Filip E.F. Thiessen

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Breast Reconstruction after Mastectomy

Thierry Tondou^{1,2}, Wiebren A.A. Tjalma^{1,3} and Filip E. F. Thiessen^{1,2}

¹Multidisciplinary Breast Clinic—Unit of Gynaecological Oncology, Antwerp University Hospital, University of Antwerp, Belgium.

²Plastic Surgery Unit, Antwerp University Hospital, Belgium.

³Department of Obstetrics and Gynaecology, Antwerp University Hospital, University of Antwerp, Belgium.

Corresponding author

Thierry Tondou M.D.

Department of Plastic, Reconstructive and Aesthetic Surgery, Antwerp University Hospital

Multidisciplinary Breast Clinic—Unit of Gynecologic Oncology, Antwerp University Hospital, University of Antwerp, Antwerp, Belgium

Wilrijkstraat 10

2650 Edegem

t.tondu@clinic12b.be

Abstract:

Reconstructive surgery aims to improve quality of life by recreating a natural-looking breast that is warm to the touch. To obtain symmetry and body contour alignment, restoration of volume within the skin envelope is mandatory. The chosen reconstruction technique depends on the characteristics of the diseased breast, the shape and volume of the contralateral breast, and the technical skills of the surgical team. Timing, type and different possibilities of breast reconstruction are discussed.

Key-words: prosthetic breast reconstruction, autologous breast reconstruction, composite breast reconstruction, prophylactic breast reconstruction

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Introduction

Surgery has an important role to play in breast cancer treatment. The survival after breast conservative surgery with radiotherapy is equal to mastectomy. A quality indicator project in Belgium revealed that approximately 40% of women with breast cancer will undergo a mastectomy (1). This figure can be explained in part by the use of breast MRI. Breast MRI allows a better staging, thereby increasing the mastectomy rate (2,3). A mastectomy is a lifesaving but mutilating procedure. It is important not only to survive but also life (4). Therefore, the quality of life and good cosmetic outcome is mandatory after breast cancer treatment (4). Reconstructive surgery aims to improve quality of life by recreating a natural-looking breast that is warm to the touch. To obtain symmetry and body contour alignment, restoration of volume within the skin envelope is mandatory. The chosen reconstruction technique depends on the characteristics of the diseased breast, the shape and volume of the contralateral breast, and the technical skills of the surgical team. Importantly, the patient's expectations also need to be considered, as the reconstructed breast will never have a normal appearance.

Primary, secondary and tertiary breast reconstruction

Reconstruction can occur immediately following mastectomy in a one-stage procedure or be delayed. Primary breast reconstruction is an option when it is oncologically safe and when adjuvant therapy has no influence on the final result. This has a psychological advantage for the patient, who will thus never have the experience of breast amputation. Nevertheless, unrealistic expectations about the final shape and appearance may arise.

Secondary breast reconstruction can be performed years after mastectomy. Due to the loss of a skin envelope, a staged procedure is often indicated. In contrast with primary reconstruction, post-operative quality of life improves dramatically when a second breast is reconstructed.

Tertiary procedures are salvage procedures that try to solve the complications of the initial breast reconstruction (e.g. prosthetic breast distortion or flap necrosis).

Prosthetic, autologous and composite reconstructions

The advantages and disadvantages of the different types of breast reconstruction are shown in table 1.

Prosthetic reconstruction

Prosthetic breast reconstruction remains the most performed method worldwide (5). Operating time is shorter and concerns with donor site scars, or morbidity, and flap perfusion can be avoided. Implants can be round or anatomical; they can be filled with saline or a cohesive silicone gel, have a textured or micro-textured surface, or be covered in polyurethane. A lack of breast skin makes a staged approach involving skin expansion necessary.

In order to produce symmetry with the contralateral breast, modern implants are available in varying heights, projections and base widths. Very satisfying results are obtained when used in non-ptotic breasts. In ptotic breasts, however, a contralateral corrective procedure is necessary. Relatively larger implants can be used, if placed above the pectoral muscle and result in more ptotic breasts. The disadvantages of this technique are a higher risk of rippling in the upper breast pole and the need for sufficient skin to cover a larger prosthesis. A sub-pectoral prosthesis often lacks a natural ptotic lower breast pole (Figure 1). Radiotherapy results in a higher risk of postoperative infection and late capsular contracture (6).

Autologous reconstruction (pedicled and free flaps)

Pedicled flaps

The musculocutaneous latissimus dorsi (LD) flap and thoracodorsal artery perforator (TDAP) flap

Once the workhorse of breast reconstruction, the LD-flap is nowadays no longer the first choice. Instead, the Deep Inferior Epigastric Artery Perforator flap (DIEP), which is harvested without muscle damage and provides a greater quantity of vascularized tissue, has taken its place. Furthermore, a reliable vascular supply can be derived from the descending and transverse branches of the thoracodorsal artery. The TDAP flap is a muscle-sparing flap usually harvested on a perforating vessel overlying the descending branch of the thoracodorsal artery (7).

The large skin paddle can be positioned transversely or more obliquely, such that the donor scar lies along a natural crease. Subcutaneous bevelling will provide more fatty tissue and the

medial breast mound can be adequately reached. The transverse diameter of the flap is as large as the base of the amputated breast.

A tissue expander or prosthesis can add extra volume to the breast. Another possibility for augmenting volume is fat grafting, immediately before harvesting the flap or as a secondary procedure (8). If a prosthesis is used, greater latissimus dorsi muscle volume can be included in the flap to provide complete muscle coverage of the prosthesis or expander. Prepared with only one perforator, the muscle-sparing thoracodorsal artery perforator flap is used in the same manner as the LD-flap (9).

Free flaps

The idea of “like by like” replacement refers to reconstruction of a natural-looking, warm and ptotic breast that resembles the contralateral side. Evolution in microsurgery now allows transplantation and replacement of large volumes of autologous tissue, even from anatomically remote areas.

The Transverse Rectus Abdominis (TRAM) flap

As microsurgical skills and experience have advanced, the rates of flap loss in high volume centres have diminished. The TRAM flap uses the deep inferior epigastric artery and vein to supply and drain the transplanted musculocutaneous tissue. Additional preparation and anastomosis of the superficial inferior epigastric vein improves venous drainage, thus improving safety with the technique. Although the results of reconstruction are satisfactory, considerable donor site morbidity can occur. Rectus muscle damage with consequent abdominal wall herniation and bulging is frequently reported (10).

The Deep Inferior Epigastric Artery Perforator (DIEAP) flap

The main goal of the perforator flap is to diminish donor site morbidity by sparing the muscles and improving function and strength. Although the DIEAP flap has become the golden standard in microsurgical breast reconstruction, a recent review was unable to demonstrate any superiority compared with pedicled abdominal flaps (11). Nevertheless, sparing of abdominal wall strength is preferred to muscle weakness. Due to its vascular supply and microvascular branching, sufficient tissue can be provided in most patients. A bilateral blood supply allows for simultaneous bilateral reconstruction and conservation of abdominal wall integrity diminishes the complication rate significantly (10). The length of the skin paddle and volume of the flap allow creation of a ptotic breast, which avoids contralateral surgery. Recently, lymph node transplants have been included in the flap. Specific shaping of the

breast with positioning of nodes in the axilla, creates lymphatic drainage in a lymph-oedema-affected arm (12) (Figure 2).

Preoperative evaluation of the flap microvasculature by ultrasound or by computed tomographic angiography allows evaluation of the pedicle anatomy as well as the perforators and their distribution within the flap (13). Per-operative indocyanine mapping is an important tool for identifying poorly vascularized distal flap areas, thus helping to prevent fat necrosis or partial flap necrosis (14).

The Superficial Inferior Epigastric Artery (SIEA) flap

The SIEA flap can be an alternative to the DIEAP flap, although these vessels dominate in only 30 % of patients (15). A shorter pedicle is obtained due to distal positioning of the vessels. The principle advantage is the absence of any abdominal wall morbidity, but flap shaping is less versatile and distal necrosis occurs more easily due to the more superficial vascular supply.

The SGAP (Superior Gluteal Artery Perforator) flap and the IGAP (Inferior Gluteal Artery Perforator) flap

The SGAP and IGAP flaps are based on cutaneous perforators of the superior and inferior gluteal arteries respectively. These are terminal branches of the internal iliac artery. If the abdominal wall cannot be used, these flaps provide a satisfactory alternative. In a series of 170 GAP flaps, Guerra described a 6% rate of vascular complications requiring anastomotic revision. Total flap failure rate was 2% (16). This technique is ideally suited to reconstruction of small to moderately sized breasts. Donor site scar visibility and morbidity are minimal. Dissection can be tedious, however and may give rise to limited pedicle length. The procedure also requires a change in body positioning during surgery.

The Anterolateral Thigh (ALT) flap

The anterolateral thigh (ALT) flap is based on septocutaneous or musculocutaneous perforators of the descending branch of the lateral circumflex artery, a branch of the deep femoral artery. Extensively used in head and neck reconstruction, its pliability and large skin paddle makes it an alternative for breast reconstruction in moderately sized breasts, although the position of the scar may not be acceptable to some patients. The pedicle length is up to 10 cm and Wei described a total failure rate of 1,79% (17).

Transverse Myocutaneous Gracilis (TMG) flap - Transverse Upper Gracilis (TUG) flap

The TMG or TUG flap is perfused by the ascending branch of the medial circumflex femoral artery supplying the gracilis muscle. The pedicle is short (6 cm) and the flap size is limited by the volume of tissue available on the inner thigh. The skin paddle is transverse or combined with a vertical part (fleur-de-lis). Coning of the flap results in an acceptable projecting breast shape. The thigh adductor muscles compensate for functional morbidity with loss of the gracilis muscle. Anterior dissection with disruption of lymphatic vessels in the femoral triangle must be avoided. Donor site dehiscence may prolong healing and as is observed in inner thigh lift procedures, the scar may sag beneath the bikini-line. These flaps are an alternative for small to moderate breast reconstructions in women who want to avoid scars on the abdomen, the back or the buttocks, or for patients who have previously undergone abdominoplasty or liposuction. Slim patients who lack sufficient abdominal tissue or who are unable to have an implant reconstruction are also appropriate candidates (18).

Profunda Femoris Artery Perforator (PFAP) flap

The PFAP flap has a long pedicle (10-13 cm) and is prepared using the proximal musculocutaneous perforator of the first medial branch of the profunda femoris artery. Excess tissue on the posteromedial inner thigh is used. The skin paddle is elliptical with a maximal width of 10 cm allowing primary closure. This technique is used for small to moderately sized breasts. As in the TUG flap, there is an elevated risk of wound dehiscence. The donor site is well hidden in the crease although sagging occurs (19).

Lumbar Artery Perforator (LAP) flap

The LAP flap contains excess skin and fat tissue extending from the lower back to upper buttock. In a series of 35 LAP flaps by Peeters, a vessel interposition graft was necessary in 80 % to correct pedicle length or recipient vessel mismatch. Larger flaps can be harvested by gluteal extension (20).

The deep circumflex iliac artery (DCIA) flap or Rubens flap – the Dog Ear flap

The DCIA flap uses fatty tissue in the region overlying or just above the iliac crest. It is a second choice after previous abdominoplasty, as a salvage procedure after failed free flap breast reconstruction or as a second free flap in case of contralateral breast cancer. Donor site morbidity is minimal when the abdominal wall musculature is closed correctly. Recently, Colebunders has used the lateral dog ears remaining after DIEAP breast reconstruction donor site closure, as a DCIA perforator flap (21).

Composite reconstruction

Combining autologous tissue with foreign material has been used for decades (e.g. LD-flap with a prosthesis). Skin flap thickness for prosthesis coverage is a problem in a pre-pectoral position or in the lower lateral quadrant in a sub-pectoral position. An acellular dermal matrix is an additional tool for resolving these problems (22). Recently, fat grafting has been used to improve upper pole prosthesis coverage in a staged procedure (serial deflation-lipofilling), allowing use of a much smaller prosthesis (23).

Bilateral prophylactic surgery and primary breast reconstruction

5%–7% of breast cancer cases are due to a genetic defect. Women with mutations have an elevated lifetime risk of developing breast cancer. Immediate prosthesis reconstruction after bilateral preventive skin and/or nipple sparing mastectomy is challenging due to poor dermal vascularization of the mastectomy flaps. Changing nipple position results in a higher risk of nipple necrosis (24). Figure 3 shows a successfully staged technique with bilateral nipple and areola sparing mastectomy. Immediate prosthetic reconstruction should only be considered in small, non-ptotic breasts.

Bilateral DIEAP flaps are the autologous golden standard. Secondary correction of ptosis or removal of the monitoring free flap skin-island is usually necessary.

Conclusion

Over the last three decades, a multidisciplinary surgical approach has resulted in an exponential growth in breast reconstruction possibilities. A breast that appears and feels realistic should be created using low-risk surgery, especially in genetically predisposed young women. Perforator flap surgery is nowadays the ultimate tool for reducing functional donor site morbidity. Evolution in prosthesis types and materials such as acellular matrices is largely responsible for the increased number of prosthetic reconstructions worldwide.

The trained plastic microsurgeon has a vast armamentarium for dealing with challenging tertiary procedures in case of flap loss or late major prosthetic complications such as severe recurrent capsular fibrosis. Secondary morbidities such as lymph-oedema can simultaneously be addressed in specific autologous procedures. Finally, artistically performed composite surgeries can sculpt a definite breast shape. 3D bio-printing by tissue engineering and stem cell technology are promising techniques for the future.

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Figure Caption

Figr-1

Figure 1: Primary prosthetic reconstruction

(Nipple sparing reconstruction – NSM / Non nipple-sparing reconstruction – NNSM / Moderate Profile – MP / High Profile – HP / Acellular dermal matrix – ADM / type IV subcutaneous mastectomy : Weiss pattern incision subcutaneous mastectomy))

Figr-2

Figure 2

Preoperative and postoperative view after 1 year of a subcutaneous mastectomy left and primary DIEAP flap reconstruction left, left nipple and areola reconstruction, bilateral tattooing of nipple and areola-complex and a contralateral breast reduction with inferior pedicle.

Figr-3

Figure 3

Preoperative and postoperative view after 1,5 year of a staged prophylactic procedure with bilateral reduction mammoplasty followed by bilateral nipple and areola sparing mastectomy, skin expansion and definite bilateral subpectoral prosthetic reconstruction

Table 1: Advantages and disadvantages of different types of breast reconstruction

Reconstruction type/ pro-con's	Prosthetic	Autologous free flap	Autologous pedicled flap
Primary reconstruction	Yes	Yes	Yes
Secondary reconstruction	2 or more stages	1 stage possible	1 stage possible
Procedure length	1-2 h	6h	2-3 h
Breast behavior	Static	Dynamic	Dynamic
Capsular contraction risk	Yes	No	No (Yes when Composite)
Pre-reconstruction radiotherapy	Higher complication risk	Low (at least 6 months after RTH)	Low
Hospital stay	Day case	4-5 days	2-3 days
Permanent result	No	Yes	Yes
Temperature	Less warm	Body temperature	Body temperature
Donor site scars	No	Yes	Yes
Donor site morbidity	No	Yes	Yes
Flap perfusion	No	Yes	Yes
Symmetry	Small non-ptotic breasts	Moderate ptosis and volume	Small non-ptotic breasts
Ptosis solution	No	Yes	No
Rippling	Yes	No	No
Emptiness upper breast pole	No	Sometimes	Sometimes