Contents

10.6. Superior-pedicle, inverted-T mammoplasty

PÉTER KELEMEN, JÁNOS JÓSVAY

10.6.1. Introduction

The first breast reduction surgeries were performed towards the end of the 18th century. Later, with the development of plastic surgery in the 20th century, numerous more reliable surgical techniques were described. With appropriate patient selection, the superior-pedicle, inverted-T technique (Pitanguy, 1967) is one of the most reliable and popular surgical techniques (Level II. OPS) for medium or large breasts (B+ bra cup size). It is ideally suited for tumours located inferior to the central horizontal dual-layer fascia (Würinger's septum/fascia) in the lower quadrants, close to the inframammary fold (IMF) (20%) and occasionally for central tumours (20-25%). The technique is named after the direction of blood supply of the remaining breast tissue and nipple-areolar complex (NAC), and it also gets its name from the inverted-T shaped suture line running in the axis of the lower poles and the IMF. Planning and performing the surgery requires theoretical and practical plastic surgical proficiency in breast reduction and mammoplasty techniques. Besides its obvious oncological advantages, this procedure has many other benefits in terms of improved aesthetic outcomes and quality of life (dressing, sports activity, reduced vertebral loading), especially for unusually large breasts. In addition to the shape and size of the breast, tumour parameters, breast density and patient co-morbidities (obesity, smoking, diabetes etc.) also need to be evaluated in order to determine eligibility for surgery. For large breasts, wound healing problems due to a larger wound surface may delay the initiation of adjuvant therapy. Dissection of the breast tissue in the lower quadrants from the pectoral fascia and division of the upper and lower hemispheres by the Würinger's fascia facilitate an oncologically safe, wide anatomical resection. After making an incision in the IMF and dissecting the breast tissue from the pectoral fascia, the parenchyma can be palpated between the fingers, which can serve as an important practical feature for assessing the tumour margins. This type of surgery requires contralateral symmetrisation, which can be performed immediately or on a delayed basis.

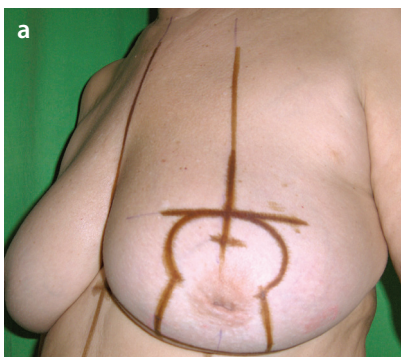


Figure 10.6.1a. 64-year-old female patient with palpable ILC at the junction of the lower quadrants, cT2N0 M0. Marking and surgical planning for inverted-T technique

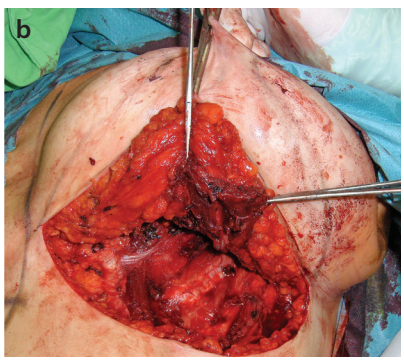


Figure 10.6.1b. "En bloc" resection, containing the pectoral fascia below the tumour

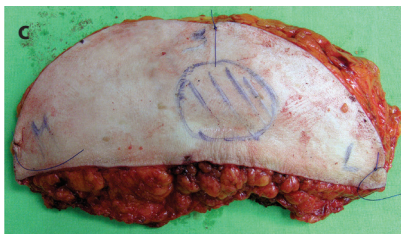


Figure 10.6.1c. Specimen with conventional labelling, weights 391 g.

Figure 10.6.1d. Reconstruction of the breast

Figure 10.6.1e. Cosmetic outcome at 5-year recurrence-free control

10.6.2. Marking and surgical planning

The procedure may be performed by two teams (reconstruction by a plastic surgeon can follow oncosurgical resection by a breast surgeon), but it is preferable for the entire surgery to be planned and performed by an oncoplastic breast surgeon. Following preoperative marking, the tumour can be excised "en bloc" with extended margins and atraumatic tissue manipulation to include the skin over the tumour. After the tumour bed is marked, the breast is remodelled.

For large breasts (D+ bra cup size) or gigantomastia (breast volume is larger than 1500 ml) the reduction can exceed 50% of the total breast volume. If this is the case, then the resection should contain the skin of the lower hemisphere. The advantage of "en bloc" resection is the lack of unnecessary undermining of skin or breast tissue, resulting in a lower rate of wound healing disturbances. In smaller breasts (B-C bra cup size), particularly if the tumour is located medially or laterally, symmetrical excision of the parenchyma may be needed. In such cases, the lower pole of the breast is mobilised from an inframammary incision, the tissue around the tumour is palpated, and then a wide excision (with 1-1.5 fingerbreadths of free margin) is performed, containing the skin above the tumour. This gives the possibility of approximating the remaining breast tissue by appropriate rotation, without leaving any dead space. During patient evaluation, the safety of preservation of the NAC has to be oncologically and surgically evaluated (see in Chapter 10.3.).Tissue necrosis and consequent wound healing

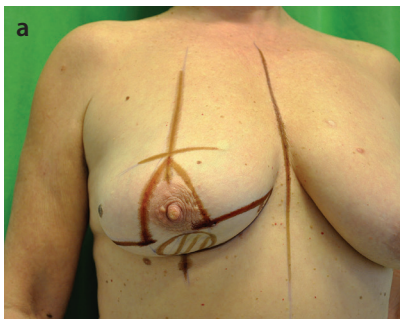


Figure 10.6.2a. 53-year-old female patient with tumour at the junction of the lower quadrants, close to the NAC

Figure 10.6.2b. Wide excision, containing the NAC, 18 mm IDC and 4 mm-sized satellite tumour, pT1cpN0(i+)(sn)

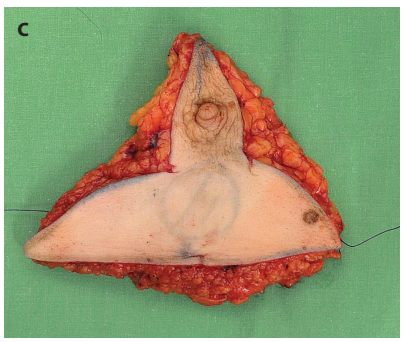


Figure 10.6.2c. A 272 g specimen after conventional orientation

Figure 10.6.2d. Tumour excision followed by inverted-T mammoplasty and nipple reconstruction

Figure 10.6.2e. Cosmetic result at 19 months postoperative

Figure 10.6.3a. Planning for inverted-T breast reduction. 55-year-old female patient with palpable tumour at the junction of the lower quadrants. Imaging studies showed a 20 mm-sized tumour

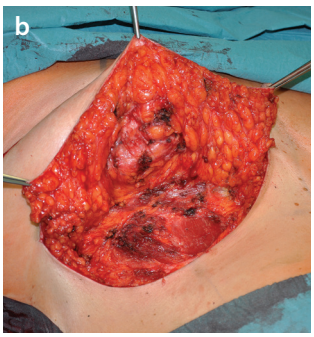


Figure 10.6.3b. Superior pedicled inverted-T OPS. pT2pN0(sn), surgical margin is >10 mm in all directions

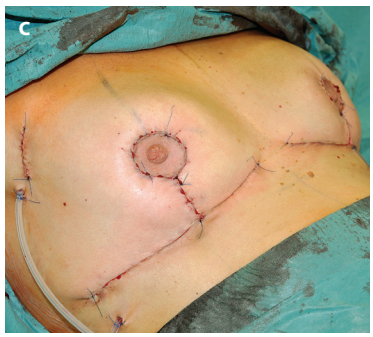


Figure 10.6.3c. Immediate contralateral symmetrisation

disturbances caused by insufficient blood supply to the NAC may delay the initiation of adjuvant therapy. If the nipple needs to be lifted by more than 10-12 centimetres, the risk of partial or complete necrosis of NAC caused by problems with blood supply is increased. If any sign of tissue ischemia (congestion, whitening) is noticed during the operation, removal of the NAC has to be preferred (see in Chapter 10.14.). A neo-NAC can be created either immediately or on a delayed basis. The wound should always be closed without any tension, even if this compromises the shape of the breast to some degree, in order to reduce the likelihood of wound related complications.

During the surgical planning, the patient should be examined both in standing and supine positions. The midline and the breast meridian (that is not necessarily in line with the nipple) is drawn in standing position. The IMF is marked and projected on the anterior surface on meridian of the breast. This shows the subsequent position of the post-reduction nipple. A perpendicular line is drawn on the meridian at a 2-centimetre distance from this point, indicating the upper margin of the areola. Preoperative marking of the areola depends on the experience of the surgeon. While some prefer to perform accurate preoperative planning and then proceed to incise the epidermis as the first step of the procedure, others only plan the location of the neo-nipple preoperatively. The exact location of the areola and de-epithelisation of the skin are left as one of the last steps of the surgery. The latter technique enables the precise repositioning of the neo-NAC in every direction on the remodelled breast at the end of the operation. It is recommended that individual surgeons choose their preferred method based on their own experience. Care should be taken to avoid excessive cranial lifting, which lets the nipple "fall out" of the bra cup. Repositioning of an excessively cranially placed neo-NAC is complicated, and very difficult to manage without leaving visible, deforming scars. The margin of the de-epithelisation (dermal flap) is marked out in a circular or onion shape. The vertical incision limbs are determined by the lines connecting the midpoint of the IMF and the position of the neo-nipple, while internally and externally rotating the breast. The horizontal incision is drawn from this line over a distance of 9-12 centimetres, depending on the size of the breast remnant after resection. The size of the areola is reduced as necessary, usually to a diameter of 3.5-4 cm.

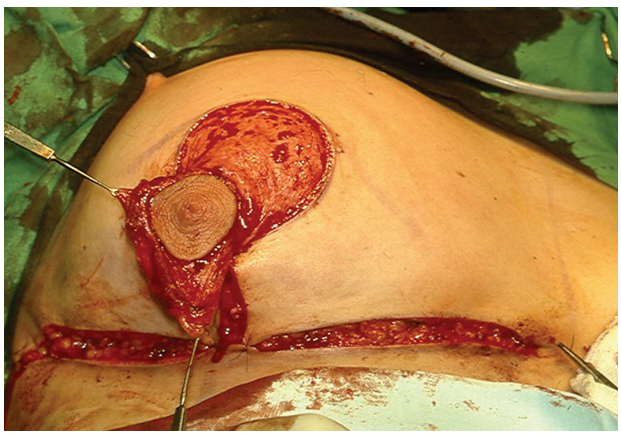


Figure 10.6.4. Cranially de-epithelialised dermal flap

10.6.3. Surgical technique

The surgical markings are checked in a position identical to the one on operating table. The markings can be redrawn after prepping the operation field. For a palpable lesion, the incisions can reliably be drawn in advance. For non-palpable tumours, the exact location and extent of resection can usually be decided only on the operating table.

The ROLL technique is recommended in preference to other localisation techniques for non-palpable tumours. Since the point of insertion of the localisation needle/hook wire is not necessarily part of the operative field in every case, "en bloc" resections can be challenging for wire-guided localisation. In these cases, the primary reference points are drawn preoperatively, most importantly the place of the new nipple and the upper margin of the areola in the breast meridian. The procedure classically begins with de-epithelisation of the cranial dermal flap, and then the IMF is incised.The glandular breast tissue is dissected from (or with) the pectoral fascia to the Würinger's septum, its caudal plate is transected so that the breast can be bloodlessly separated into upper and lower hemispheres by experienced hands.

Complete or partial removal of the lower quadrants forming the lower hemisphere can be performed along this anatomical layer, with or without the covering skin. The new shape of the breast after resection is developed downwards by merging the parenchyma and removing the redundant skin in the direction of the IMF.Reshaping the remaining breast tissue results in a lifted, tighter breast with a narrower base. The location of the tumour bed is marked by titanium clips, and the wound is closed using simple or running absorbable subcutaneous monofilament sutures in multiple layers. Suction drains can be placed into the wound cavity as needed and left there until less than 50 ml clear serous fluid is drained per day. Wound dressing should be managed according to general surgery principles. The sutures need to be removed in multiple stages, depending on the pace of wound healing, usually after 2-3 weeks. Patients must wear a supporting brasserie for 6 weeks to reduce tension on wound edges. In the first 4 weeks, this should be worn continuously, and after that only during the daytime.

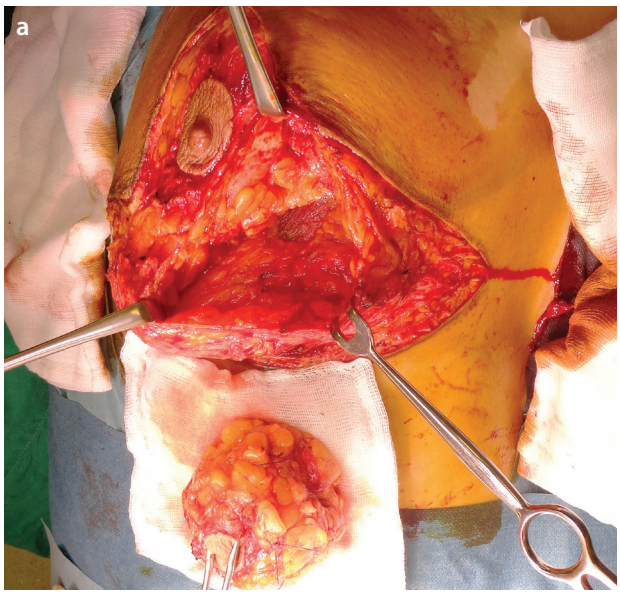
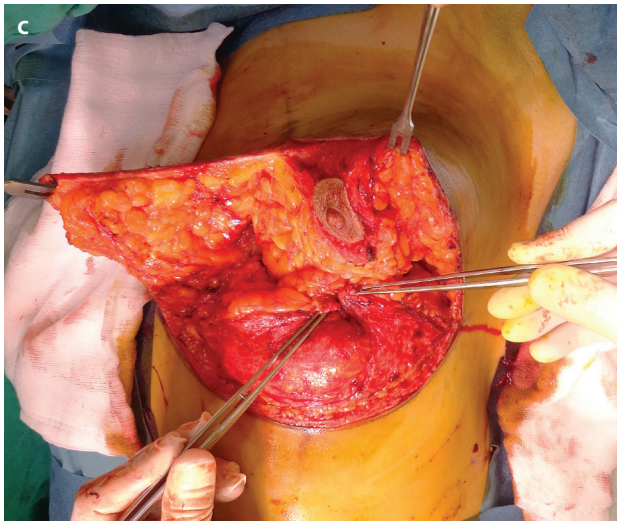


Figure 10.6.5a 52-year-old patient after excision of a 33 mm-sized IDC from the lower-outer quadrant, treated by superior pedicle, inverted-T OPS. pT2N1M0 (Grade III., ER 90%, PR70%, Her2: negative, Ki67 40%). (Photos by Z Mátrai, NIO)

Figure 10.6.5b The pectoral fascia is also removed below the tumour. Clip marking. Parenchyma of the lower quadrants in the de-epithelialised area is partially intact



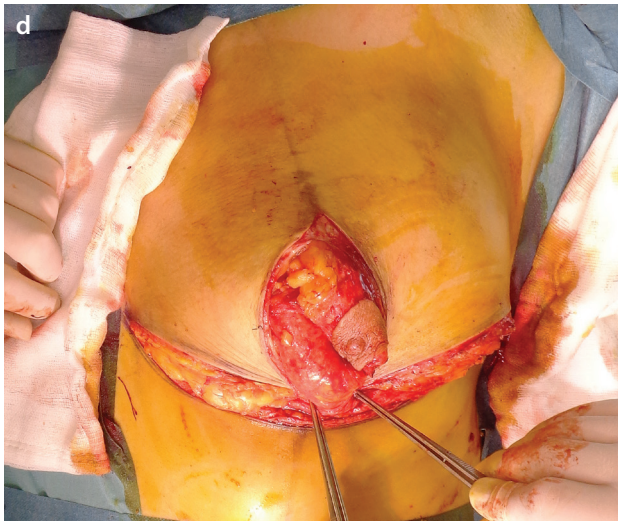
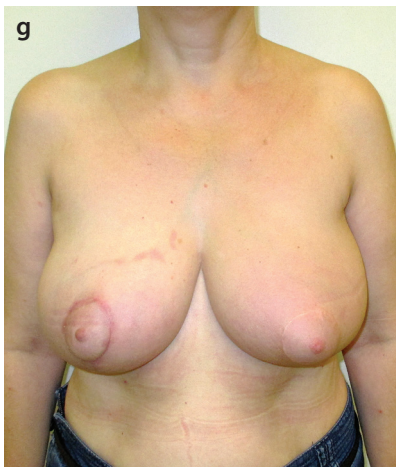


Figure 10.6.5c-d Remodelling the breast above Redon drain, using 2-0 and 3-0 Vicryl absorbable sutures

Figure 10.6.5e Cosmetic outcome 6 weeks after surgery, with concurrent adjuvant chemotherapy

Figure 10.6.5f Cosmetic outcome in the 9th postoperative month after WBI



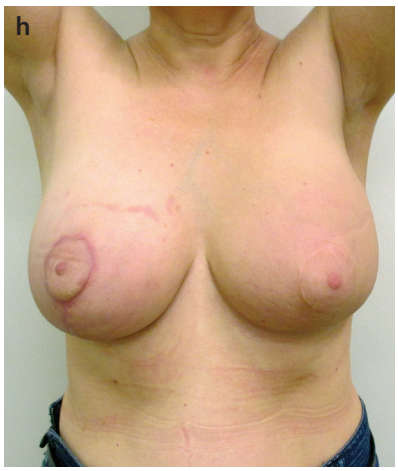


Figure 10.6.5g-i Cosmetic outcome after symmetrisation 13 months after OPS

Figure 10.6.5j-m. Long term cosmetic outcome at 60 months postoperative

Raising the arms overhead should be done only slowly and carefully. Manual labour and heavy lifting (more than 1-2 kilograms), physical training and sports are not recommended for 6 weeks. Sunbathing and use of sunbeds are also discouraged.

10.6.4. Complications

After breast reduction surgery, complications can occur (3-5%), as they can after any surgical procedure (bleeding, infection, wound healing disturbances). Fat necrosis in the parenchyma may develop, proportional to the size of the operated breast. In 30-50% of cases, the wound edges may slightly dehisce, and a small ulcer develops at the intersection of the vertical and horizontal incisions, 7 to 10 days after the procedure. Through this opening, necrotic fat may leak from the cavity as a yellowish-pink discharge. This spontaneously heals after a couple of weeks and does not require any special treatment. Only infrequently (2-5%), proportional to the size of the breast, some degree of wound dehiscence or skin necrosis may occur. This typical wound complication may also spontaneously heal with proper conservative treatment without any additional surgery, but usually leaves behind a broader and thicker scar (see also in Chapter 10.14.). Frequency and extent of transient loss of nipple and areola sensation are also proportional to the size of the breast. It can

range from complete loss of sensation to mild numbness or transient disturbing hyperaesthesia. Sensation usually gradually returns in a couple weeks or months, but a permanent loss might occur. Blood supply of the nipple and areola becomes impaired intraoperatively, proportional to the initial grade of ptosis of the affected breast. This general rule means that Higher grade of ptosis necessitates more extensive mobilisation of the dermoglandular flap, resulting in higher rate of insufficient blood supply and ischaemia of the NAC. This rarely (3-6%) results in partial or complete necrosis of the areola (influenced by impaired perfusion derived from general status, obesity, smoking or older age). The areola can be reconstructed by another surgery or tattooing in the latter instance of complete necrosis (see also in Chapter 10.14.).

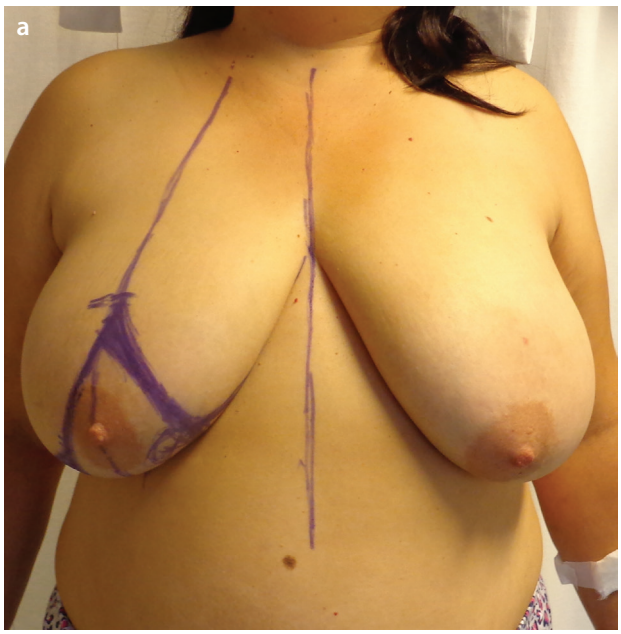
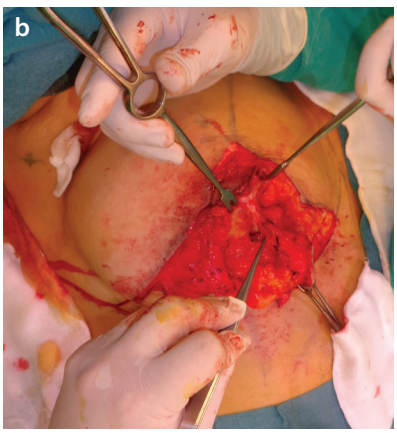


Figure 10.6.6a-m. The 51-year-old patient had a cT2N0 M0 IDC in her right breast located in the lower-inner quadrant. A superior-pedicle, inverted-T OPS was marked up. (Photo by Z Mátrai, NIO)

10.6.5. Conclusion

In conclusion, it can be stated that breast reduction oncoplastic techniques provide safe and wide resection margins. Complications (wound dehiscence, serous discharge, skin necrosis) do not delay the initiation of adjuvant therapy, and do not compromise follow-up and local control with adequate patient selection, according to retrospective studies. Local recurrence does not exceed the rate seen after conventional breast-conserving surgery. Asgeirsson et al. described a 0-1.8% per year local recurrence rate and 0-18% of cosmetic failure rate after 4.5 years of follow-up. Clough et al. described a 9.4% 5-year local recurrence rate. It is important for local control to identify and follow-up postoperative lesions (oil cysts, fat necrosis, calcification).



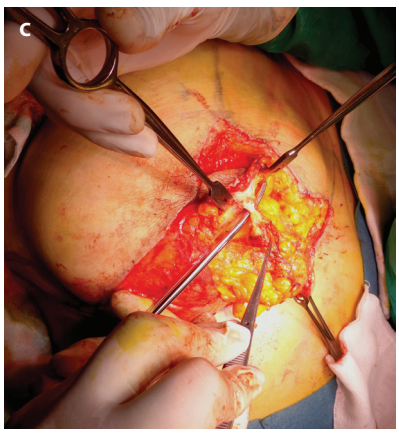


Figure 10.6.6b-c. The tumour was resected wide en bloc with the central ductal branch, which was dissected just below the nipple

Figure 10.6.6d-e. Tumour excision and specimen orientation. (Continued on the next page)

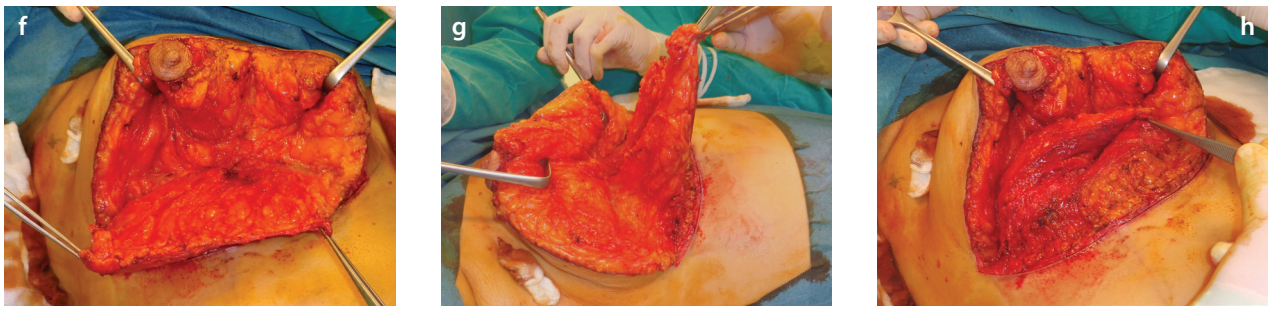


Figure 10.6.6f-h. De-epithelisation of the dermoglandular flap of the lower breast pole, and remodelling of the breast

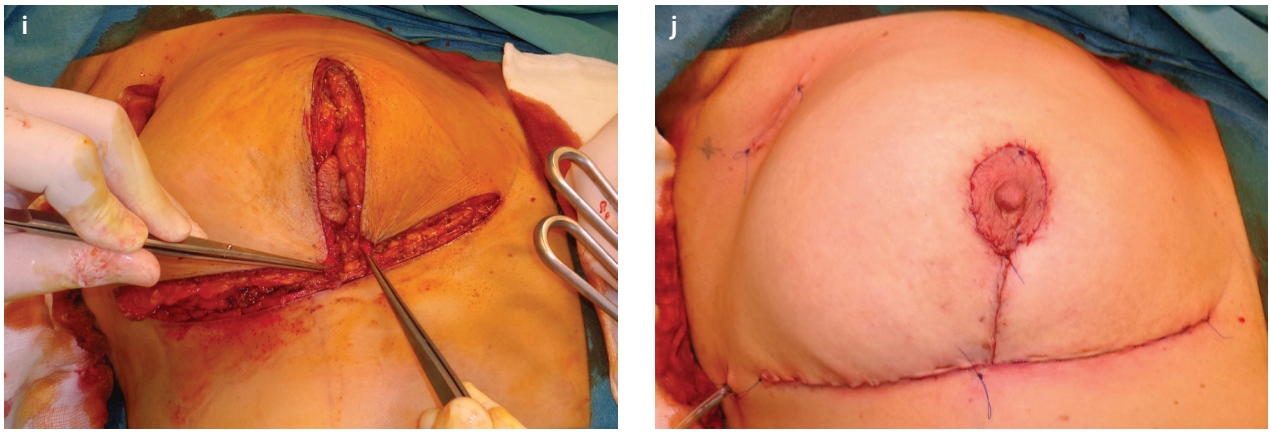


Figure 10.6.6i-j. Closure of the skin envelope

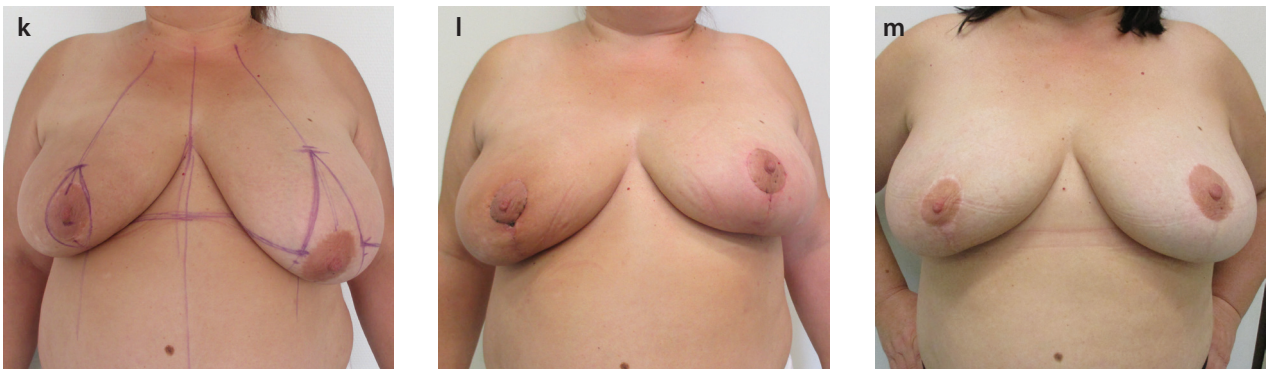


Figure 10.6.6k. Cosmetic outcome at 9 months postoperatively, after WBI

Figure 10.6.6l. Symmetrisation on the left side via inverted-T inferior pedicled reduction mastopexy, and elevation of the NAC with a re-mastopexy on the right side

Figure 10.6.6m. Cosmetic outcome at 48 months after the primary operation

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10.7. Vertical oncoplastic techniques

PÉTER KELEMEN, JÁNOS JÓSVAY

10.7.1. Introduction

Vertical oncoplastic techniques are based on the mastopexy and reduction techniques described by Madeleine Lejour in 1999. They (especially the medial pedicle version) became popular via the work of Elizabeth J. Hall-Findlay. The principle of the procedure is to avoid any incision in the inframammary fold (IMF). The scar line is only periareolar and vertical in the lower quadrants, stopping at the inframammary crease or 1-2 centimetres above, depending on the amount of excess skin. It provides the possibility of creating pedicles from any side of the NAC. The vertical incision can be extended laterally to "J", "L" or even inverse T-shape if needed. This technique is preferred when the breast is small or medium in size and has a regular shape, or if the tumour is located at the junction of the lower or upper quadrants in a slightly ptotic breast. Inappropriate use of this technique to avoid scarring in a larger breast is pointless, since the periareolar and vertical removal of the excess skin needs wide skin and parenchymal undermining, resulting in unnecessary wound surfaces and the possibility of complications.

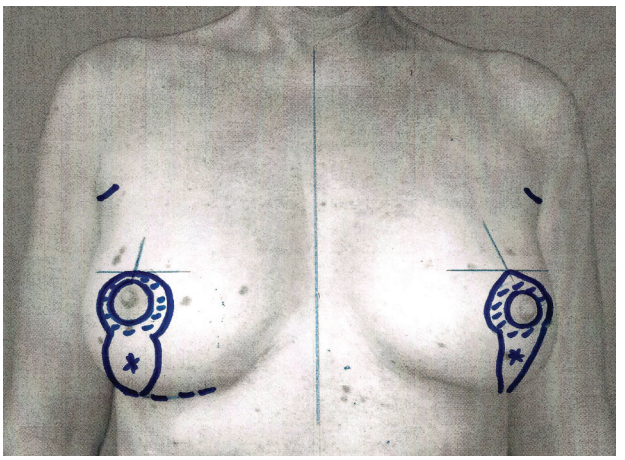


Figure 10.7.1. Schematic drawing of vertical mammoplasty. Mammoplasty with an "8" or "snowman" shape on the right side. Classic "V" shaped excision and periareolar de-epithelialisation on the left side. Sentinel lymph node biopsy is performed from a separate incision

10.7.2. Marking and surgical technique

While planning the surgery, a "V" shape is drawn under the NAC, suited in size to the amount of skin to be excised, and a periareolar circle to close the legs of the "V" (See Figure 10.7.1., left side).

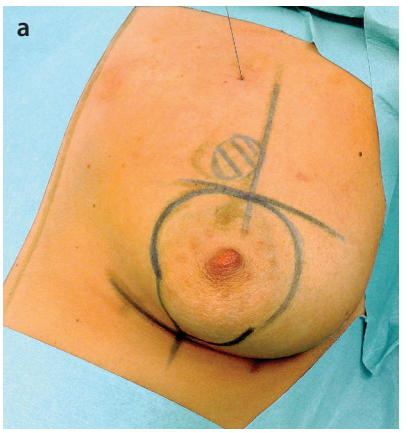
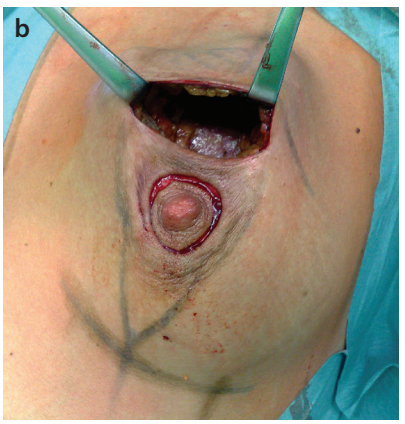


Figure 10.7.2a. A wire in a ptotic breast marks sclerosing adenosis situated medially, above the NAC



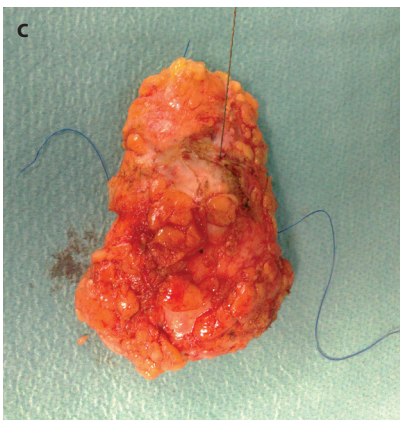


Figure 10.7.2b-c. After removing the specimen (weight: 74 g), the tissue defect is reconstructed by the dual plane approach and vertical technique with a V-shaped skin incision

Figure 10.7.2d. Closure of the circumvertical wound with intracutaneous suture

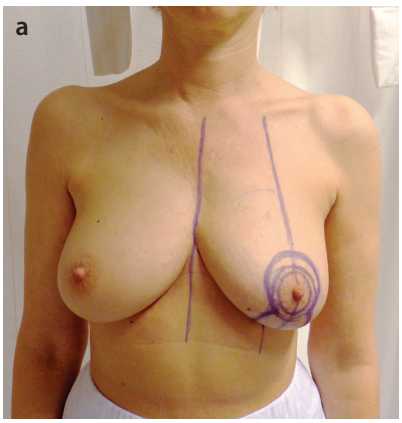


Figure 10.7.3a. A cT1cN0M0 ILC is revealed in the upper inner quadrant of the left breast. Preoperative planning. (Photos by Z Mátrai, NIO)

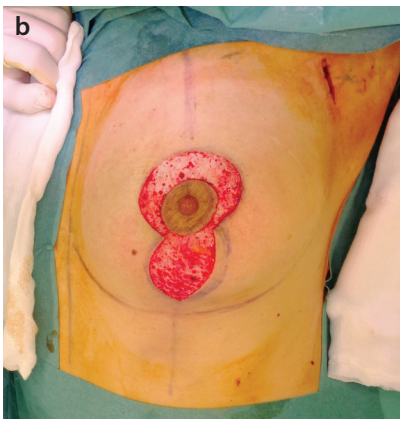


Figure 10.7.3b. De-epithelisation for circum-vertical OPS

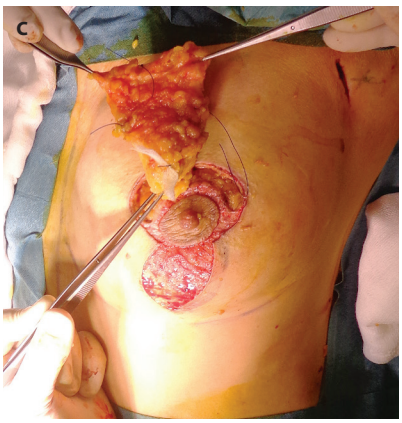


Figure 10.7.3c. Dual-plane mobilisation of the upper pole parenchyma from the periphery to the retromamillary area (size of the resected specimen: 6 x 3.7 x 3 cm, weight: 84 g) containing the complete ductal system of the involved breast lobe

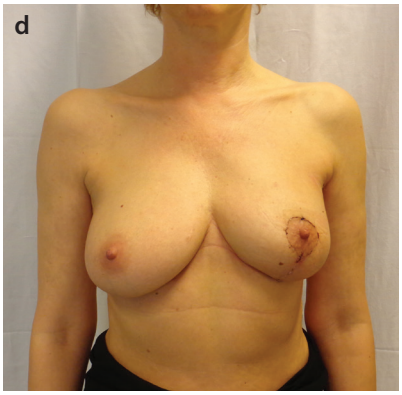


Figure 10.7.3d. Breast tissue is mobilised to fill the defect, leaving a vertical and periareolar scar

Figure 10.7.3e. Left breast immediately after whole breast irradiation (WBI)

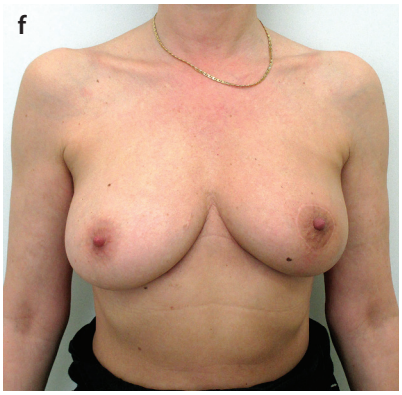


Figure 10.7.3f. Cosmetic outcome 13 months postoperatively after WBI

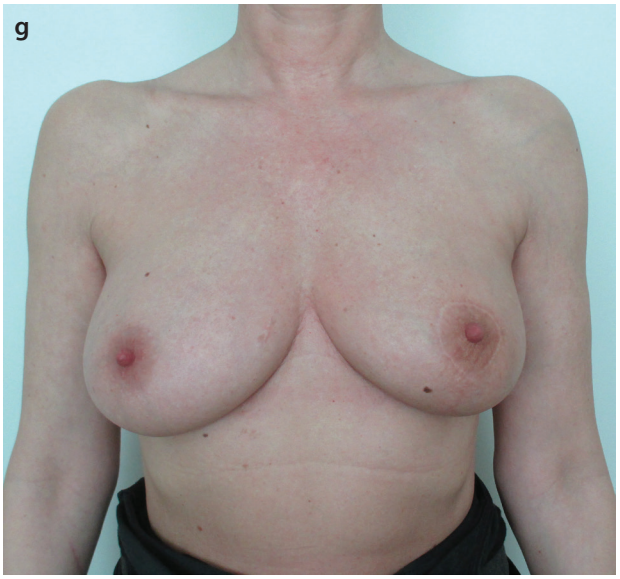


Figure 10.7.3g. Cosmetic outcome 24 months after WBI

The skin is de-epithelialised around the NAC to maintain the blood supply of the (sometimes smaller) NAC by preserving the subdermal plexus. The skin above the tumour is completely excised. After oncologically appropriate radical excision of the tumour situated at the junction of the quadrants, the tissue defect is reconstructed by mobilising the remaining breast parenchyma in one or two layers, from the medial, the lateral or both sides. The approximation is achieved by simple absorbable sutures, without leaving any dead space. The skin is closed in single or multiple layers of subcutaneous/intracutaneous monofilament sutures, in accordance with local practices. The most distal point of the vertical skin suture should be 1.5 - 2 cm above the IMF and this point can be anchored to Scarpa's fascia. This wrinkling of the vertical scar will be flattened in a couple of weeks. The wound cavity should be drained, and tumour bed should be marked with titanium clips.

Ptosis of the breast can be corrected by periareolar and vertical removal of excess skin. To achieve this, the surgical markings are drawn to mimic a "snowman" shape from the top of the subsequent areola to the IMF, allowing for the elevation of the nipple (See Figure 10.7.1., right side).Based on the orientation of surgical scar, the indications can be extended to excise tumours located in the lower inner and outer quadrants. Tissue defects can be reconstructed by dual plane mobilisation and matrix rotation glandular flap advancement, using the tissue of the adjacent quadrant. Rotation of the vertical incision can be beneficial, since undermining in one layer, dissection and rotation of breast tissue from pectoralis fascia can be enough to reconstruct the defect. It allows the removal of skin above the tumour by modifying the vertical technique and adapting it for lower quadrant tumours situated medially or laterally to the midline of the breast. In some cases, tumours located centrally and above the areola in the axis or near-axis can be removed using a vertical approach, especially in ptotic breasts.

This surgical technique can be chosen after regular quadrantectomy of superficial tumours. By taking advantage of the ptosis, a well-vascularised dermoglandular flap is brought to cover the defect.Vertical oncoplastic techniques require proficiency in mastopexy. Lacking this expertise can result in poor cosmetic and oncological outcomes.

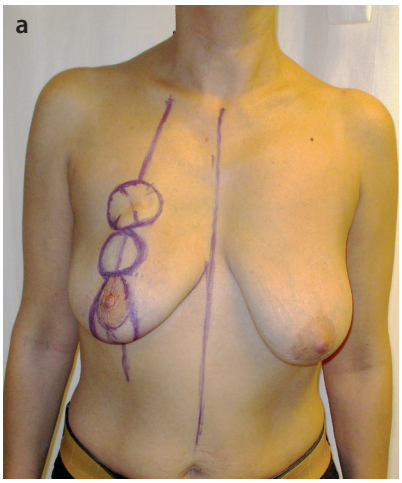


Figure 10.7.4a. A cT2N0 M0 IDC located high in the right breast, superficial just below the skin. Surgical plan of circumvertical OPS for quadrantectomy. (Photos by Z Mátrai, NIO)

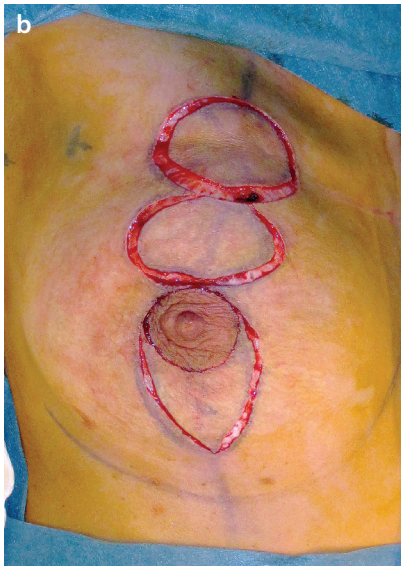


Figure 10.7.4b. Circular skin incisions oriented in the vertical axis of the breast

Figure 10.7.4c. Specimen and tumour bed after quadrantectomy (weight: 91 g)

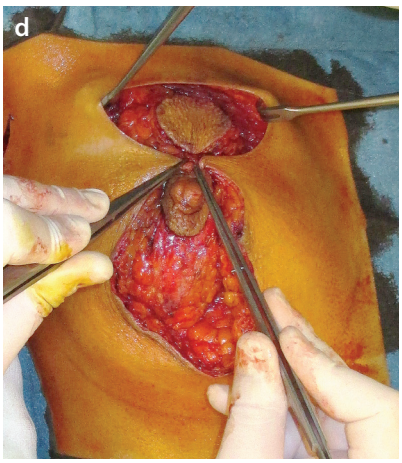


Figure 10.7.4d. Inferior pedicled dermoglandular flap transposed to the upper pole tissue defect

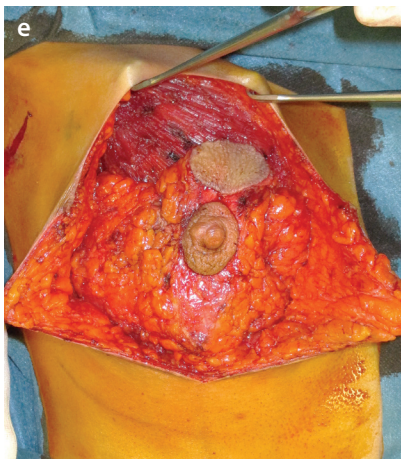
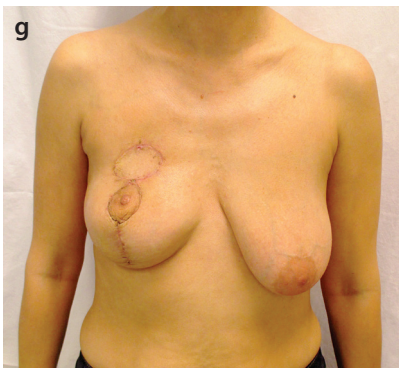
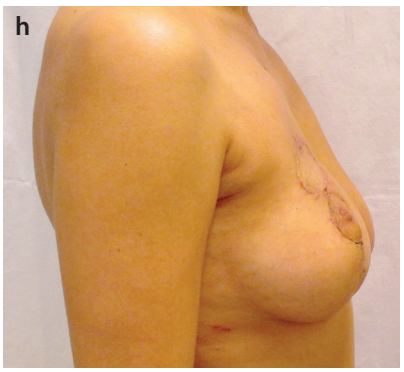


Figure 10.7.4e. Extended mobilisation of the central (perforator vessels running in the Würinger's septum) and inferior pedicled dermoglandular flap, containing not only the NAC but also a well-perfused skin island

Figure 10.7.4f. The remodelled breast just after the surgery (pT2N0(sn) IDC, R0 resection)





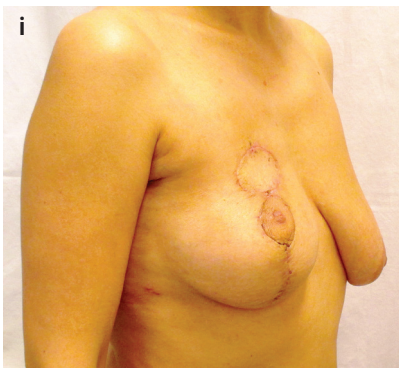


Figure 10.7.4g-i. Cosmetic outcome at 4 weeks after surgery

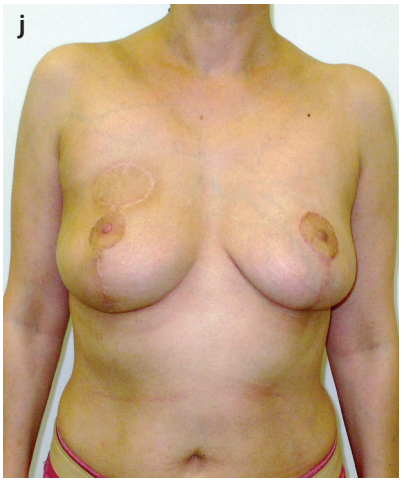


Figure 10.7.4j. Aesthetic result after adjuvant WBI and contralateral symmetrisation at 8 months after surgery

Figure 10.7.4k. Cosmetic outcome 13 months after surgery

Figure 10.7.4l. Cosmetic outcome 24 months after surgery

Figure 10.7.4m-p. Long term cosmetic outcome at 5 years after surgery. (Continued on the next page)

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Figure 10.7.4m-p. Long term cosmetic outcome at 5 years after surgery

10.8. Inferior-pedicle, inverted-T mammoplasty

ZOLTÁN MÁTRAI, PÉTER KELEMEN

10.8.1. Introduction

The size and shape of the female breast has led to the development of a variety of technical variations in aesthetic surgery. Classic plastic surgical principles and techniques of mammoplasty and breast reduction are reviewed in Chapter 10.3. The main purpose of these procedures is to achieve optimal aesthetic shape and a proportional size with the least scarring and complications, primarily by tensionless tissue approximation and preservation of blood supply of the nipple-areolar complex (NAC). Ribeiro described the inferior-pedicle, inverted-T reduction technique in 1975. The most important advantages of this technique are the safe preservation of the circulation of the NAC by the inferior pedicle, especially in remarkably large-sized breasts, in addition to filling the

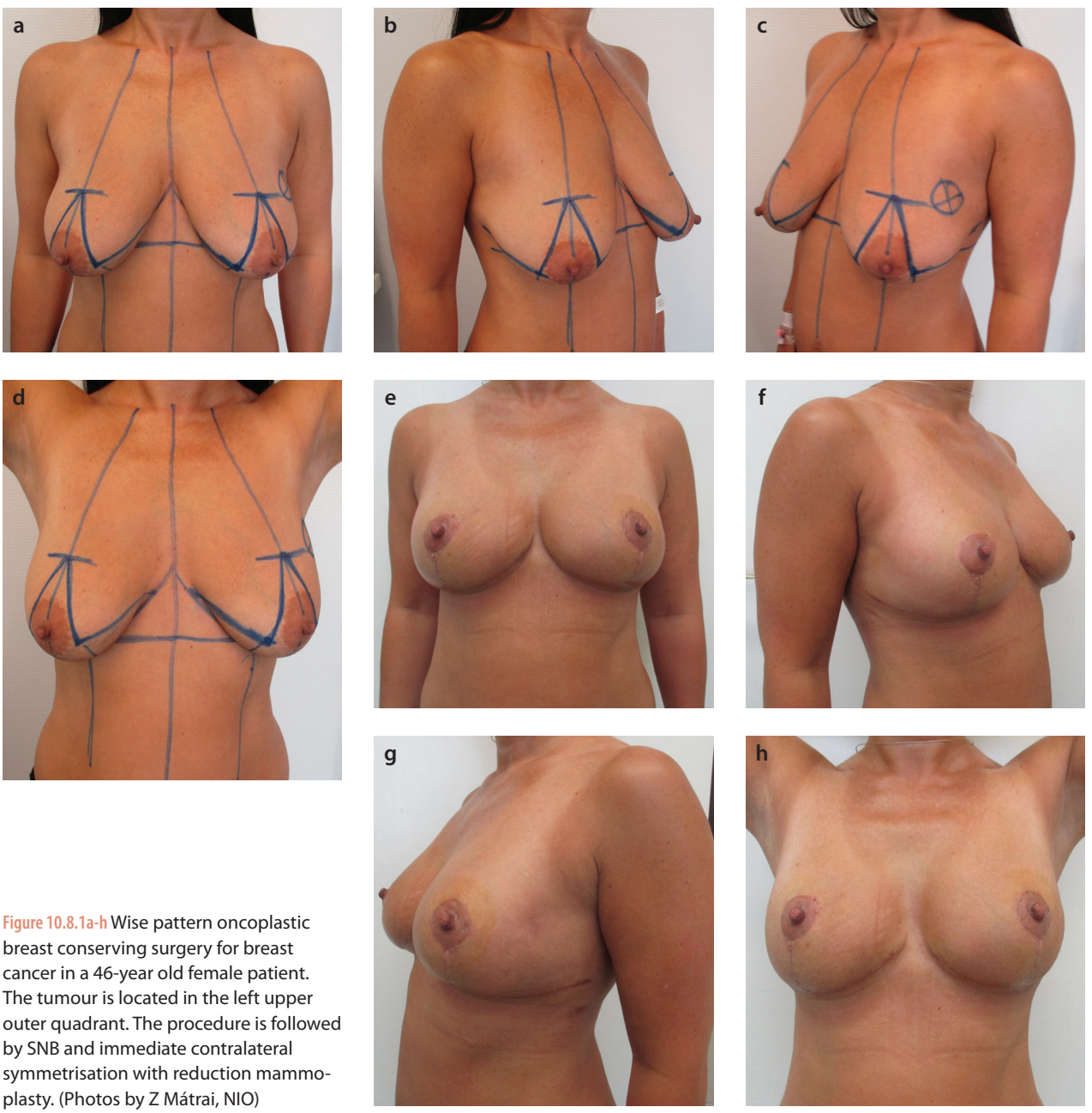


Figure 10.8.1a-h Wise pattern oncoplastic breast conserving surgery for breast cancer in a 46-year old female patient. The tumour is located in the left upper outer quadrant. The procedure is followed by SNB and immediate contralateral symmetrisation with reduction mammoplasty. (Photos by Z Mátrai, NIO)

volume of the upper pole of the breast by the parenchyma of the lower hemisphere. Planning and implementation of the procedure requires plastic surgical or oncoplastic proficiency.

In a similar way as the superior-pedicle, inverted-T reduction mammoplasty can also be adapted to oncoplastic surgery (OPS) as a so-called therapeutic mastopexy (Level II OPS) with appropriate patient selection. The clear advantage of this technique is that it allows oncoplastic excision and reconstruction of a tumour from any quadrants of the breast, including central tumours (see in Chapter 10.3), in larger (B+ cup size) and ptotic breasts. This is what separates this technique from others. The ideal situation is one in which the tumour is located in the area of the subsequent neo-NAC placement at a suitable height in a ptotic breast. In this case, after an oncologically safe en bloc resection of the tumour, if necessary with the overlying skin, the NAC can be precisely transposed into the defect. The tissue defect is filled by the breast parenchyma below the NAC, without leaving an open cavity.

Extensive resection is also feasible in large-sized breasts to alleviate the complaints of breast hypertrophy. If the lesion is located high over the level of ideal neo-position of the NAC, as mentioned above, therapeutic mammoplasty can be used with a minor modification. The defect can be filled by an inferior pedicled advancement flap, or in case of a synchronous skin defect by a skin island flap.

Figure 10.8.2a. Preoperative marking for inferior-pedicle, inverted-T mammoplasty for a palpable, cT1cN0M0 tumour at the junction of the upper quadrants. The tumour is situated above the NAC, in cosmetically optimal position

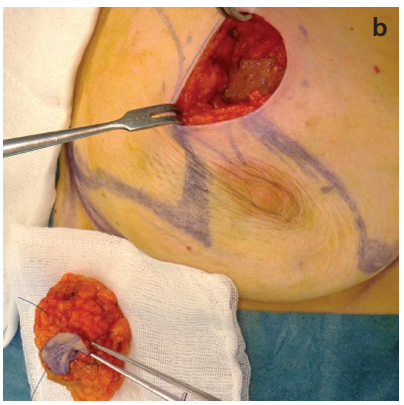


Figure 10.8.2b. Conventional quadrantectomy. The specimen weighs 70 g. Microscopically negative surgical margins. pT2N0(sn)

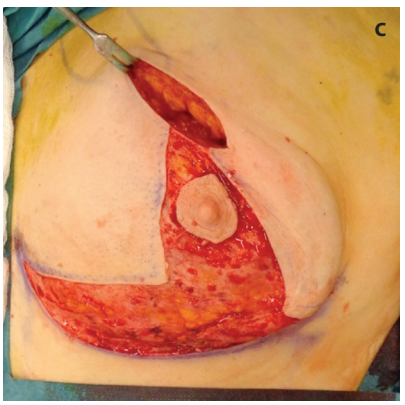


Figure 10.8.2c. De-epithelialisation matching the preoperative planning

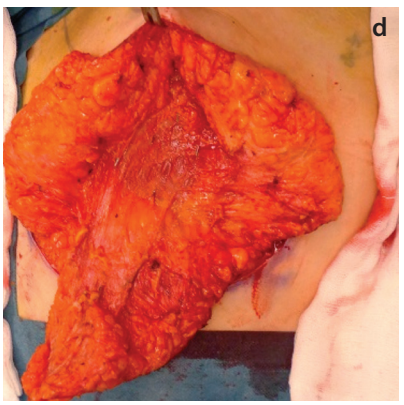
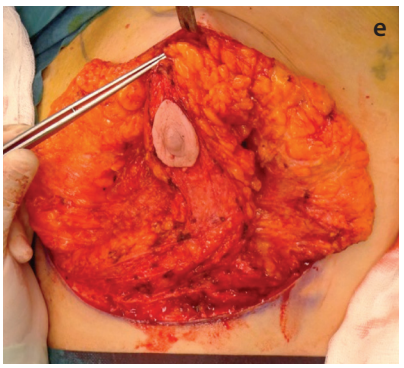


Figure 10.8.2d. Using proper surgical technique, there is great mobility of the central dermoglandular flap



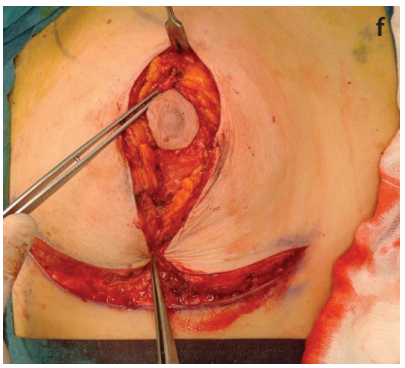


Figure 10.8.2e-f. Remodelling of the dermoglandular flaps

Figure 10.8.2g. Conventional inverted-T shaped wound after skin closure. (Photos by Z Mátrai, NIO)

In such cases, lateral matrix rotation technique is a suitable alternative.

Tumours located at the junction of the inner or outer quadrants that require quadrantectomy can also be filled by the transposition of the dermoglandular tissue from the lower-outer and lower-inner quadrants. In cases of tumours of the lower quadrants, the defect can also be filled by transposition of the adjacent, well-vascularised

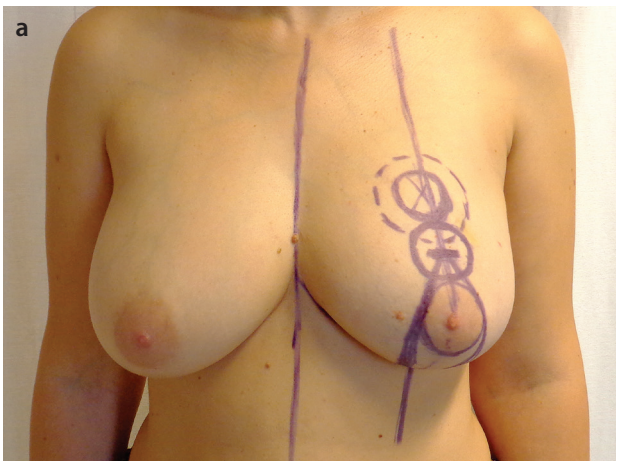


Figure 10.8.3a. Proper, accurate preoperative marking for a superficial, cT2N0M0 IDC with DCIS component at the junction of the upper quadrants

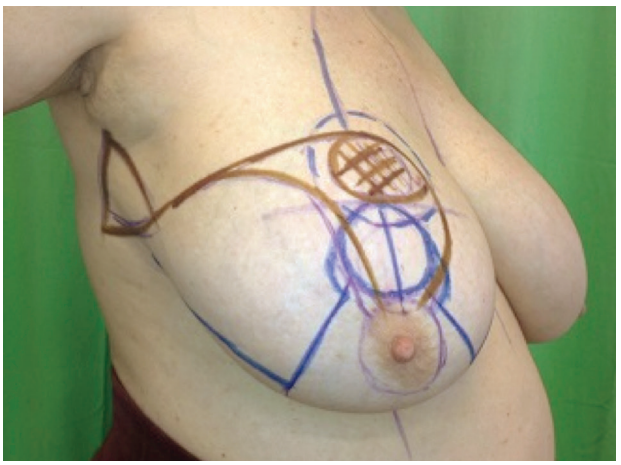


Figure 10.8.4. Location of the tumour allows various surgical techniques. (Photo by: P. Kelemen, Szt. Imre Hospital)

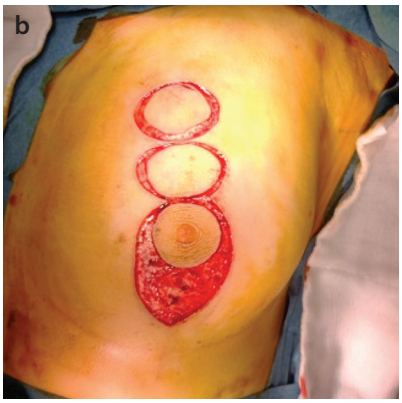


Figure 10.8.3b. Skin island over the NAC and the area of quadrantectomy above both

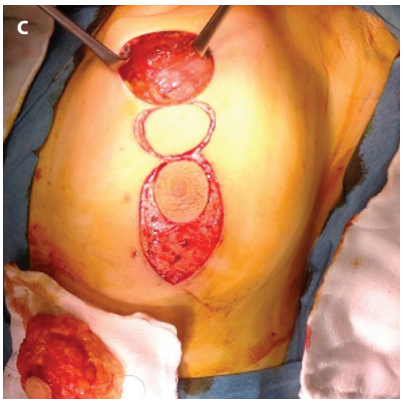


Figure 10.8.3c. Conventional quadrantectomy. The specimen weighs 94 g. Microscopically negative surgical margins. pT2N0(sn)

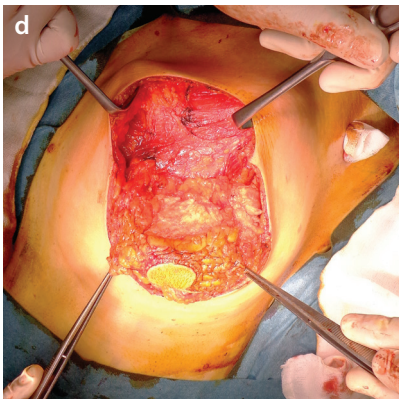
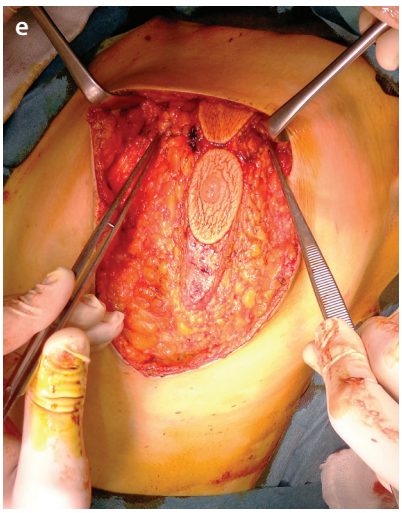


Figure 10.8.3d. Inferior pedicle dermoglandular flap and the tissue defect to be filled



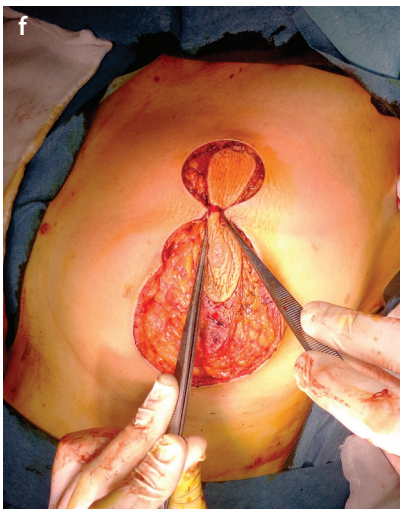


Figure 10.8.3e-f. Remodelling

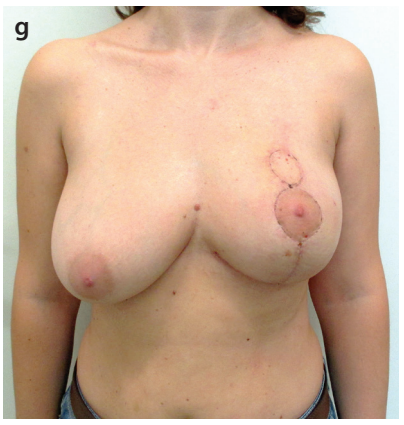


Figure 10.8.3g. Cosmetic outcome. Oncologically radical procedure; the young patient is cosmetically satisfied. (Photos by Z Mátrai, NIO)

dermoglandular tissue. This kind of remodelling requires plastic surgical expertise.

If the breast is operated on using any reduction or mammoplasty techniques, the contralateral breast should also be symmetrised in size and shape. This can be performed simultaneously with the oncoplastic procedure or as a delayed procedure after adjuvant radiotherapy (RT) when the final shape of the breast is attained and if significant change in the weight of the patient is not expected.

10.8.2. Surgical technique

Preoperative planning of the classic inverted-T-shaped incision is discussed in the chapters on mastopexies (Wise pattern mastopexy) and superior-pedicle, inverted-T mammoplasty. In this chapter, only some practical considerations for the planning of this procedure are reviewed. The first is the importance of the position of the neo-NAC and neo-nipple, which is discussed in detail in Chapter 10.6. Preoperative planning of the cranial edge of the areola, transection, and de-epithelisation during the early stage of the procedure requires plastic surgical skills. Malposition and cranial location of the neo-NAC cause the nipple bottoming out of the cup ("stargazing" phenomenon), which is a difficult-to-correct cosmetic handicap.

Therapeutic mastopexy of a larger sized breast should be accompanied by resection of excess skin, proportional to the volume reduction of the breast. Otherwise, the inverted-T sutures may cause tension, resulting in ischaemia of the skin edges. It is important to avoid very wide angles of vertical incisions during planning, otherwise the reduced skin envelope will not be able to cover the remaining parenchyma. Vertical incisions should not be too long (>9-10 cm), as they increase the aesthetically unfavourable sagging of the "belly" of the lower pole, and do not help to safely cover the residual glandular tissue. If the surgeon is not confident about their markings, then excess skin should be left. After the parenchymal resection, the skin can be adapted from above downwards with the help of a stapler, all along the inverted-T incision line. It can be redesigned, redrawn, additionally de-epithelialised and approximated without tension.

The key to success is accurate preoperative planning and precise marking up on the breast.

As the first step of the procedure, infiltration of saline-diluted adrenaline (1:1000) along the line of incision is indicated, as is routine during any OPS-technique. The aim is to prevent oozing of blood from the subdermal plexus that could compromise the dissection. The NAC is marked by an appropriate-sized (35-45 mm) cookie-cutter and the epidermis is transected along the preoperatively planned incision line (except for the skin of the neo-areola). Before cutting through full thickness of the skin, it is advisable to de-epithelialise a 4-5 mm-wide zone around all skin edges to avoid necrosis of the skin edges along the incision lines. The most medial part of the horizontal incision line should follow the inframammary fold (IMF), but preferably it should not be closer than 2 cm from the sternum, as this area is prone to wound hypertrophy and keloid formation.

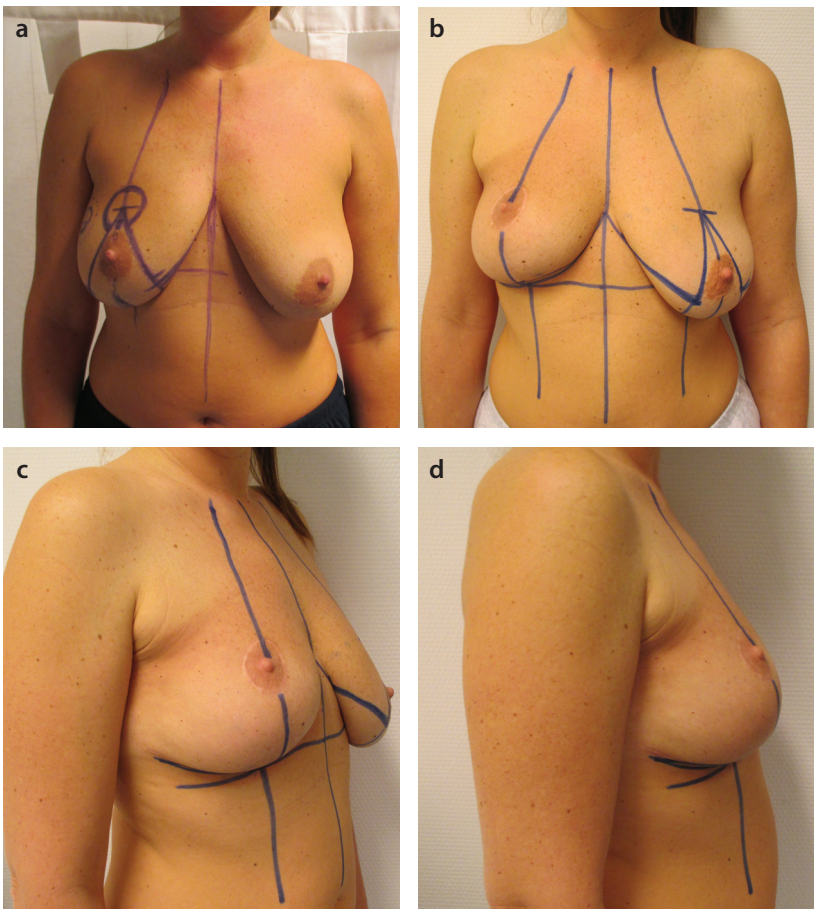


Figure 10.8.5a-d. Inferior-pedicle, Wise pattern inverted-T mammoplasty planned and performed too cranial for a tumour at the junction of the upper quadrants. It is recognisable on the postoperative pictures, especially on the right one, that the NAC is situated ca. 20 mm above the optimal position on the greatest curvature of the breast. (Photos by Z Mátrai, NIO)

Corresponding to the location of the tumour, either a wide excision or quadrantectomy can be performed, respecting Turnbull's principles (see Figure 10.8.2. a-b).

The tumour can also be removed after cautious stretching and de-epithelisation of the entire area.

Vigorous traction or squeezing of tumour-containing tissue, dermal or dermoglandular flaps should be avoided. According to the judgment and expertise of the surgeon, de-epithelisation can be accomplished with a scalpel or with a pair of scissors after scoring the epidermis at 2-3 mm intervals in a zebra-stripe pattern. In the IMF, the epidermis can be lifted with forceps and tangentially sharply dissected with a scalpel.

After conventional orientation markers, the specimen is sent for intraoperative mammography, for macroscopic pathological margin assessment or for histology.

For either axillary procedure, sentinel lymph node biopsy (SNB) or axillary lymph node dissection (ALND), a separate incision is recommended as a preferable option. Otherwise, extensive undermining is needed below the lateral skin flap, which can result in vascular impairment from the supplying perforator vessels and consequential ischaemia. If ALND is indicated, the block dissection should be performed only after removing the tumour.

After sending the specimen to pathology, the breast is prepped once more, gloves and instruments are changed

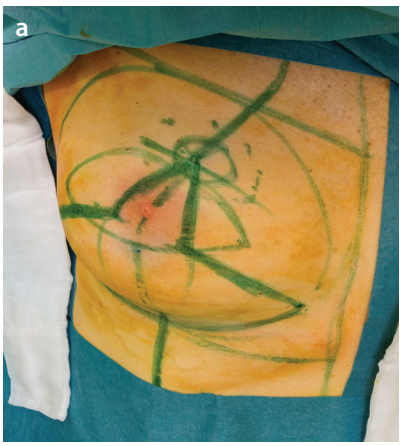


Figure 10.8.6a. Before the operation the preoperative mark up in standing position was done including the midline of the body, the footprint of the breast, the meridian of the breast, the IMF, the desired height of the neo-nipple position and the area of the skin excess to be removed by de-epithelialisation

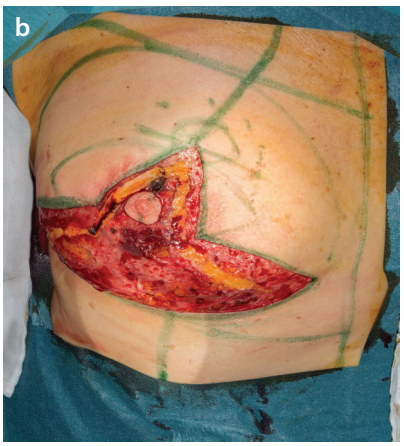


Fig.10.8.6b. De-epithelialisation of the preoperatively marked skin area on the lower breast pole with a scalpel. The de-epithelialised dermis is transected 5-10 mm from the markings in the vertical line with a cutting and coagulation (electrosurgical) device

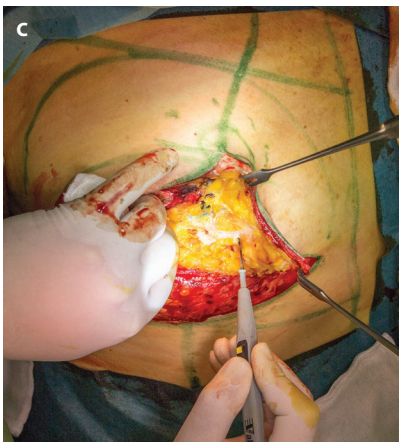


Fig.10.8.6c. On the vertical wound edges elevated by skin hooks the dissection is performed over the layer of superficial fascia in lamina anterior towards the pectoralis major muscle superficial fascia both in the medial and the lateral direction

Fig.10.8.6d-f. Considering the size and location of the tumour, wide excision or quadrantectomy is performed

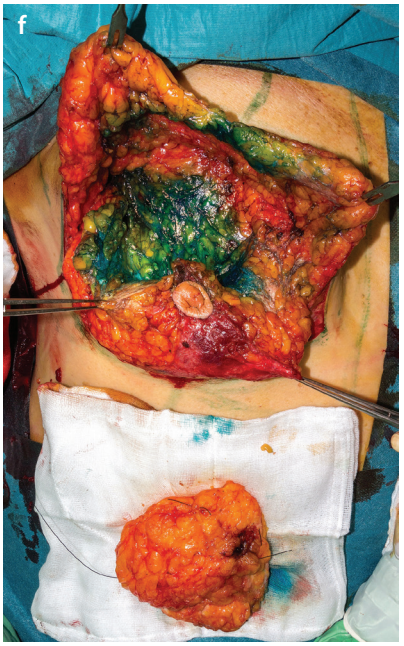


Fig.10.8.6g. By modifying the classic Wise pattern mastopexy, the mobility of the central glandular area is significantly increased by transecting the caudal horizontal incision (representing the IMF) with a slight downward inclination of the diathermy by the level of the pectoral muscle and chest wall. The structure of the IMF should not be divided, since the parenchyma could slip below the horizontal incision

(especially during immediate symmetrisation). The de-epithelialised dermis is transected at a distance of 4-5 mm from the markings in the vertical line with a cutting and coagulating (electrosurgical) device. (see Figure 10.8.6b.) With meticulous haemostasis, it is continued on the lower horizontal wound edges and distal edges in the IMF. It should be noted that precise mono- or bipolar coagulation of the bleeding is essential in OPS techniques. After accurately identifying the bleed, the vessels are clamped/caught, so that any unnecessary coagulation in a pool of blood that could lead to tissue necrosis is avoided. Adipose tissue is particularly sensitive to "scalding", resulting in fat necrosis.

At the vertical wound edges, only the dermis is elevated with skin hooks by the assistant. It should be raised and held while the operating surgeon uses counter-traction. Dissection should proceed both in the medial and lateral directions in the avascular plane, in the space between the anterior layer of the superficial pectoral fascia and the subcutaneous tissue. It is situated at a depth of 0.5-2 cm, and may vary in individuals. (see Figure 10.8.6c.) The central and surrounding flaps are dissected to the surface of the pectoralis major muscle, leaving well-vascula-

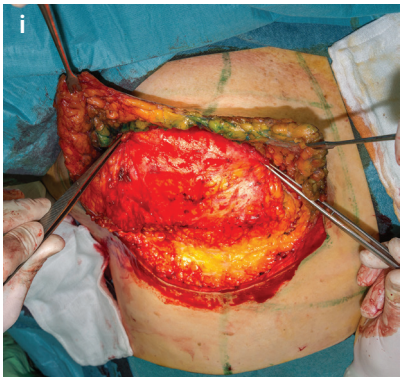


Fig.10.8.6h-i. After transecting Scarpa's fascia the residual breast tissue and NAC are supplied by the perforating vessels of the Würinger's septum, allowing the central glandular area to slide and rotate even by 5-6 cm into any quadrant without tension

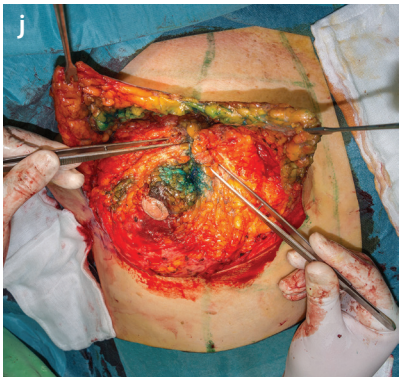


Fig.10.8.6j. The defect caused by the removal of the tumour is easily closed by surrounding parenchyma pillars using simple interrupted 2.0 absorbable sutures

Fig.10.8.6k-n. Next step is the approximation and closure of the dermis and subcutaneous tissue with simple interrupted absorbable sutures. Monofilament continuous 4.0 non-absorbable sutures are used for skin closure for the periareolar wound and continuous 3.0 non-absorbable sutures for the horizontal and vertical incisions in dual layer. (Photos by Z Mátrai, NIO)

rised flaps. It should be noted that the medial and lateral skin flaps can be mobilised partially or completely as an initial step, prior to resection of the tumour, depending on its location and size. In such cases, the tumour can be resected with a sufficient margin of margin from the denuded parenchyma. The retromammillary area can be excised in a wedge or cake shape in its full thickness, and then the glandular pillars can be approximated with absorbable sutures. In the case of extended dermoglandular mobilisation (so-called modified Wise pattern OPS), the flaps are supplied by peripheral perforating vessels, while the NAC and parenchyma are supplied by perforating vessels running in the Würinger's septum.

While dissecting this layer medially and laterally, some prominent intercostal perforating vessels are encountered at the level of the Würinger's septum, the trunk of which should be preserved. Dissecting laterally in the plane over the pectoralis major muscle to perform the axillary procedure is not recommended because some of the supplying vessels of the dermoglandular flap may be jeopardised. The medial and lateral flaps should be gently everted and covered with saline-soaked gauze to prevent them from drying out. Then the central dermoglandular flap should be mobilised.

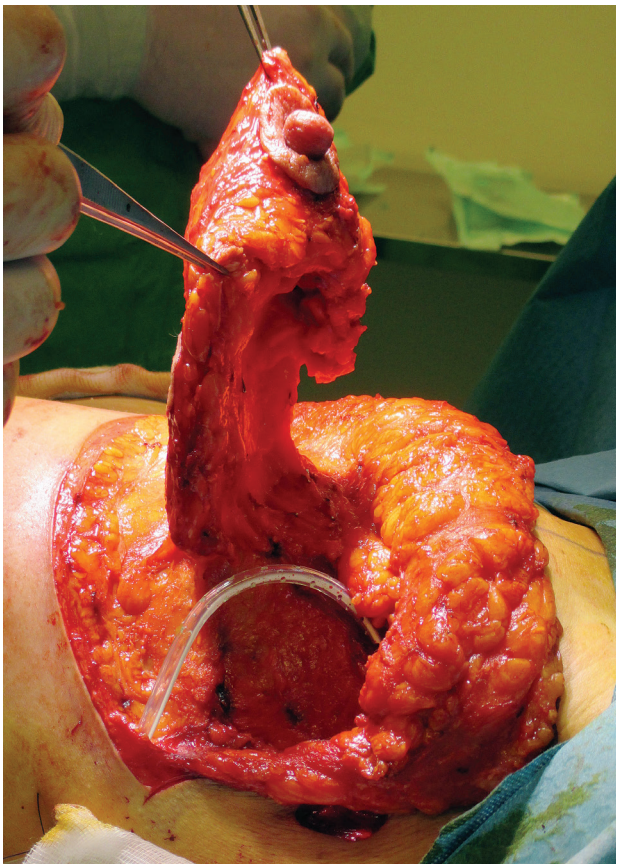


Figure 10.8.7. The circulation of the parenchyma and the complete NAC is supplied through a narrow pedicle by the vessels running in the Würinger's septum. (Photo by Z Mátrai, NIO)

By the modification of the classic Wise pattern mastopexy (modified Wise pattern OPS), increase in the mobility (with preservation of the circulation) of the central glandular area by 5-6 cm can be achieved, which allows the breast surgeon the freedom to slide and rotate into any quadrant without tension. (see Figure 10.8.6g-j.) The residual breast tissue and NAC are primarily supplied by the perforating vessels of the Würinger's septum after wide dermoglandular dissection. The caudal horizontal incision (representing the IMF) should be transected perpendicularly and with a slight downwards angulation of the diathermy at the level of the pectoralis major muscle and chest wall. The integrity of the IMF should not be disrupted, as the parenchyma could slip below the horizontal incision. After transecting Scarpa's fascia, the perforating vessels are visible at this level. They should not be harmed, as the central glandular area can be mobilised by 3-5 cm in any direction. (see Figure 10.8.6.e, and 10.8.3.d–e) If rotation of the dermoglandular flap is too demanding, then the flap can be mobilised from the chest wall by transecting some of the perforating intercostal vessels. Thoughtful attention should be given to avoid ischaemia and consequential (partial or complete) necrosis of the flap, covering skin, or NAC. General instructions about the extent of dissection on the chest wall are beyond the purview of this chapter, and experience in plastic and breast surgery is essential. A practical tip is to experience first-hand the location and size of the perforating intercostal vessels during conventional mastectomy, where the surgeon performs the procedure a couple of times with a scalpel and bipolar forceps to dissect the glandular tissue from the pectoralis major muscle instead of the now commonly-used diathermy. Removing the glandular tissue using a scalpel is slightly slower, but accurate dissection reveals the different flow patterns from the ensuing bleeding. Precise coagulation with bipolar forceps prevents any major blood loss compared to conventional diathermy dissection. A remarkable technical part of the operation is the preservation (with at least 10 mm margin) of the subdermal plexus, especially the one supplying the NAC and surrounding dermal area.After the dissection, meticulous haemostasis and tumour bed marking (ideally 3 clips on the pectoral fascia, 4 clips on the resection margins of the breast parenchyma) is performed. A drain is inserted from a separate site; revision and remodelling with absorbable sutures are then carried out. The first and most important suture is the one attaching the medial and lateral dermoglandular flaps at the appropriate edge of the IMF. (see Figure 10.8.2.f) The suture is placed in the intact dermis while the assistant elevates the central lobe with an instrument inserted from above. The suture may be under some tension, but it provides shape to the breast immediately. The central dermoglandular flap – with or without a skin island –

can be transposed into the tissue defect and anchored with absorbable sutures, if necessary. The next step is the approximation and closure of the dermis and subcutaneous tissue with simple interrupted absorbable sutures. A slipshod approach should be avoided. According to plastic surgical principles, the aim is to relieve tension from the skin sutures. Inadequate approximation results in a defective shape of the breast, widening of skin sutures, or even hernia-like protrusions, or so-called "bottoming out". The dermoglandular flaps are approximated without leaving any dead space. Monofilament threads are recommended for skin closure: 4.0/5.0 for the periareolar wound, and 3.0/4.0 in a single or dual layer for the horizontal and vertical incisions. Suture lines can be supported with SteriStrips, covered with mupirocin-soaked gauze and usual wound dressing.

If further reduction is required to accurately adapt the flaps, the upper central region is the most suitable for supplementary glandular resection. Proper orientation of the resected parenchyma is also necessary, in accordance with oncosurgical principles. This is the only way to ascertain if re-excision is required. Otherwise, mastectomy may be unavoidable. The wound cavity (which is mostly virtual as it is only beneath the skin) should be drained. The suction drain can be removed if it drains less than 50 ml clear serous fluid per day. Wound dressing should be managed according to standard general surgery principles. The sutures need to be removed in multiple steps, depending on the pace of wound healing, usually after 2-3 weeks.

The pathology report may warrant a re-excision of the surgical margins. If so, then the wound and remodelled breast parenchyma should be opened and separated, and a precise re-excision should be performed, followed by clip marking. If it is not possible to do this safely or if the volume of the breast does not allow any further excision, mastectomy is indicated.

10.8.3. Complications

If the dermoglandular flap contains the NAC and a skin island, the dermis and subcutaneous tissue between the NAC and adjacent skin should be handled with respect, avoiding any trauma, as this area provides blood supply to the flap. Its stem should not be narrowed, even if it is wrinkled, because this can lead to the necrosis of the skin edges or the complete flap (see Figure 10.8.3.f). See further details in chapter 10.14.

Extensive mobilisation of the glandular tissue from the pectoral fascia can result in fat necrosis, which in turn prolongs healing time and delays the initiation of adjuvant therapies. Necrotic fat can be removed using needle aspiration or on occasion through partial opening of the wound. Often, *Pseudomonas aeruginosa* can thrive in the liquefying fat, evident by greenish discoloration on the wound dressing. Frequently, Staphylococcus species from the skin can cause long-lasting oozing of the wound. Fat necrosis and a delayed fibrotic reaction can mimic pathological lesions, disturbing local control during follow-up.

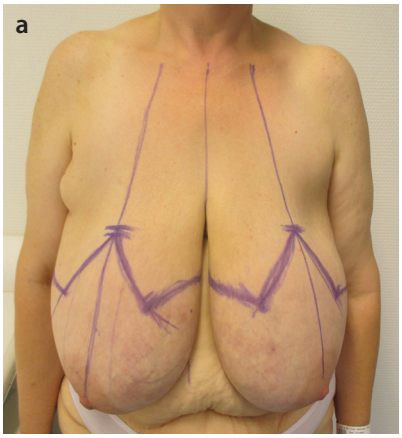
10.8.4. Other special considerations of the technique

The final shape of the breast develops a couple of months after surgery, depending on the fixing of the central dermoglandular lobe to the chest wall (see Ultrapro mesh sling suspension technique Fig.12.18a-j.). Meanwhile, the breast descends below the skin filling the lower quadrants, limited by the length of the vertical scar. The final cosmetic result is significantly influenced by the adjuvant RT, which causes fibrosis of the whole breast parenchyma to varying extents.

In the case of a mildly ptotic breast (see in Chapter 10.2.4.) alternative options are the omega and horizontal mammoplasty. Both provide limited range of breast reduction and cosmetic correction, but are safer for the blood supply of the NAC. The vertical length of the lower pole and height of the NAC should be considered, since the skin of the lower pole is not reduced, occasionally resulting in a ptotic or pseudo-ptotic breast. It must be borne in mind that shape and size of the breast is not necessarily supreme in breast-conserving surgery. After proper patient selection (described in the Introduction) and providing detailed information, the expectations of the patient must be considered.

Alternative options for this technique are the "J" and "L" mammoplasty (Level II OPS). These represent a transition between vertical and inverted-T techniques in terms of surgical scars. In most of the cases, a single-layer mobilisation of the parenchyma is sufficient. They are suitable for the correction of mild hypertrophy and ptosis, especially for tumours situated in the lower outer quadrant. The blood supply of the areola is from the cranial side, so resection is manageable from the area above the IMF, centrally and in the lower quadrants. This technique is different from the vertical mammoplasty only with respect to the surgical incisions, which are described in the relevant chapters.

According to the 2015 St Gallen Consensus Conference, breast-conserving surgery is feasible in multicentric or multifocal tumours if resection margins are microscopically free. ("A clear majority of the Panel agreed that multifocal and multicentric tumours could be treated with breast conservation, provided the above



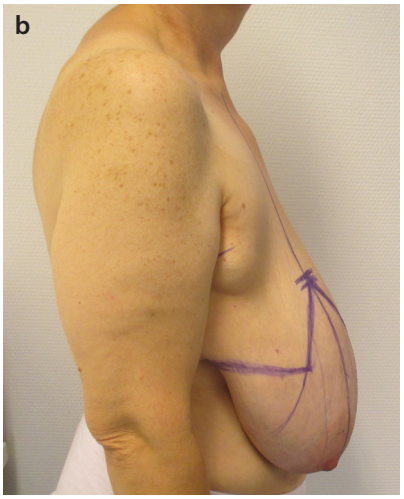
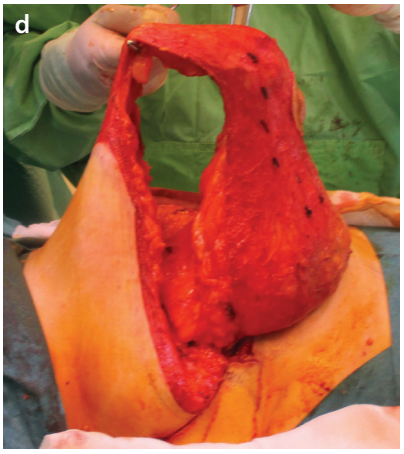


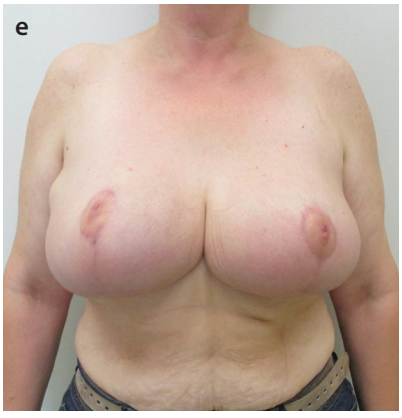
Figure10.8.8.a-b. Gigantomastia and extreme degree of ptosis

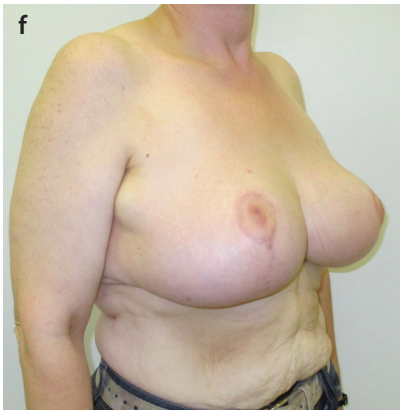


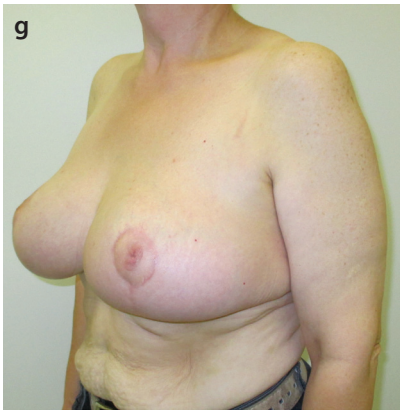
margin clearance was obtained and whole breast radiotherapy was planned") With minor modifications (e.g. vertical dual pedicle approach, according to McKissock, to preserve the blood supply of the NAC), inferior-pedicle inverted-T mammoplasty is suitable for therapeutic mastopexy and radical removal of even multicentric tumours. Understandably, these extended procedures require advanced oncoplastic experience.

The weakest part of inverted-T mammoplasty is the meeting-point of the vertical and horizontal incisions. The skin corners of the medial and lateral dermoglandular flaps at this point may become necrosed, resulting in delayed wound healing. In OPS, any complication leads to delay in adjuvant therapy; therefore, care should be taken to prevent compli-

Figure10.8.8.c-d Halves of the breast by the Würinger septum. The blood supply of the NAC is provided by the central pedicle of the Würinger septum and according to McKissock technique. Lift of the mamilla is > 20 cm







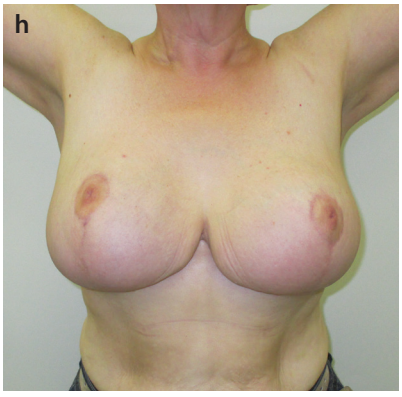


Figure10.8.8.e-h. Cosmetic result, viable nipples on both sides at 3 months after surgery

Figure10.8.8i. Late cosmetic result at 4 years after surgery. (Photos by Z Mátrai, NIO)

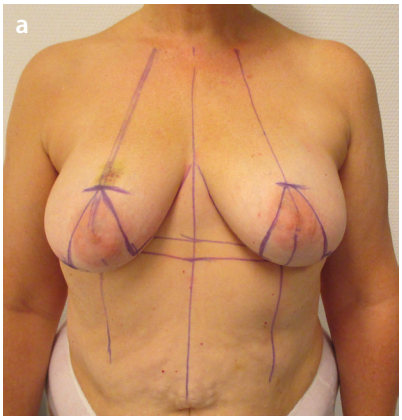
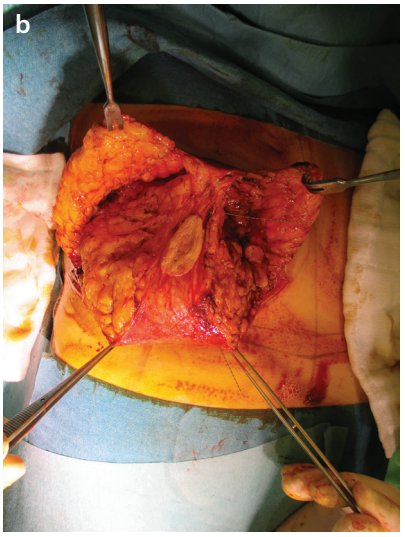


Figure 10.8.9a. In the right breast of a 63-year-old female patient, a 26 mm large, vaguely palpable invasive ductal cancer in the lower outer quadrant was identified. Meanwhile, a second non-palpable atypical fibroadenoma was reported in the upper inner quadrant



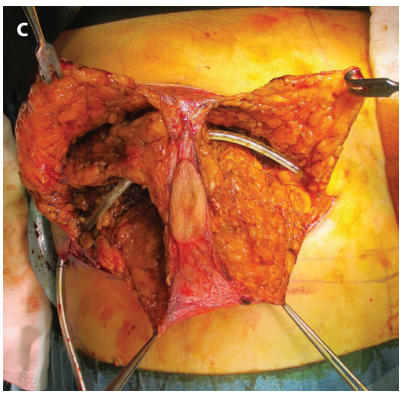
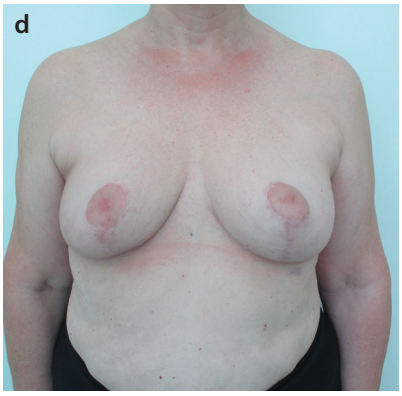


Figure 10.8.9b-c. modified inverted-T oncoplastic technique according to McKissock. The lower-outer quadrant was removed with ROLL guidance and the second lesion of the upper inner quadrant was excised with wire-guided localisation. Intraoperative specimen sonography shows clear margin for both lesions. Axillary SNB was performed for the malignant lesion of the lower outer quadrant



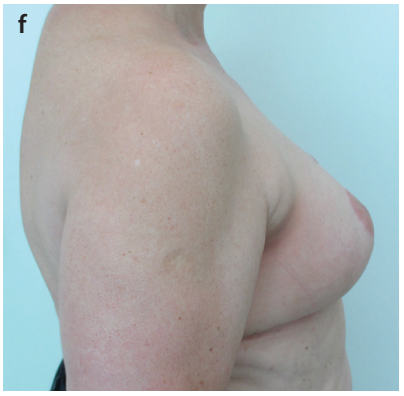


Figure 10.8.9d-g. Cosmetic end result at 6 months after surgery. (Photos by Z Mátrai, NIO)

cations as far as possible. Necrosis of this three-pointer can be decreased by leaving a 4-5 mm dermal edge extending from the wound edges. Similarly, two triangles of sides measuring 2 cm length with an adequate dermal edge should be left on the IMF during the initial skin incisions. Consequently, the fitting of the three flaps results in an inverted-Y shaped final scar, instead of the inverted-T.

It is an interesting observation that the cosmetic outcome after inverted-T mammoplasty for breast cancer is beyond expectations and with high patient satisfaction. This is a pleasing fact, but sometimes the patient is more concerned about the timing of the symmetrisation procedure, than her oncological status or multidisciplinary treatment.

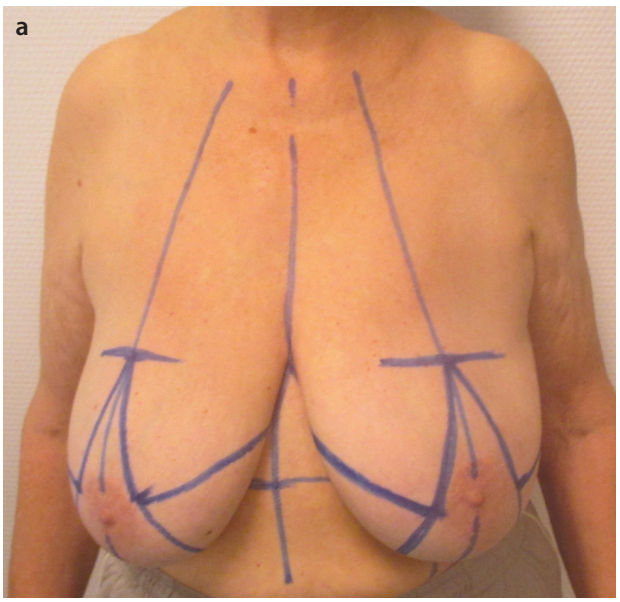


Figure 10.8.10a. In the right breast of a 72-year-old female patient, a 35 mm large palpable invasive ductal cancer in the upper-inner quadrant was identified. A second non-palpable invasive tumour focus was identified by MRI in the lower outer quadrant

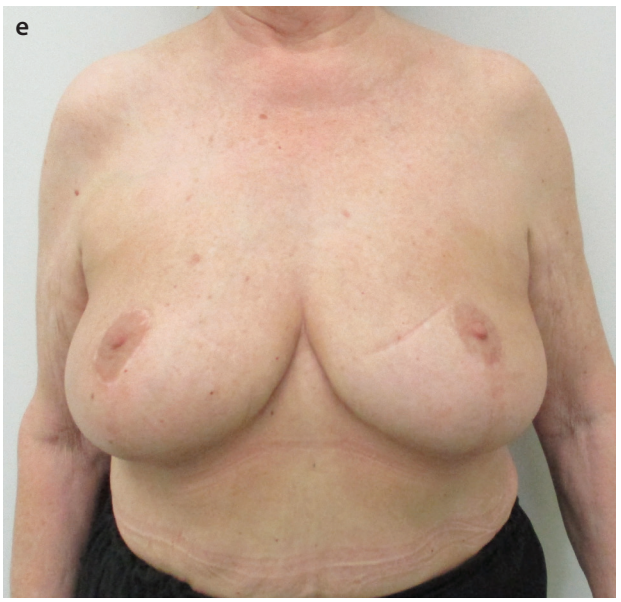
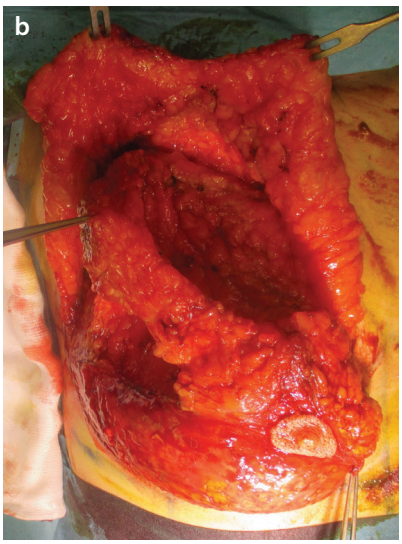
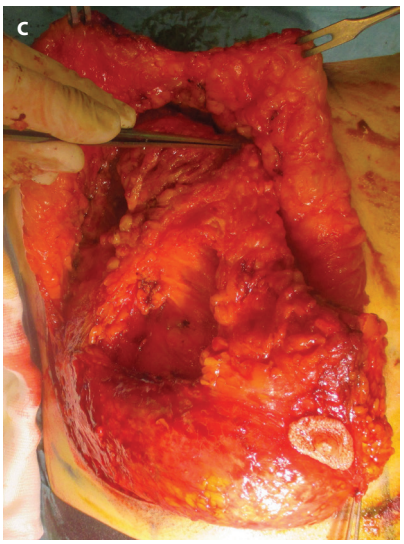


Figure 10.8.10e. Cosmetic end result at 7 months after surgery. (Photos by Z Mátrai, NIO





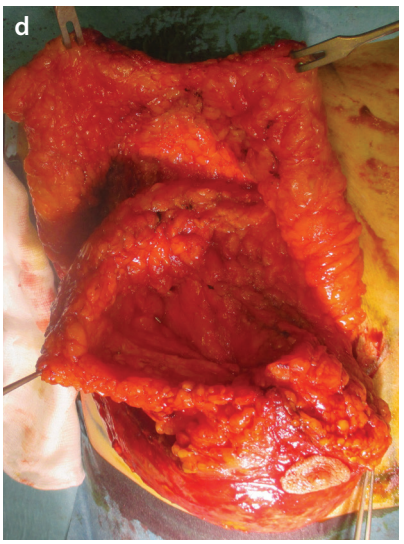
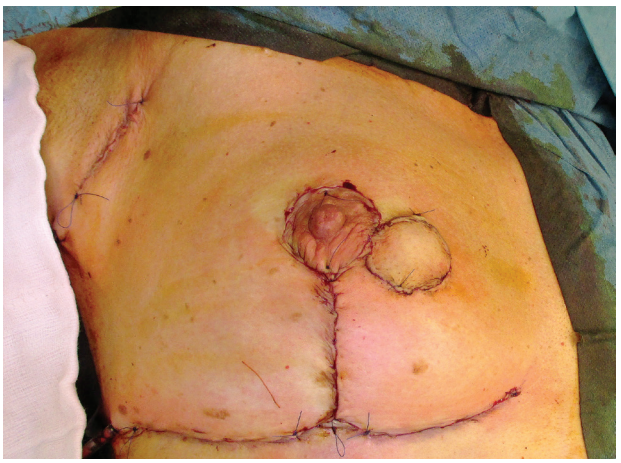


Figure 10.8.10b-d. modified inverted-T oncoplastic technique according to McKissock. The upper-inner quadrant was removed, and the second lesion of the lower outer quadrant was excised with ROLL guidance. Intraoperative specimen sonography shows free margin of the non-palpable lesion



10.8.11. Incisions of the inverted-T can be converted to inverted-V, decreasing the likelihood of ischaemic necrosis of the medial and lateral corners that are the weak spots of the flaps. (Photo by Z Mátrai, NIO)

If a complete mastectomy is required, this may be particularly distressing for the patient. The breast surgeon should not be party to the omission of complete mastectomy as the procedure of choice, simply for cosmetic reasons. Instead, the surgeon should put forward the possibility of post-mastectomy reconstruction that is suitable for the patient's oncological treatment. This situation emphasises the difference between "oncoplastic" and "onco-aesthetic" surgery.

It is advisable to cover surgical scars with contact patches, silicone gels or other anti-keloid creams for 6-12 months. The scars become almost invisible with the passage of time and as a result of adjuvant RT.

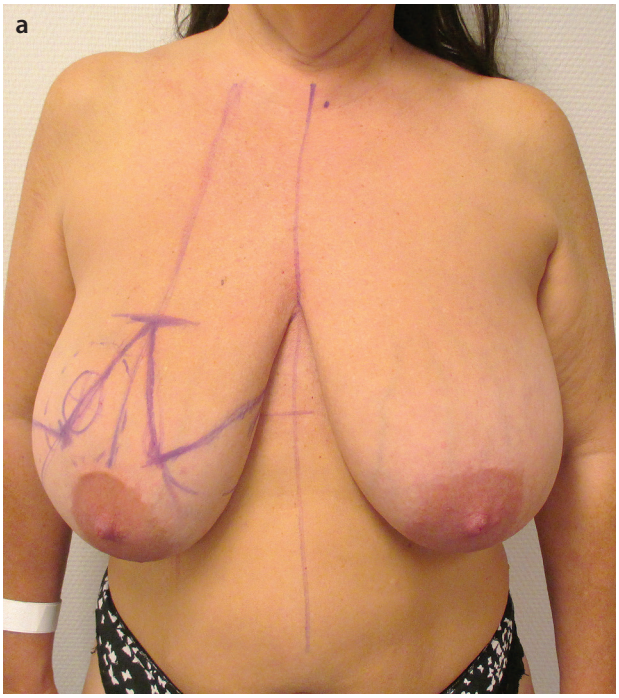


Figure10.8.12a. Histologically confirmed cT2N0M0 lesion in the right upper inner quadrant in 49-year-old female patient Preoperative marking for inverted-T OPS

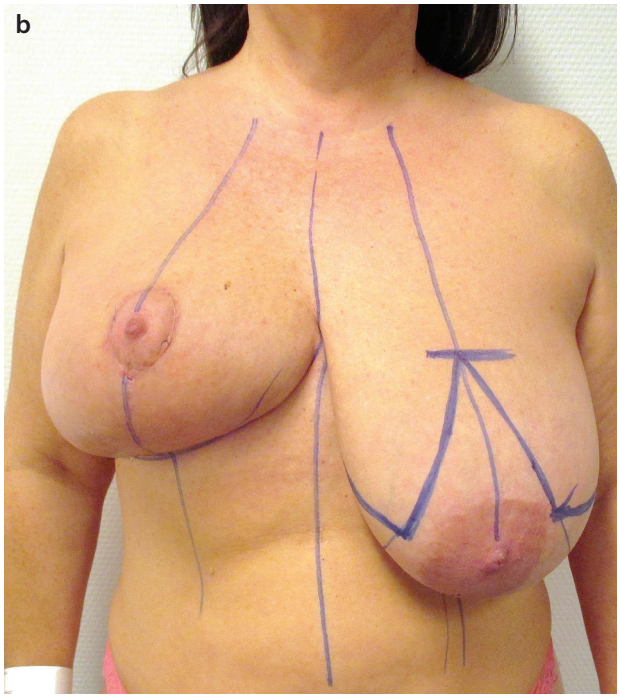
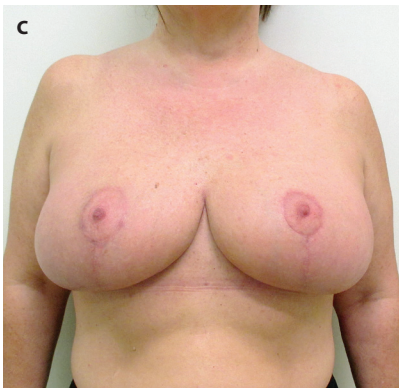
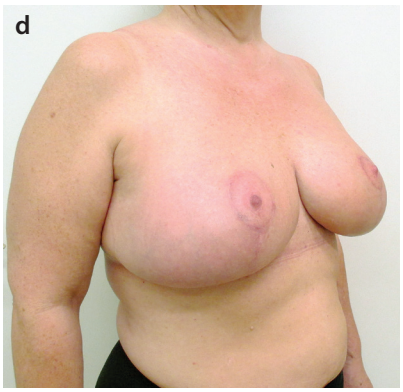


Figure10.8.12b. Early postoperative status after Wise pattern OPS and axillary SNB on the right side. pT2N0(sn)M0 IDC, Grade III., ER:90%, PR: 80%, HER2: negative, Ki67:30%. Delayed symmetrisation on the left side





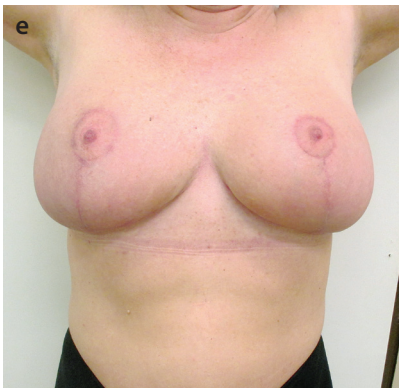


Figure10.8.12c-e. Cosmetic outcomes at the 22nd postoperative month after right side adjuvant WBI. (Photos by Z Mátrai, NIO)

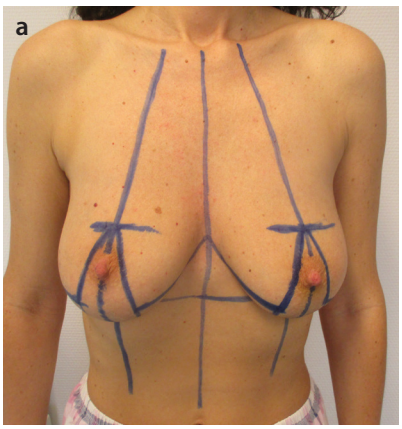


Figure 10.8.13a. Bilateral, non-palpable breast cancer in a 42-year-old female patient. cT1cN0M0 lesion in the upper outer quadrant on the right side, cT1cN0M0 lesion at the junction of the upper quadrants on the left side

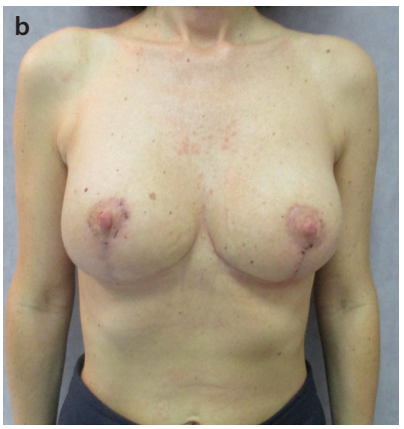


Figure 10.8.13b-e. Status in 5th postoperative week after bilateral Wise pattern OPS. Both tumours were resected with clear margins. pT2N0(sn) in the right side, pT1cN0(sn) on the left side. (Photos by Z Mátrai, NIO)

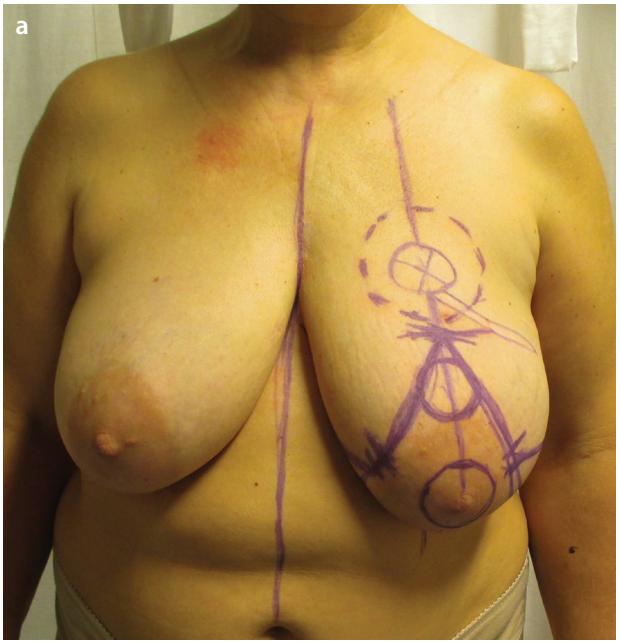


Figure 10.8.14a. Superficial, 37 mm large invasive ductal cancer in the right upper pole

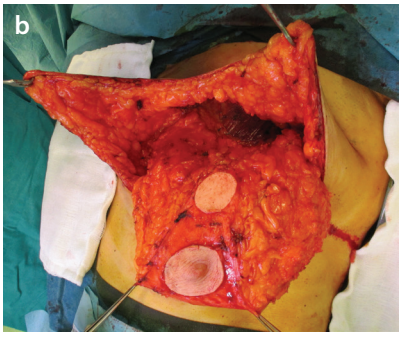


Figure 10.8.14b. Complete removal of tumour located in the upper pole of the breast, along with the skin over the tumour. R0 resection

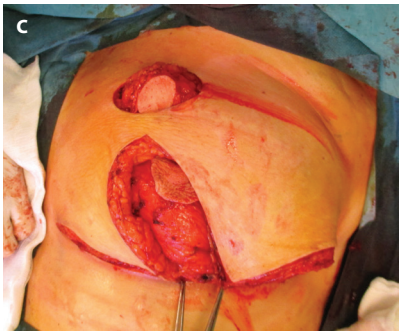


Figure 10.8.14c. Inferior-pedicle, Wise pattern inverted-T mammoplasty. Replacing the skin of the upper pole with a skin island of the central area of the breast

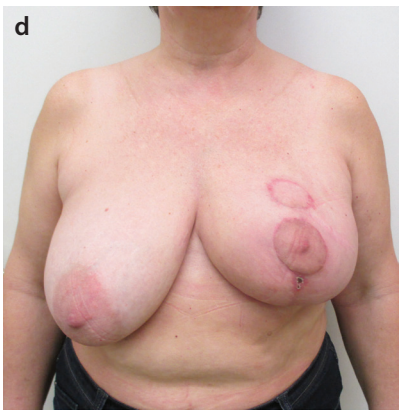


Figure 10.8.14d. Cosmetic outcome 4 weeks after surgery. Circulation of the skin island is intact

Figure 10.8.14e. Cosmetic outcome after WBI at 6 months after surgery

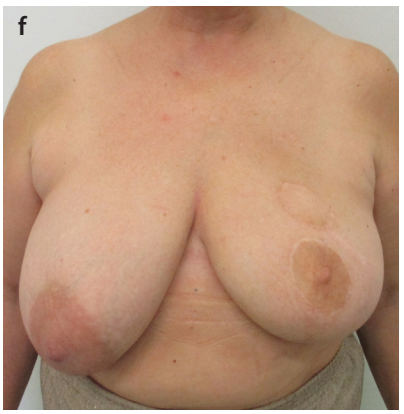


Figure 10.8.14f. Long term cosmetic outcome at 4 years after surgery without symmetrisation. (Photos by Z Mátrai, NIO)

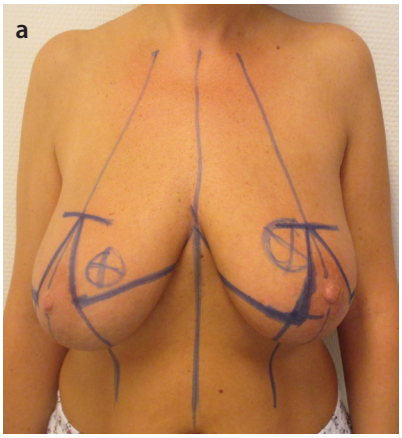


Figure 10.8.15a. The 43-year-old patient had synchronous bilateral tumours (in the right breast cT2N0 NOS (Luminal A) in the upper inner quadrant, in the left breast cT2N0 NOS (Luminal A) in the upper inner quadrant)

Figure 10.8.15b-e. Cosmetic outcome at 12 months after surgery after bilateral modified Wise type OPS and WBI

Figure 10.8.15f-i. Cosmetic outcome at 48 months after surgery. Characteristic changes of ageing are visible. In this case the patient gained an extra 5 kg in weight due to adjuvant endocrine therapy. In line with to the weight, gain both breasts have become enlarged, and moderate pseudoptosis is to be seen, but the breasts are still proportionate with the patient's body. Periareolar and vertical scars were significantly worse at one year after surgery than later, which is welcome, as was the change of decoloration of the skin of the NAC after WBI. Patient is free from recurrence and still very satisfied with the long-term cosmetic outcome of the breasts

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11.7. Nipple-sparing mastectomy

ZOLTÁN MÁTRAI, GYÖRGY TIZEDES

11.7.1. Introduction

The preservation of the nipple-areola complex (NAC) as a key cosmetic subunit of the breast has become a top priority as skin-sparing mastectomy (SSM) and immediate breast reconstruction (IBR) have gained in popularity. The name of this oncoplastic surgical technique is nipple-sparing mastectomy (NSM). The goal of NSM is to achieve maximal parenchymal resection while preserving all of the skin of the breast (envelope) thereby improving the aesthetic result following immediate breast reconstruction (IBR). It avoids a loss of projection of the neo-breast mound consequent to the removal of the NAC as well as preventing staged nipple reconstruction surgery and subsequent tattooing. Importantly, it also prevents the psychological impact associated with nipple loss and the time interval between the surgeries. In a NSM, reconstruction, therefore, merely involves a restoration of the volume and contour. On an average 80% of patients who undergo breast reconstruction require a second stage nipple reconstruction. According to Jabor et al. the aesthetic results of nipple reconstruction were assessed as excellent/good in 64%, fair in 22% and in 14% they were poor. To achieve an acceptable result, 66% of the patients needed one, 32% two and 2% required three surgeries. The reasons for the lack of acceptance of nipple reconstruction are as follows: nipple projection, colour, shape, size, texture and position. The "neo-nipple" is insensate, non-erectile, losses projection, and the tattooing fades over time. The NSM maintains the breast shape, by preventing distorting scars at the point of highest projection on the apex of the breast cone.

From the oncological point of view, NSM significantly differs from SSM. The main difference is the preservation of the nipple with is complex anatomy, containing ductal tissue. Some previous publications reported cancer involvement of the nipple in up to 54% of cases. The fears around NSM revolve around oncological safety due to the risk of an occult or new primary cancer in the residual parenchyma of the preserved NAC. This is because the blood supply of the nipple depends on the amount of parenchyma preserved in the core of nipple. Breast cancer is known to originate from the terminal ductolobular units (TDLU's), and it has been demonstrated that in 9% of cases the NAC contains TDLU's. Aesthetic concerns are around the viability of the preserved NAC.

The Hartmann et al. article in the New England Journal of Medicine in 1999, which included the results of 639 medium and high risk (according to the Gail Model) patients who underwent a prophylactic NSM in 90% and standard mastectomy (SM) in 10% at the Mayo Clinic, gave a big boost to the clinical acceptance of NSM. During an average 14-year follow-up period, the breast cancer risk in both groups was decreased by 89.5% and 94%, respectively. In this study, there was no significant difference in breast cancer incidence after NSM and SM (1.2% vs. 0%). Only one of the seven recurrences affected the NAC, which meant 0.2% of all the cases. Another milestone was the study published by Gerber and Krause in 2003 involving 286 selected breast cancer patients (tumour-nipple distance: TND > 2 cm), which compared NSM and SM results after an average of 59 months' follow-up period. The nipple, after intraoperative frozen section (FS) examination, was preserved in 61 patients of the 112 planned NSM (54.5%). Tumour recurrence was detected after NSM in 5.4%, and after SM in 8.2%. Only one recurrence was detected in the NAC after NSM. Rate of excellent/good aesthetic result after NSM was 91.1%, which was significantly better than that seen after SM. They stated that cancers distant from the nipple are not associated with a higher risk of local recurrence after NSM. Several studies have since been published concerning this previously taboo procedure.

11.7.2. Indications for NSM and precise patient selection

Due to a lack of data from prospective randomised studies the indications for NSM are still not well established. The 2017 NCCN Breast Cancer Version 2 Guideline advises caution when using this procedure in breast cancer or in prophylactic surgery. The NCCN guidelines state that NAC-sparing procedures may be an option in breast cancer patients who are carefully selected by experienced multidisciplinary teams. Retrospective data support NAC-sparing procedures for breast cancer therapy, with low local recurrence rates for early-stage and biologically favourable (i.e. Grade I or II, node-negative, HER2-negative, no lymphovascular invasion) invasive cancers and/or DCIS that are peripherally located in the breast (> 2 cm from nipple). Nipple preservation is contraindicated in cases in which there is preoperative clinical evidence of nipple involvement including Paget's disease, nipple discharge associated with malignancy, and/or imaging findings suggesting malignant involvement of the

nipple or sub-areolar tissues. Nipple margin assessment is mandatory and should be marked. According to the guidelines, there are several prospective trials underway to evaluate NAC-sparing mastectomy in breast cancer, and enrolment in such trials is encouraged.

According to the meta-analysis by Mallon et al. in 2013, in which 29 NSM clinical studies (none randomised) were analysed, NSM and IBR are only successful and safe in well-selected patients with competently performed surgery. Occult tumour involvement of the NAC (which was described in only 8 publications) was found in 11.5% (0-53%), and it was influenced by independent factors such as TND < 2 cm, grade, lymph node metastasis, lymphovascular infiltration, HER2-positivity, ER/PR- negativity, >T2 tumour size, retroareolar or central tumour location and multicentricity. Consequently, cases that would be suitable for NSM are well circumscribed, solitary or multifocal tumours that are more than 2 cm from the nipple, that are Grade 1/2, lymph node negative and HER2-negative tumours without lymphovascular invasion. The problem is that not all these factors can be accurately determined preoperatively in all cases. According to the St Gallen International Expert Consensus on the Primary Therapy of Early Breast Cancer in 2013, NSM was considered acceptable provided the margin close to the nipple was not involved.

In a subsequent statement of the 15th St. Gallen International Breast Cancer Conference in 2017, V. Galimberti placed the focus on the oncological safety of NSM (see below). Dr Galimberti spoke about how the preservation of most of the breast skin and NAC improved the aesthetic outcome. This, in turn, had a positive impact on patient satisfaction and resulted in a psychosexual benefit. It was stated that NSM is a safe surgical procedure in patients undergoing neoadjuvant chemotherapy (CHT), and it is also safe for high-risk women undergoing prophylactic mastectomies. It is mandatory, however, to have a negative retro-areolar margin on frozen section. The main complication of NSM is necrosis of the NAC. The data indicate that as the surgeon's experience increases the frequency of this complication declines. The new technique of robotic NSM, in selected patients, is reliable and reproducible with a short learning curve.

The cases that are considered for NSM should be discussed in detail within a multidisciplinary team. In addition to the oncological aspects, patients have to be informed of the surgery-specific complications and advised explicitly that based on intraoperative frozen section assessment or final histology the entire NAC and/or skin flaps may need to be removed/revised. Surgical success is based on oncological safety, low rates of complications and comprehensive training of breast and plastic surgeons. NSM should be performed only by trained breast surgeons, bearing in mind that oncological safety is the priority in all cases. NSM is only advisable in those cases when the mastectomy is associated with an immediate (IBR) or a delayed-immediate breast reconstruction (D-IBR), with rare exceptions.

Primarily, the ideal candidates for this procedure are low-risk patients who have a good performance status, are not obese, do not smoke, are not diabetic, have not received radiotherapy (relative contraindication), do not have a connective tissue disorder and who do not have multiple pre-existing surgical scars on the breast. Women with large areola or large pendulous/ptotic breasts are not considered to be optimal candidates for this procedure, as the required reduction of the skin envelope could lead to a higher rate of nipple necrosis.

NSM could be beneficial in cases where breast-conserving surgery (BCS) would lead to oncologically and aesthetically unacceptable results and where a tumour does not directly infiltrate the NAC or when an invasive tumour or DCIS is not located directly behind the nipple. Ideally, the tumour should be at a distance of 1-2 cm from the nipple (even after neo-adjuvant treatment). The NSM and IBR seems to be a suitable surgical approach that preserves the already expanded skin in previously augmented breasts that develop cancer. The therapeutic indications need several special considerations, and before optimising the cosmetic results, we first need to minimise the risk of tumour recurrence. This can be achieved by selecting the previously introduced concept of the low (oncological) risk patient. A precise surgical technique (marking the retromammary area for the pathologist, intraoperative frozen section (FS), the coring of the nipple tissue etc.; see below) adds to the oncological safety. Contraindications for NSM include late tumour stages, the direct involvement of the skin and the nipple, erythema, inflammatory breast cancer or lymphangitis carcinomatosa, extensive lymphovascular infiltration (according to several authors the basal subtype as well) and Paget's disease.

The average involvement of the NAC by a tumour according to several studies is between 11-15%, but excluding the studies that involve fewer than 100 cases, it is between 6-31%. The direct infiltration of the NAC in 58-82% of the positive cases could not be clinically established preoperatively. The predictive model of the Massachusetts General Hospital Nipple Involvement Calculator (http://cancer.lifemath.net/breastcancer/nipplecalc/index.php) allows dynamic usage, so a shorter TND in small tumours and longer in large tumours (e.g. in a 5 cm tumour with a 2 cm TND the risk of tumour involvement in the NAC is 46%). Intraoperative FS assessment of the retroareolar tissues should remain as the standard of care.

Friedman et al. used MR imaging, which could predict NAC involvement almost every time. They examined the

retroareolar tissue by preoperative ultrasound-guided vacuum-assisted core biopsy to determine occult involvement of the NAC. In the clinically negative cases, 19% were proven to have a tumour in the NAC, with 100% correlation on final histopathology.

Despite the predictive models and an accurate assessment, a tumour may still be detected in the retroareolar tissue during surgery or following detailed histological examination, and this warrants a completion excision of the nipple or even the whole NAC. Histological verification is mandatory, and high-resolution MR imaging is advised during preoperative assessments. The tumour biology must be considered because it influences disease progression.

The indications are genuinely inconsistent at present for prophylactic surgeries in a population known to have both high risk and very high aesthetic expectations (e.g. BRCA 1/2 mutation carriers). According to the current EUSOMA 2002 guideline, SM, SSM and NSM can be performed for prophylactic surgery, but for NSM the patient has to be informed that keeping the NAC means decrease in risk reduction. The NCCN Breast Cancer Risk Reduction Guideline (Version 1. 2017) currently suggests only a "bilateral total mastectomy" for risk-reducing surgery.

In contrast, several recently published reports seem to suggest that the oncologic outcomes of NSM are comparable to SSM, with locoregional recurrence rates as low as 2% at 3-year follow up. As the techniques for NSM have evolved, complications have been reduced to acceptably low rates, making the procedure technically feasible and safe. Furthermore, excellent aesthetic outcomes and high levels of patient satisfaction after breast reconstruction have been achieved; this is particularly important for women considering bilateral mastectomy to reduce the risk of developing breast cancer. As rates of NSM continue to rise, it is essential to retrieve confirmatory evidence in support of the oncologic safety of the technique for therapeutic as well as risk-reducing indications in high-risk patients.

According to the statement of the 15th St Gallen International Breast Cancer Conference 2017, NSM is also suitable for prophylactic mastectomies in high-risk women based on the results of Manning et al. These authors published their data relating to 177 NSMs performed in 89 BRCA mutation carriers between September 2005 and December 2013. Twenty-six patients with a median age of 41 years underwent NSM for early-stage breast cancer and a contralateral prophylactic mastectomy. Mean tumour size was 1.4 cm (range 0.1-3.5). Sixty-three patients with a median age of 39 years had a prophylactic NSM, eight of whom had an incidental diagnosis of ductal carcinoma in situ. There were no local or regional recurrences in the 26 patients with breast cancer at a median follow-up of 28 months (IQR: 15-43). There were no newly diagnosed breast cancers in the 63 patients undergoing prophylactic NSM at a median follow-up of 26 months (11-42). All patients had IBR. Five patients (6%) required subsequent excision of the nipple-areola complex for oncological or other reasons. Skin desquamation occurred in 68 (38.4%) of the 177 breasts, and most resolved without intervention. Debridement was required in 13 (7.3%) of the 177 breasts, and tissue-expander or implant removal was necessary in six cases (3.4%). The authors concluded that NSM is an acceptable choice for patients with BRCA gene mutations, with no evidence of compromise to the oncological safety at short-term follow-up. Complication rates were acceptable, and subsequent excision of the NAC was rarely required.

In the past years, there has been an increasing trend, mainly in the USA, for prophylactic removal of the unaffected contralateral breast in average-risk breast cancer patients. In risk-reducing surgery, the patient has to be informed about the risks and benefits of different surgical and non-surgical options, but in theory NSM can be considered, after excluding pre-existing tumours (breast MR). However, there is a lack of high-level evidence for the routine use of NSM. A prospective, consecutive and standardised registration will pool patients' data together, to overcome any selection bias or limit the sample size.

There is a need for an international registry because any new surgical technique needs to be validated as feasible and safe before implementation. A well-designed prospective database is required to reduce uncertainty regarding NSM. At present, a randomised controlled trial (RCT) comparing nipple sparing techniques vs SM (followed by reconstruction) is neither feasible nor ethical as only a limited number of breast units perform NSM, and therefore most patients and physicians are not fully informed about this alternative to SM and reconstruction. At present, neither standardisation of the surgical technique nor surveillance protocol for NSM have been established; interested clinicians, therefore, need to work collectively to establish a network to identify evidence-based standard of care guidelines.

The International Nipple SParIng mastectomy REgistry (INSPIRE) is a patient-centred phase IV trial that aims to gain insight into treatment strategies for women undergoing NSM and IBR for breast cancer or risk reduction. The target is to provide robust prospective evidence on its oncological safety, complications (associated risks of nipple and skin necrosis, infection rates, reconstruction loss, nipple symmetry) and patient-reported outcome measures (PROMs). The INSPIRE project will provide pooled evidence derived from a prospective collaborative high-quality registry between international centres to implement NSM. The findings will clarify if and how NSM can safely become part of our daily armamentarium. The primary objective is to determine

the oncological safety of NSM. Secondary objectives are to investigate NSM's outcomes, complication rates from surgery and radiation therapy, to compare details relevant to surgical techniques and preoperative imaging, to obtain evidence-based information which will assist in the treatment planning of future patients who are offered a mastectomy for cancer treatment or as a risk-reducing procedure, and to assess patient satisfaction (quality of life questionnaire). The study is running under the auspices of the European Registration of Cancer Care (EURECCA) breast group, with Riccardo Audisio and Isabel Rubio as Principal Investigators.

According to the expert panel opinion of the Oncoplastic Breast Consortium consensus conference on NSM

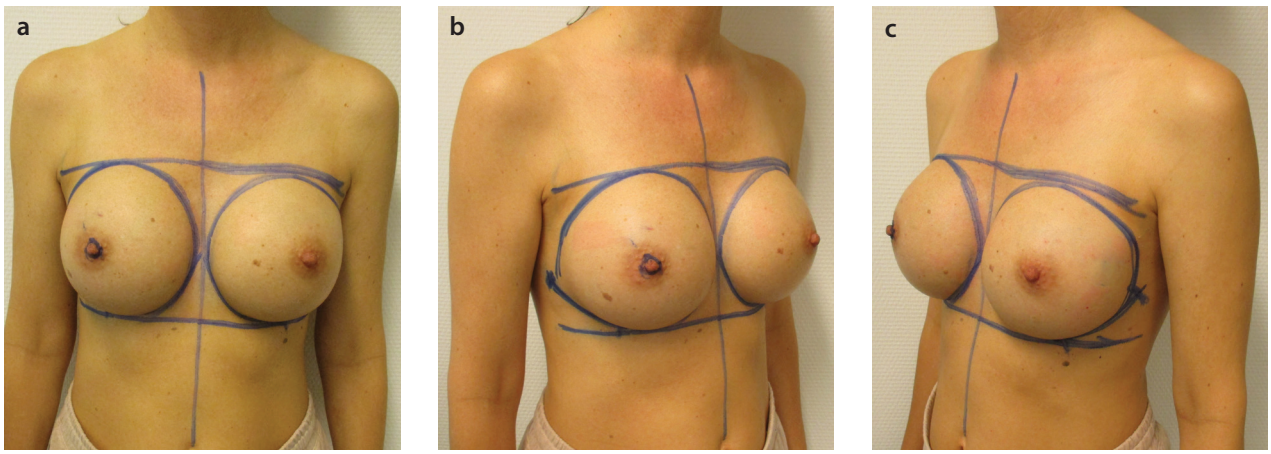


Figure11.7.1a-d. 43-year-old patient with retroareolar DCIS in the right breast and cT1ccN0 M0, IDC (Luminal B) in the left breast. ASM on the right side and NSM on the left side were performed with SNB on both sides with D-IBR (550 cm^3 tissue expanders)

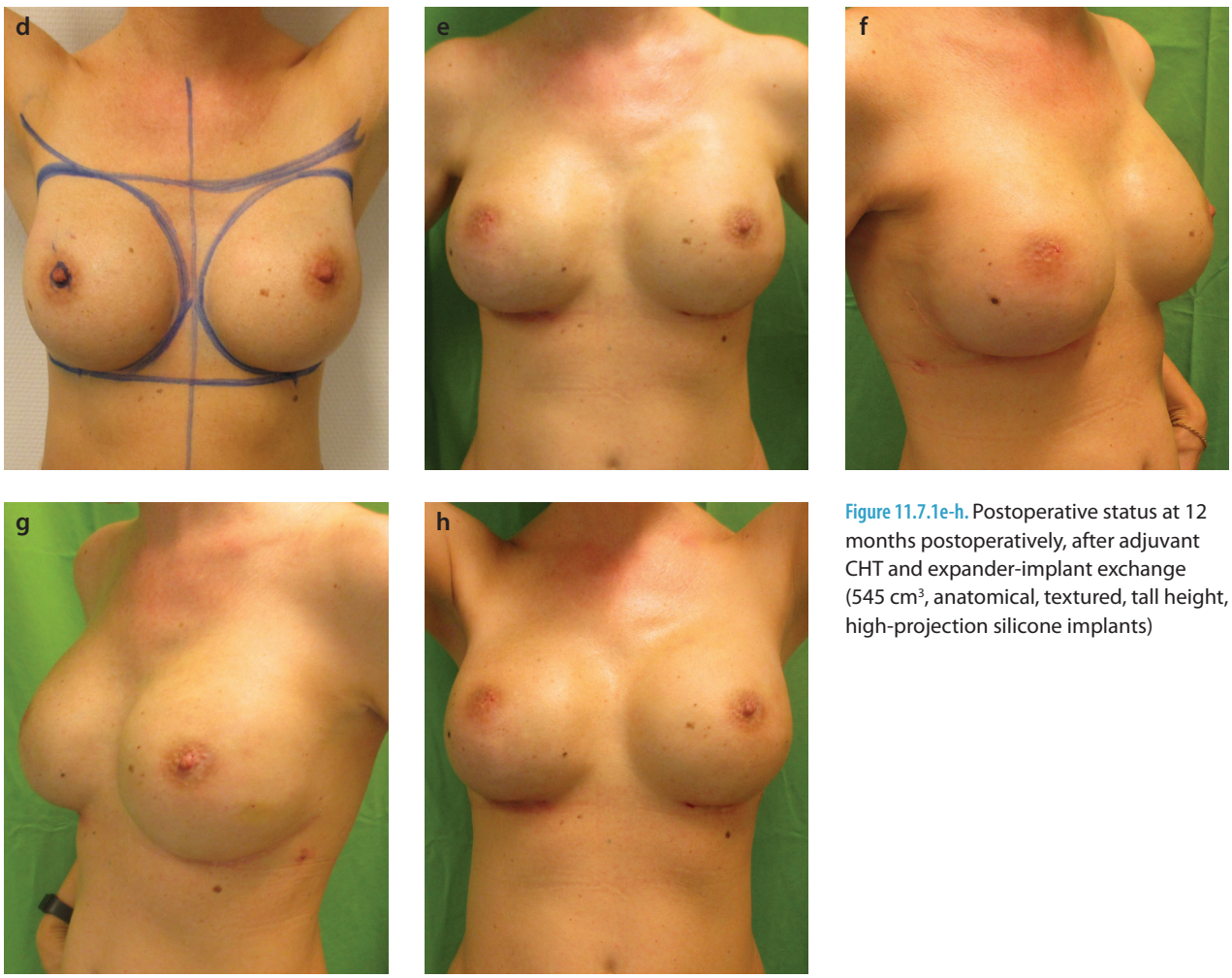


Figure 11.7.1e-h. Postoperative status at 12 months postoperatively, after adjuvant CHT and expander-implant exchange (545 cm^3, anatomical, textured, tall height, high-projection silicone implants)

Figure 11.7.1i-l. Cosmetic outcome at 18 months postoperatively, after nipple reconstruction on the right side and bilateral lipomodelling. (Photos by Z. Mátrai, NIO)

by Weber WP et al. there was consensus that NSM can be performed for any tumor size that does not involve the skin or NAC independent of axillary status. However, the panel was divided when asked if NSM could be offered to patients with locally advanced breast cancer (LABC) without the use of successful neoadjuvant chemotherapy. Several groups have broadened the indication for NSM to include patients with LABC, who have been successfully downstaged with neoadjuvant systemic therapies. The evidence base for use of NSM in this setting is currently poor and more studies with longer follow-up are required. The panel recommended NSM for early breast cancer and ductal carcinoma in situ (DCIS), and, unanimously, in the risk reducing setting. This latter indication is now well-established in clinical practice. The panel strongly felt that only specialized surgeons with high-volume training should perform NSM. This claim has been made repeatedly in the past by specialized breast and plastic surgeons, and should be supported by volume-outcome research with caseload as predictor and rate of complications and local recurrence as outcomes. NSM certainly is technically challenging and surgeons experience greater physical symptoms, mental strain, and fatigue with NSM than SSM.

The list of indications for NSM is still not comprehensive, and there is no high-level evidence of its oncological safety. The authors of this chapter emphasise that in high-risk cases, primary cancer or recurrence can occur in the remaining TDLUs in the nipple even after coring of the nipple in the absence of adjuvant RT. In a high-risk case, it is recommended to choose an areola-sparing mastectomy (ASM) using technical best practice (see Chapter 11.6.) and preserving the entire pigmented areola by removing the nipple and parenchyma en bloc, so the entire central ductal system is removed. The skin of the areola retains the breast's projection, does not require tattooing, and after delayed implant and/or autologous reconstruction, nipple reconstruction can easily be performed using the pigmented epidermis of the areola with complete oncological safety.

11.7.3. Microstructure of the nipple

To perform a NSM, the surgeon must know the microscopic anatomy of the nipple (see Chapter 2.). Rusby et al. described the microcirculation of the nipple and the location of the blood vessels relative to the ducts. Mean diameter of the nipple was measured at 11.1 mm and the central duct cluster at 5.2 mm. In coronal sections, it was found that if a 2-3 mm peripheral tissue rim is left at the border of the nipple-areola under the skin, then nearly all of the ducts (at 2 mm 96%, at 3 mm 87%) are removed. At 2 mm, 50% and at 3 mm 66% of the micro-capillaries of the nipple are preserved, proving that approximately 1/3 of the nipple-supplying vessels run in the central ductal branch. However, the ratio of the arterioles to venules is not known, nor whether they remain functional after NSM. Based on a knowledge of micro-anatomy, it can be said that the removal of all ducts is associated with a high risk of NAC necrosis. The real question related to the safety of NSM is, therefore, how much of breast parenchyma can be preserved to leave an acceptable oncological risk without causing ischaemia of the nipple.

11.7.4. Surgical technique of nipple-sparing mastectomy

The location of the incision is primarily determined by the size and ptosis of the breast. It should allow for: adequate dissection around the nipple maintaining its blood supply; the type of reconstruction planned; and appropriate axillary intervention. It is essential that the incision provides adequate access for removing the entire breast parenchyma as well as direct visual access to the entire surgical field. Misaligned incisions can cause oncological and technical complications. The skin incision can be hemi-periareolar (up to 30%-40% of the circumference), hemi-periareolar with a radial (mainly lateral or vertical) extension, lateral radial, transareolar, peri- and transmamillary with lateral or medial extension and in the lower or lateral inframammary fold (IMF).

Any pre-existing scars on the breast should be used as far as possible, but the blood supply of the nipple must be carefully monitored. In case of a small diameter areola and larger breast the hemi-periareolar incision with a horizontal lateral extension or "Hockey-stick" incision can give good access; however, it can harm the blood supply to the lower half of the areola. An incision exceeding 30% of the circumference of the areola is an independent risk factor for nipple necrosis. Extensions to the inner part of the breast or the upper inner quadrant should be avoided. If a transareolar peri- or transmamillary incision is used, in smaller breasts, attention should be paid to the perimamillary arteries and to the effect of the potential reduction in projection caused by the scar around the nipple. Medial and lateral extension of the transmamillary incision makes the NAC bi-lobed, but does not interfere with its blood supply and provides good retroareolar access. Incision lines in the folds are aesthetically beneficial and do not impair the blood supply of the skin, but access to the parasternal and sub-clavicular areas requires special attention.

At the MSKCC, the preferred incisions were as follows: "Hockey stick" 53%, inframammary 21.7%, omega type 12.2%, placed in a pre-existing scar 8.7% and trans-areolar 4.4%. NSM loses its cosmetic advantage in large, ptotic breasts because in these cases a skin reducing incision is required (see skin-reducing mastectomy, Chapter 11.8.). If the length of the skin flap is threatened with ischaemia, then depending on the type of reconstruction, the NAC can be transplanted as a full thickness skin graft onto the de-epithelialised skin envelope. Nava et al. reported a 78.7% patient satisfaction rate with NSM in patients with especially large and ptotic breasts. For symmetrisation, using the same breast incision as the contralateral breast is recommended. The

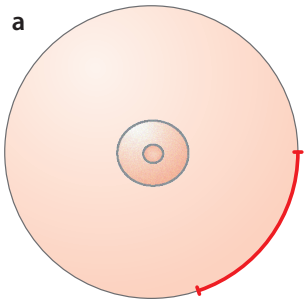
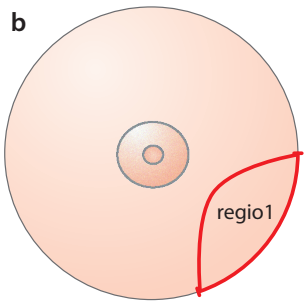


Figure11.7.2a. As first step of the NSM, a 7-9 cm long skin incision is placed in the IMF



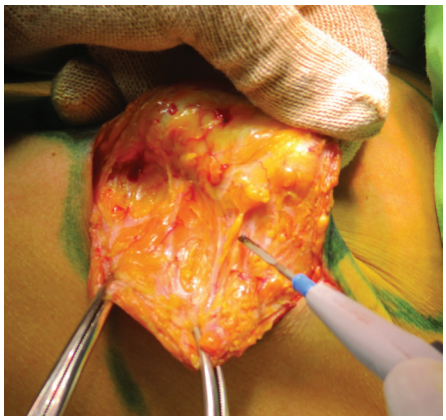
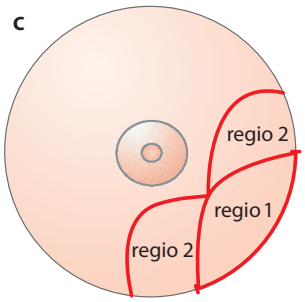


Figure 11.7.2b. After parenchyma mobilisation from the pectoralis major muscle, the glandular dissection from the skin starts centrally (region 1) from the skin incision over the lamina anterior of the superficial pectoral fascia and beneath the subcutaneous fat



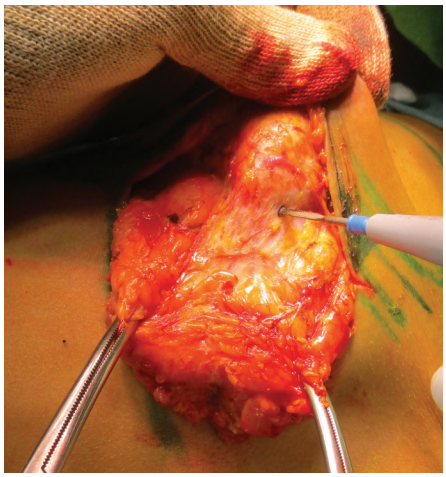


Figure 11.7.2c. The parenchyma dissection starts from the skin incision in a central direction, and should be followed by the mobilisation of the parenchyma in both directions (region 2) to the periphery. With the additional mobilisation of the gland from 2nd regions the surgeon is able to pull the parenchyma (part region1 and regions2) easily direct to the level of the skin incision

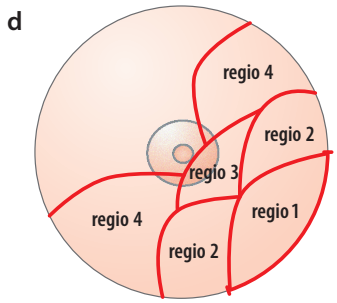


Figure 11.7.2d. The previous glandular mobilisation makes further dissection centrally (region 3) possible with adequate access. At the level of the nipple after the dissection of region 3, once again peripheral dissection (region 4- region 4) should be performed, in order to have the necessary clear exploration to further subcutaneous dissection away from the skin incision

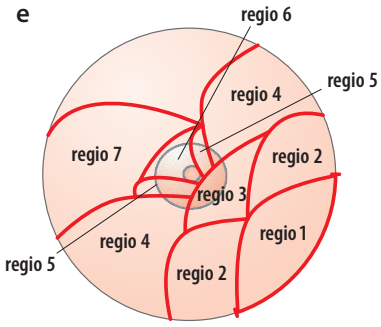
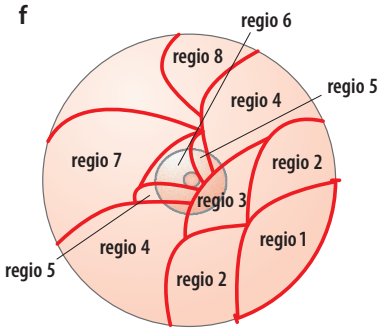


Figure 11.7.2e. In the proper layer, the retroareolar area is first dissected circularly in a U shape (region 5-region 5), then directly retromamillarly the central ducts are transected (region 6)



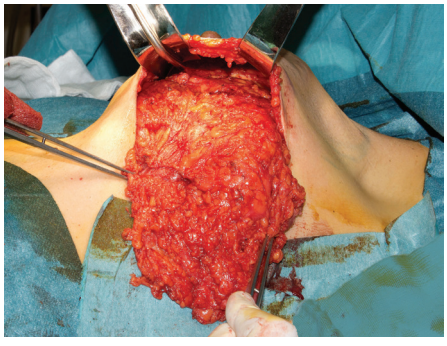
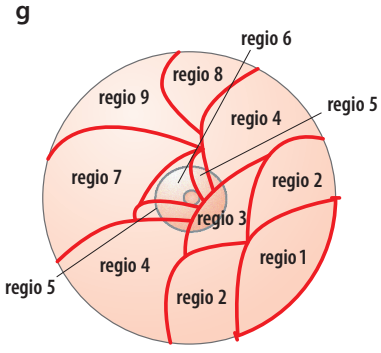


Figure 11.7.2f. The next step is to dissect again peripherally (region 7 and region 8). In these regions the surgeon meets the robust perforator vessels



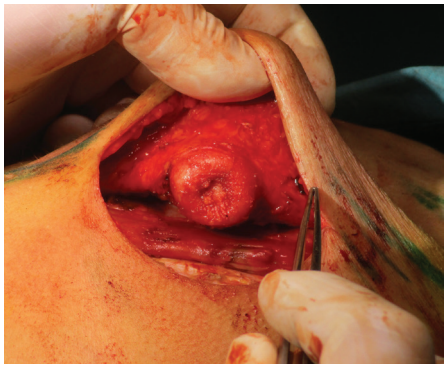


Figure 11.7.2g. If the glandular mobilisation was performed using the step by step method (central by peripheral and repeated), then region 9, the most distant area from the incision, is easily accessible by gently pulling the parenchyma to the level of the skin incision. This manoeuvre is facilitated by turning the skin inside-out, resulting in clear access to the subcutaneous plane even in region 9. The nipple looks like an orifice from the subcutaneous view after adequate parenchymal resection and coring. (Photos by Z. Mátrai, NIO)

author most often uses a roughly 7-9 cm long skin incision in the IMF, oriented slightly laterally.

This incision allows safe access and has a low rate of ischaemic complications for the skin envelope and NAC, using the surgical technique described below. During surgery, the surgeon is seated so that the surgical field is at eye level. It is recommended that the skin is incised with a scalpel and then an electric cutting-coagulating hand-held device should be used for further dissection. By attaching skin hooks or cat's paw retractors to the wound edges of the breast skin envelope, the assistant cautiously raises the wound edge. The surgeon (as partially described in Chapter 11.6., surgical technique for ASM), then separates the parenchyma along with the fascia from the pectoralis major muscle over the entire footprint of the breast. (see Figures 11.6.5. a-b.)

The parenchyma with the attached breast envelope thus becomes very mobile. The perforator vessels coming through the pectoralis major muscle should be carefully coagulated, bearing in mind the importance of a bloodless surgical field, without which it is challenging to identify the optimal plane for subcutaneous dissection, resulting in further bleeding, skin ischaemia or residual parenchyma. During parenchymal mobilisation of the pectoralis major muscle plate, the peripheral perforators must be spared to ensure blood supply to the skin envelope. These perforators are found at the level of the IMF, parasternally in the 2nd and 3rd intercostal space and between 11 and 1 o'clock positions. Injury to the parasternal perforators also implies excessive dissection of the footprint mainly in the submuscular plane, threatening synmastia. The perforator in the 2nd intercostal space is robust and quickly branches after leaving the muscle. If it is damaged then

using a monopolar coagulating current (bipolar forceps, clips are recommended) could result in thermal injury to skin flap, the best way to avoid any injury is to prevent any injury to the vessel. If the parenchyma reaches these vessels or even slightly engulfs them, you could try to remove the parenchyma entirely around the main vessel using only the tip of the coagulator for dissection with no current. Also, it is important not to forget the need to mobilise the tail of Spence.

For the next step with the skin edge elevated cranially with hooks, a right-handed surgeon grasps the parenchyma with their left hand (using forceps) and with a gentle pull, identifies the plane between the lamina anterior of the superficial fascia and the subcutaneous fat. With the diathermy on low power, the surgeon begins to separate the parenchyma from the skin. It is important to emphasise that the subcutaneous tissue right below the wound edge should not be thinned too much, because this results in ischaemia which in turn predisposes to bacterial contamination. After the initial 10-15 mm from the wound edge, the forceps is replaced with 2 tissue-holding (Lumnitzer, Lanes or Kocher's) instruments, which can grasp the parenchyma, and the surgeon asks the assistant to use these instruments to provide gentle counter-traction. The authors wear an extra textile glove on our left hands (over the latex gloves) and then grasp the free skin edge, which is slightly turned over (inside out). As the assistant holds the parenchyma which needs to be excised, the surgeon regulates the traction by pulling the skin with their left hand, as it is especially crucial at this type of surgery not to traumatise the skin which on occasions can be extremely thin. (see Figure 11.7.2a.)

After that, one can move a few centimetres centrally in the direction of the nipple, where the dissection is relatively straightforward. (region 1). (see Figure 11.7.2.b./b.)

To be able to move further in the central direction by turning the parenchyma out and careful forward pulling, it is first necessary to mobilise the edges at the level of the skin wound (region 2 – region 2). Subsequently, the assistant releases the tissue-holding instruments, and elevates the skin wound towards the medially exploring the wound edges cranially with a sharp hook and the contralateral wound edge with a French hook. Using this method, the surgeon is able to release the lower pole of the gland from the skin. Next the same parenchyma release should be performed towards the axilla through the access of the skin incision in the IMF. (see Figure 11.7.2c./c.)

Many breast surgeons are afraid of an incision in the lateral IMF because dissection and mobilisation of the parenchyma further away from the incision occurs in a visually restrictive tunnel, so any bleeding deep in the cavity is difficult to visualise and control. Bleeding, in turn, obscures the plane above the lamina anterior,

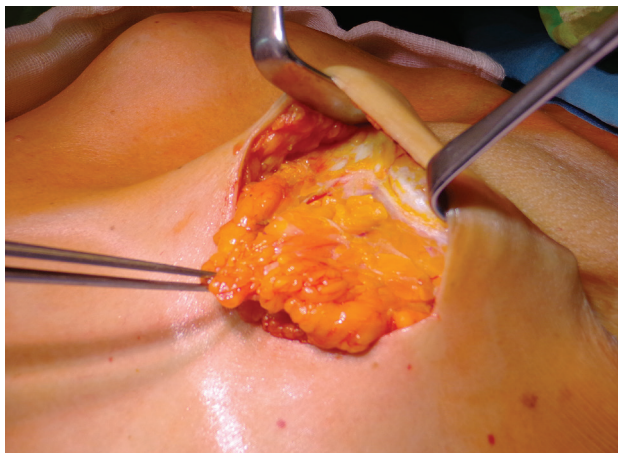


Figure 11.7.3. Epifascial dissection of the gland from the incision placed in the IMF. Sometimes the subcutaneous fat layer is very thin, but the subdermal vascular plexus should still be preserved. (Photo by Z. Mátrai, NIO)

making further progress and optimal dissection difficult. The basic element of this technique is that after central parenchymal mobilisation, the surgeon always mobilises the two lateral areas as the next step, and then the parenchyma can be easily pulled forward, in to the wound so we can continue the parenchyma dissection centrally (region 3), then again on the edges (region 4-region 4). (see Figure 11.7.2d.)

By using the above method, step-by-step, without tunnelling, we reach the sub-areolar area, where the ideal plane above the lamina anterior is altered. To this point, the ideal plane of dissection is well visualised, but here the sub-areolar subcutaneous fat thins or almost disappears. Under the white layer of the dermis, the vessels of the subdermal vascular plexus can be seen, which are separated by a loose fascial membrane.

These vessels have to be protected as much as possible. If bleeding occurs, precise coagulation should be carried out using a bipolar current; alternatively, if the bleeding is not disturbing the operation field, then it may be possible to avoid coagulation and rely on natural coagulation. On reaching the retro-areolar area, in some cases the central duct branch can easily be identified, which can be up to 5-9 mm wide. Here the appropriate retro-mamillary plane is not always easy to find. In such cases, the previous dissection around the central duct in both directions should be continued above the plane of the anterior lamina, so that it forms a "U", in the retromamillary area (region 5-region 5), allowing us to easily cut the central ductal tree connecting the previously prepared planes. (region 6). (see Figure 11.7.2e./e.)

Bacterial contamination when cutting the ducts cannot be eliminated, so a betadine wash is recommended. A single shot of preoperative antibiotic prophylaxis is indicated. The nipple margin is marked for the pathologist.

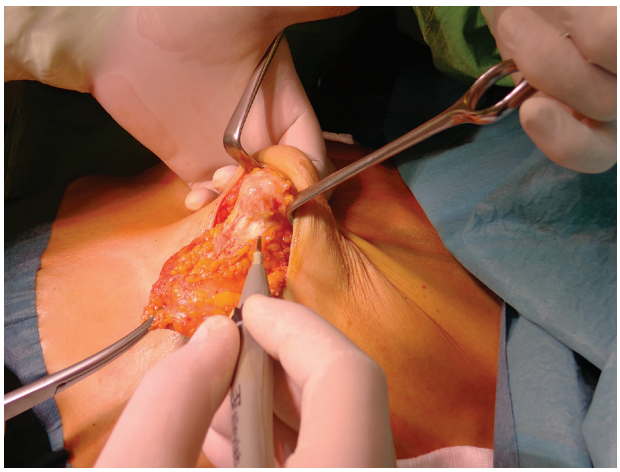


Figure 11.7.4. "Coring" by turning the nipple inside-out with a finger placed in it (Photo by Z. Mátrai, NIO)

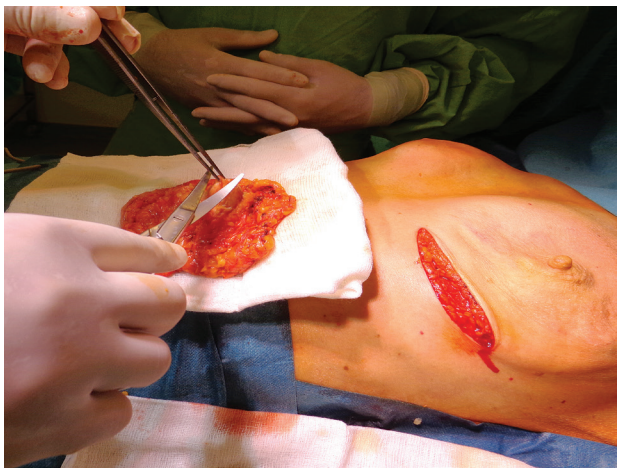


Figure 11.7.5. After orientation of the specimen, the retromamillary tissue is to be sent for intraoperative frozen section (Photo by Z. Mátrai, NIO)

It is common practice to send a tissue sample from the retro-areolar area or nipple core for an intraoperative FS. If the margin is positive for tumour then the nipple has to resected. The authors do not perform intraoperative FS, but by cautious eversion of the nipple subtotal coring of the nipple (see below) is performed in every case, and it is sent as a separate specimen for detailed histological examination.

If the margin is positive on histology, then completion excision of the nipple can be easily performed as ambulatory surgery or even during a dressing change. After coring, the inverted nipple looks like an orifice from the subdermal perspective.

The next step, which is perceived as the most difficult, is the dissection of the parenchyma from the skin opposite and furthest away from the skin incision in the upper inner quadrant. Here once again we recommend that one should return to the original concept of dissecting the

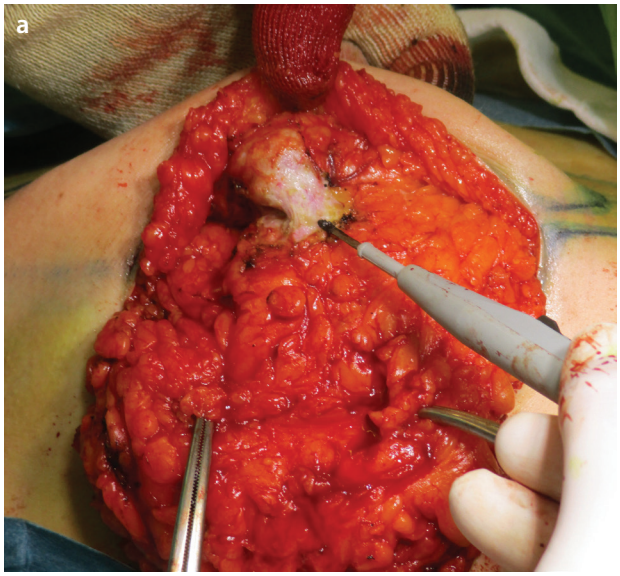


Figure 11.7.6a. The figure shows how to transect the central ductal branch retromamillarly at the ideal level in practice. The subareolar regions (region 5) next to the retromamillary area (region 6) are already circularly prepared by the surgeon, and now with his left ring finger turns the nipple inside-out so one is able to cut the central ducts directly subdermal with a cautery

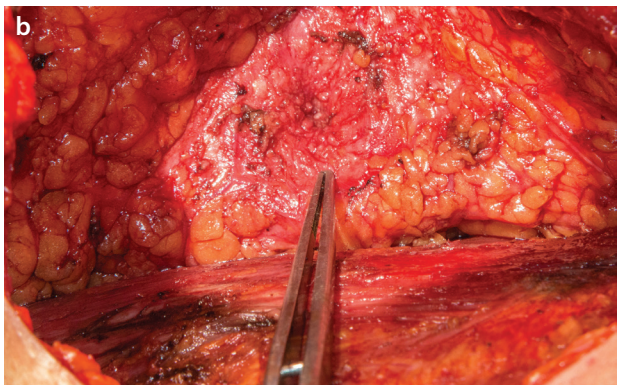


Figure 11.7.6b. After coring, the nipple inverts like an orifice

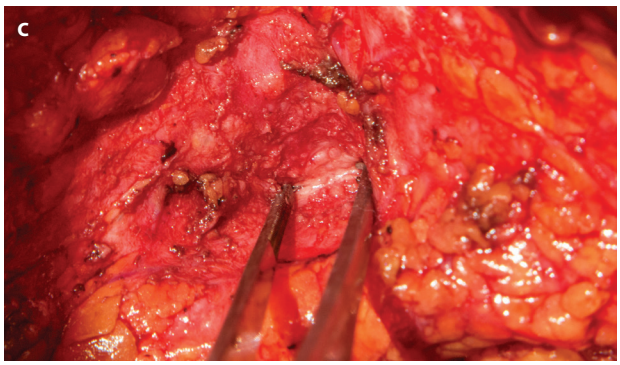


Figure 11.7.6c. Situation after coring. The forceps are placed into the "empty" nipple. (Photos by Z. Mátrai, NIO)

gland medially and then laterally; in this way, the most distant area in the middle becomes sufficiently mobile and is easily delivered into the wound. Interestingly, it is easier and better to dissect parasternally from below (region 7), especially when the parenchyma has already been separated from the pectoralis major muscle. Cranially the dissection under the skin continues from the lateral direction, and higher up we will come across the previously mentioned robust perforator vessels (region 8). (see Figure 11.7.2f./f.)

At this step the parenchyma of the upper inner quadrant connects like a pedicle to the skin and partially to the chest wall. It is easy to pull it out into the skin incision by simultaneous eversion of the skin envelope. In

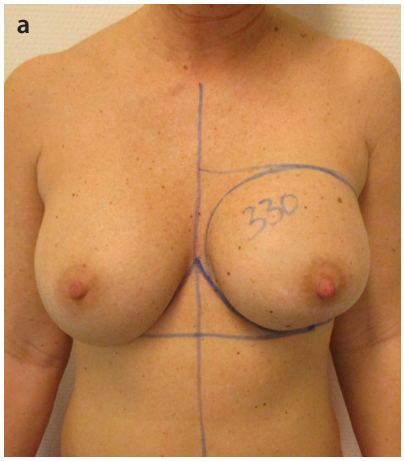
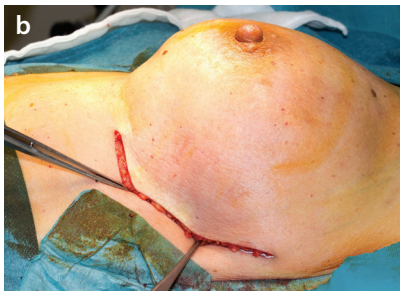


Figure 11.7.7a. The 46-year-old patient had a subpectoral silicone implant (375 cm^3 round, smooth, high-projection silicone implant) augmentation 10 years previously. This time, NSM is planned because of DCIS of the left breast



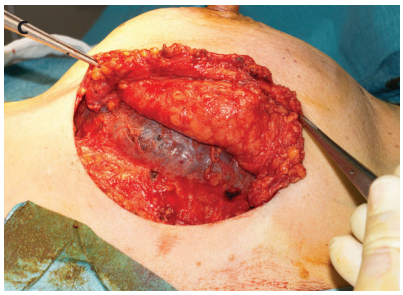


Figure 11.7.7b-c. After the skin incision placed in the IMF, the transparent capsule of the implant is becoming visible

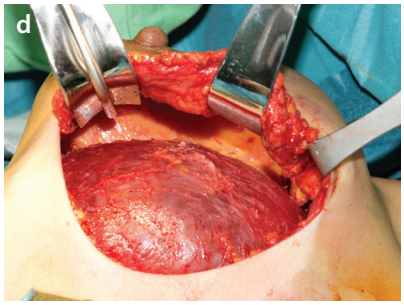


Figure 11.7.7d. The mobilisation of the parenchyma starts with the dissection of the gland from the thinned pectoralis major muscle and capsule

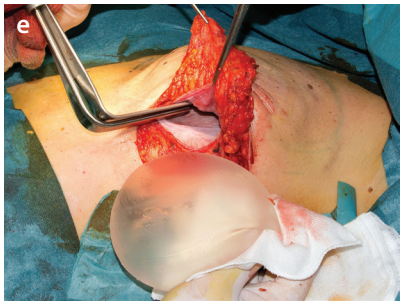


Figure 11.7.7e. The capsule is opened and the implant is removed

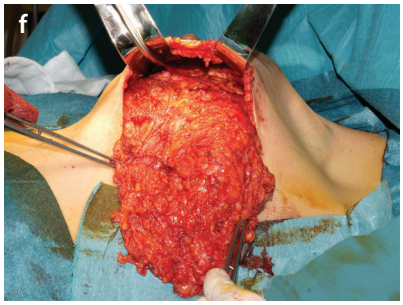
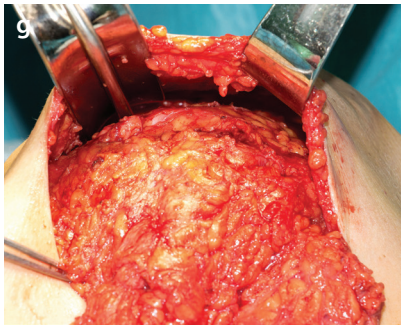


Figure 11.7.7f-g. Next step is the complete dissection of the gland from the skin envelope



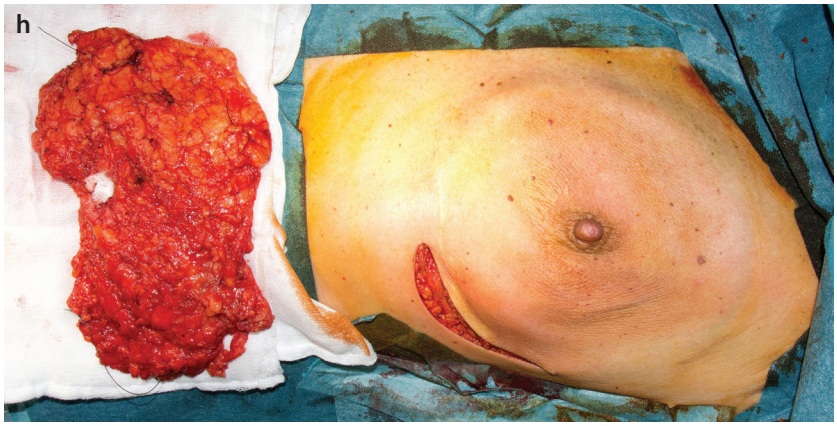
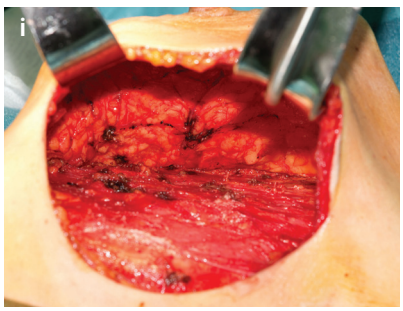


Figure 11.7.7h. Orientation of the specimen. NSM is complet

this way, the gland can be completely separated from the skin. If necessary, it can be separated from the skin by elevating the skin with a lighted retractor (region 9). (see Figure 10.7.2g./g.)

It is mandatory to orient the specimen as well as marking the nipple margin and possibly sending a separate nipple margin or core as a separate specimen for histology.



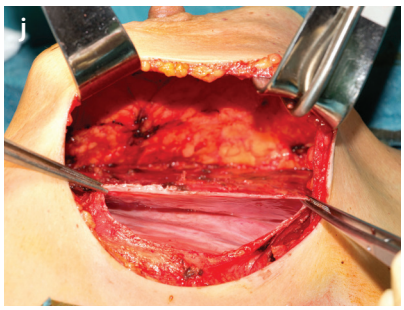


Figure 11.7.7i-j. The subcutaneous and the intracapsular spaces

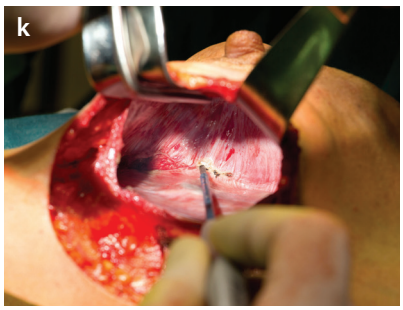
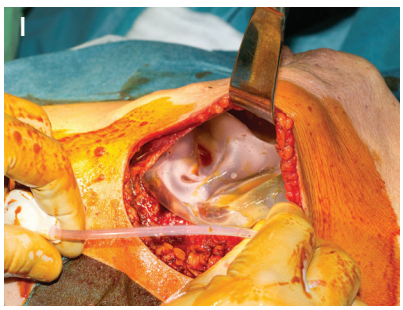
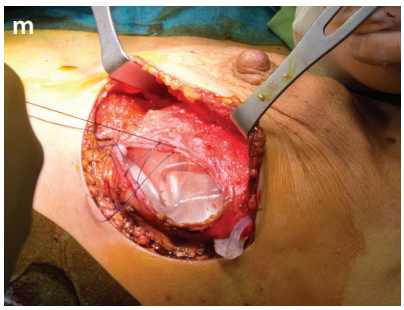


Figure 11.7.7k. The intracapsular space is being prepared for the tissue expander, by a capsuloplasty around the footprint to allow the capsule to expand





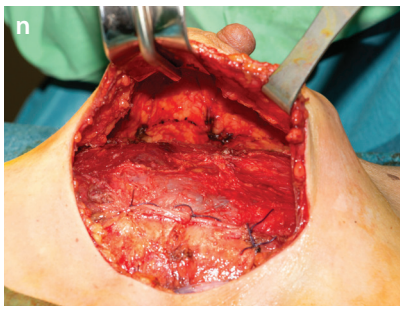


Figure 11.7.7l-n. Tissue expander is placed submuscularly

Figure 11.7.7o-p. NSM and IBR completed

Figure 11.7.7q. Cosmetic outcome at 6 weeks postoperatively.
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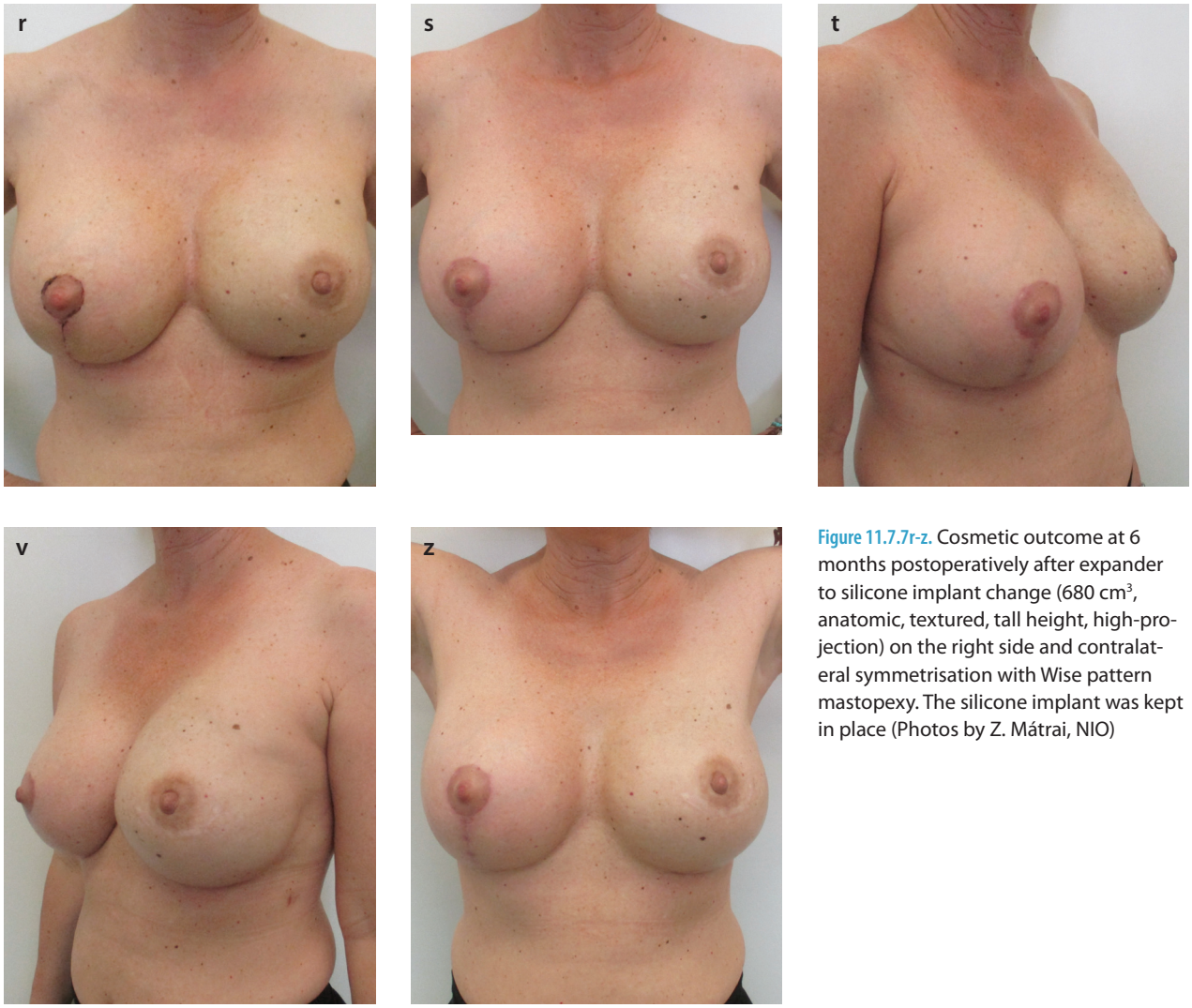


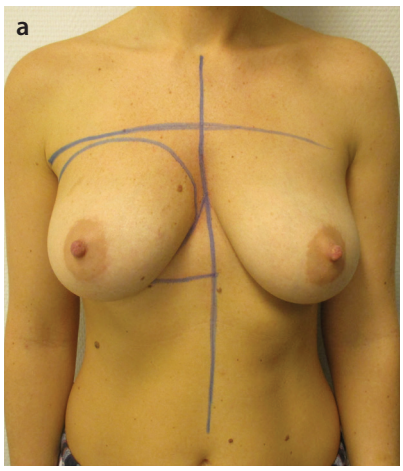
Figure 11.7.7r-z. Cosmetic outcome at 6 months postoperatively after expander to silicone implant change (680 cm^3, anatomic, textured, tall height, high-projection) on the right side and contralateral symmetrisation with Wise pattern mastopexy. The silicone implant was kept in place (Photos by Z. Mátrai, NIO)

11.7.4.1. Handling the nipple

The process of coring is performed with a tissue forceps in the right hand that holds the nipple's core or the central trunk of the ducts and lactiferous sinuses. Next, with the index finger of the left hand, the nipple is turned inside-out. The assistant then "cores" out the central ducts using sharp dissecting scissors. If this dissection is too deep, or too close to the skin edges, it can endanger the viability of the nipple. After nipple coring, variable amounts of epidermolysis can occur on the nipple surface, which will heal completely, possibly leaving behind some hypopigmentation. In severe cases, incomplete or complete necrosis of the NAC develops. Use of diathermy for coring should be avoided. The alternative is to leave a maximum 2-3 mm of tissue behind the nipple to preserve the blood supply (the author does not recommend this), accepting the minimally elevated risk of local recurrence (LR) or new tumour formation. The nipple margin or cored specimen should be sent for intraoperative FS examination if available (see above). If there is a positive margin, surgical removal of the nipple and/or areola is required.

Palmieri recommends a two-step delayed NSM technique. In the first step under local anaesthesia, he performs what he refers to as the NAC "autonomisation". Through a small peri-areolar incision he cuts the central ducts and coagulates the deep vascular plexus, so from that point on the nipple blood supply is provided by the surrounding skin. Three weeks later, the NSM takes place. Necrosis was reported in 5.5%, which was noted to be caused by thermal damage to the skin by cautery.

A new technique was reported from European Institute of Oncology in Milan in 2003, whereby the NAC was left with a 0.5-1 cm thick parenchyma island, which was treated with a single intraoperative 16 Gy dose of electron irradiation (ELIOT, Intraoperative radiation therapy with electrons) after negative FS. The intraoperative FS exam-



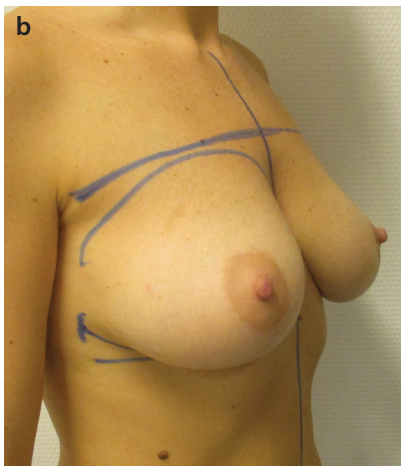
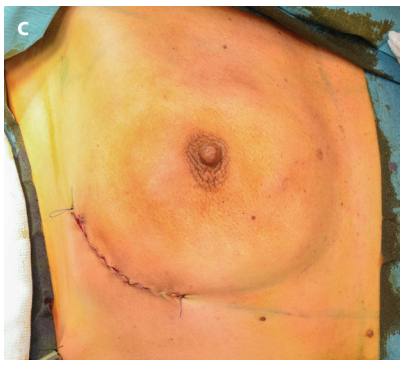


Figure 11.7.8a-b. 35-year-old patient, with a bra cup size D, slightly ptotic breast, was marked up for NSM and D-IBR, because of extensive DCIS in the right breast



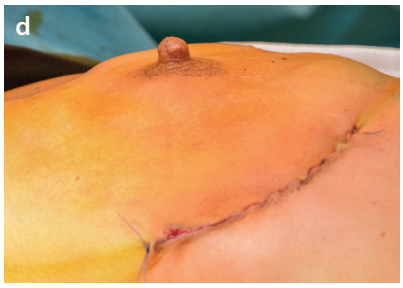


Figure 11.7.8c-d. It can be clearly seen that an oncologically complete and safe mastectomy can be performed via a 7 cm long incision in the IMF. The blood supply of the skin and the nipple is excellent. (Photos by Z. Mátrai, NIO)

ination of the nipple margin specimen is a crucial step in NSM. Despite careful patient selection, the retroareolar surgical margin may be affected by a tumour in 2.8-20% of cases. According to the literature, the false-negative rate of FS was 1-4.6%. Despite the negative intraoperative histology, on examination of 1001 NSM specimens, they found a tumour in 8.6% of the embedded sections. In controlled studies, Benediktsson and Perbeck found the intraoperative FS sensitivity to be 90.9%, and specificity 98.5%. The result is greatly influenced by the quantity, quality and proportion of fat tissue. Reservations were also observed about artefacts and the tissue loss during the study, which is why some authors recommend waiting for the final histopathological results of the retroareolar biopsy. However, if that approach is used, mistakes in specimen collection or so-called skip lesions can cause false negativity. The latter method had a sensitivity of 80% and negative predictive value of 96%.

11.7.5. Viability of the nipple

The main complication of NSM is ischaemia of the NAC, leading to partial or total necrosis; the reported incidence of this ranges from 0% to 48%, but most studies report a rate below 10%.

Data from the literature are difficult to compare as the case numbers are usually low and no standard measure is available for the degree of necrosis. Professional assessment of the ischaemic nipple is essential, as both missing the signs and unnecessary surgical intervention can compound the complication, which may require implant removal. Necrosis of the nipple is influenced by patient- and surgery-related factors. A poorly selected incision was the reason for the 60% necrosis rate for Regolo et al. when they used a periareolar incision.

Later, after they changed the incision site, the NAC complication rate decreased to 2.8%.

According to Garwood et al. the "learning curve" (for the first cohort of 64 NSM procedures, nipple viability was 80%, and for the second NSM cohort of 106 patients this increased to 96%), incisions involving >30% of the circumference of the areola in hemi-periareolar incisions, autologous reconstruction and smoking are factors that significantly affect nipple viability. The same authors reported high rates of nipple necrosis following reconstruction with fixed volume implants. Increasing the proportion of tissue expanders from 8 to 64% significantly reduced the rate of nipple loss. The more frequent necrosis affecting fixed volume implants and autologous reconstructions has been found to be associated with skin flap tension and damage to the nipple's microcirculation. The other reason associated with the inferior results in autologous reconstruction is that the NAC can survive as a full thickness skin graft on a well-vascularised pectoralis major muscle, while the peripheral area of the free flap of the abdominal wall cannot provide a well-vascularised bed.

The treatment of necrosis differs depending on extent and severity. It is recommended that full-thickness skin necrosis (partial or total) should be excised, while superficial necrosis (epidermolysis) is treated conservatively. The rate of the skin necrosis is higher with RT, (the rate of partial skin necrosis is up to 20%).

Table 11.7.1. Rates of nipple necrosis and local tumour recurrence after NSM and IBR

Author	Numbers of cancer patients	Average follow-up (months)	NAC necrosis (%)	Local recurrence rate (%)	
				Skin flap	NAC
Margulies et al., 2005	50	7.9	4	0	0
Caruso et al., 2006	50	66	2	0	2
Petit et al., 2006	102	13	5	1	0
Sacchini et al., 2006	68	25	11	2	0
Crowe et al., 2008	58	41	10	11.7	1.7
Benediktsson et Perbeck, 2008	216	156	8	–RT 28.4% +RT 8.5%	0
Gerber et al., 2009	60	101	4	11.7	0
Jensen et al., 2011	99	60	6	3	0
Harness et al., 2011	40	18.5	5	0	2.5
Nava et al., 2011	59	36	5.1	1.6	
Cont et al., 2017	518	33	nr	2.7	

IBR: immediate breast reconstruction; NAC; nipple-areola complex; nr: not reported; NSM: nipple-sparing mastectomy; RT: radiotherapy

11.7.6. Reconstructions with NSM

The optimal choice of reconstruction technique requires careful consideration, and is influenced by the factors associated with the tumour, the patient and the plastic surgeon (see Chapter 11.6.). For post NSM reconstructions, a tissue expander/ implant, or autologous tissue, or a combination of these can be used, in one or two stages. The skin incisions should be in accordance with the choice of reconstruction, allowing for the implant to be placed in its desired position, or the incisions could be optimally located to facilitate micro-anastomosis. Consideration should be given to the fact that the final histology may warrant completing skin and/or nipple excision, and one must never forget the possibility of adjuvant RT.

NSM provides ideal conditions for IBR with expanders/implants. (see Chapter 11.8.) If implant-based reconstruction is not considered optimal or is complicated due to previous RT, or if there is RT-related cosmetic harm to the aesthetic outcome of a previous reconstruction, then autologous flap-based reconstruction can be performed, or an implant-based reconstruction can be combined with autologous flaps (see Chapter 11.11 or endoscopically assisted LDm flap).

According to data from MSKCC, the cosmetic result of NSM with tissue expander reconstruction after 10.5 months' follow-up was excellent in 71.4%, good in 16.6 %, acceptable in 7% and in 5% of cases it was unacceptable.

At the Karolinska Institute (Benediktsson KP et al., 2008), IBR was performed with submuscular silicone implants and subcutaneous normal saline-filled textured implant. NAC necrosis developed in 8%. After an average 60-months' follow-up, capsular contracture (Baker 3 or 4) occurred in 20.6%, and the rate was significantly higher in the irradiated group (41.7% vs 14.5%).

At the John Wayne Cancer Institute (Jensen JA et al., 2011), 40% of the reconstructions were performed with expander implants, 23% with expander and LDmc flap and 37% with transverse rectus abdominis myocutaneous flap (TRAM). NAC necrosis occurred in 6.3%. They proved that after 60.2 months of follow-up, all three types of reconstruction can be performed successfully post NSM.

Djohan et al. published NSM and IBR cases with an average 50.4 months' follow-up; reconstruction was performed using submuscular expander/implants in 72.4%, and 27.6% had an autologous reconstruction. By the last follow-up, 40% of the cases had required at least 1 revision. Capsular contracture occurred in 6.4%, seroma in 3.8%, partial NAC necrosis in 2.6%, infection in 1.3%, haematoma in 1.3% and flap loss in 1.3%. Patient satisfaction was reported as the following: (excellent/ good vs. fair/poor): appearance 72.7% vs 27.3%, symmetry 65% vs. 35%, colour of the nipple 82% vs. 18%, sensitivity of the nipple 10.4% vs 89.6%, erectility of the nipple 27.3% vs. 72.7% and texture 67.5% vs. 32.5%. Those patients with large breasts, who were obese and had reconstruction with a large tissue expander were significantly less satisfied. The patients would change the following about the nipple: sensitivity 51%, location 23%, appearance 11%, erectility 10%, symmetry and colour 4%. 73% of the respondents would choose NSM again.

Figure 11.7.9a-b. The long-term outcome after a subcutaneously placed silicone implant following NSM on the left side. A silicone implant has to be covered by well-vascularised tissue, otherwise the ischaemic skin will slowly become "mummified" in the long term, resulting in an unnatural outcome. The patient is dissatisfied with the aesthetic result one year after surgery. (Photos by Z. Mátrai, NIO)

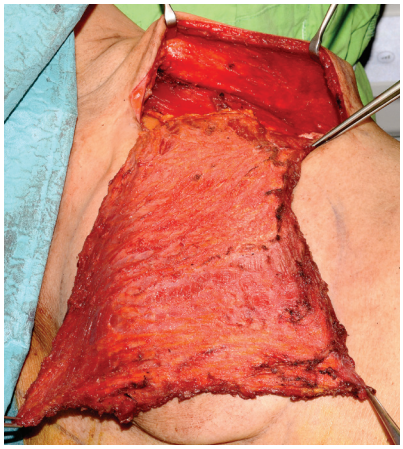


Figure 11.7.9c. Implant removal and architectural capsuloplasty with endoscopically assisted LDm flap transposition from axillary exploration

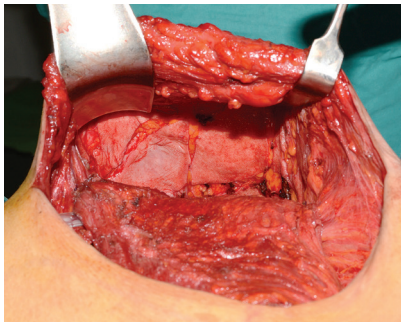


Figure 11.7.9d. Drain covering the transposed LDm flap and architectural capsuloplasty

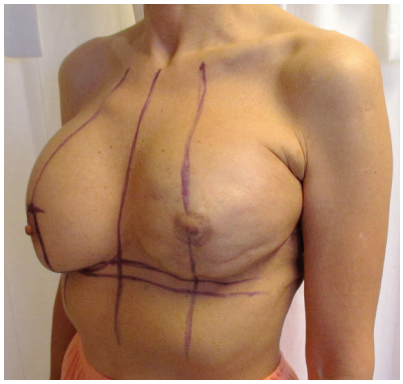


Figure 11.7.9e. Cosmetic result with an LDm flap and a 425 cm^3 textured, round, silicone implant, before symmetrisation. (Photo by Z. Mátrai, NIO)

Reconstruction with permanent implants in a one-stage procedure is one of the earliest IBR techniques. NSM with modern layer-forming materials, e.g. acellular dermal matrix (ADM), has revived this technique, using implants that can be placed entirely submuscularly or in a submuscular-subfascial pocket, or entirely prepectorally, covered with an allogenic ADM graft (see Chapter 11.9.).

Woerdeman found that implant loss rate for IBR with implants was 32% in obese patients who smoke, and 27% in those with larger than average breast size. Nava et al. used the Wise pattern skin-reducing incision and performed reconstructions using anatomical, high projection, silicone implants with average volume 442 cm^3 in especially large and ptotic breasts (average areola-IMF distance > 8 cm, sternal notch–nipple distance > 25 cm). At the same time , symmetrisation surgery was performed in 87.8%. The cosmetic result at median follow-up of 36 months was good in 78.7%, moderate in 19.7% and poor in 1.5%. Implant loss occurred in 14.2% of the cases with a total 20% complication rate.

Salgarello et al. reported their results with NSM and IBR using subpectorally-subfascially placed, high projection, anatomical silicone implants. 73% were unilateral, and 27% bilateral with an average follow-up of 26.8 months. The average implant size varied between 275-389 cm^3. The cosmetic results were very good in 24%, in 38% they were good, and acceptable in 12%, In one case with total NAC necrosis (2.4%) the patient experienced poor cosmetic result and satisfaction. Major complications occurred in one case, minor complications in 21.4%, while contour deformity was found in 19%.

It is particularly essential to visualise the quality of circulation in autologous flaps, which are mostly covered following NSM. In reconstruction with free flaps, the flap loss rate was significantly higher in fully de-epithelialised, so-called hidden flaps (6.5%) when compared with flaps retaining skin (1.8%). In the latter, circulatory insufficiency could be observed within 48 hours, and 77% could be rescued, while with hidden flaps circulatory insufficiency was observed only after 95 hours and none of the flaps could be saved. The hidden flaps can be assessed

with an implanted Doppler flowmeter, thermometer, or indocyanine technique. A small indicator skin-island can be left behind on the flap.

In reconstructions following NSM, it should be noted that keeping the whole skin can reduce the need for contralateral symmetrisation. Factors influencing symmetrisation surgery have been investigated following postmastectomy reconstruction. Delayed reconstructions required more symmetrisation surgery than IBR. In addition, higher rates were associated with implants when compared with autologous reconstruction. Significantly less contralateral surgery was required after SSM and NSM than after SM.

11.7.7. Oncological safety in risk-reducing surgeries

Currently, there are some doubts about the oncological safety of NSM when using it for prophylactic reasons. Clearly, for this indication there is need for not only a thorough preoperative assessment, but also accurate patient information and a precise surgical technique. Patients who undergo preventive surgery are known to have higher aesthetic expectations. The area for investigation for NSM is primarily whether such procedures can provide the same levels of risk reduction as SM.

Stolier and Wang compared the reliability of prophylactic SM and NSM, based on the presence of TDLUs in the nipple. They could not detect TDLUs in 29 of the 32 nipple examinations, while the remaining three had 1,2 and 3 TDLUs, all of them at the base of the nipple. Based on their results, they stated that NSM could be safely performed as a risk-reducing mastectomy (RRM).Pennisi and Capozzi, after 1500 prophylactic NSM found 0.4 % breast cancers at 10 years' follow-up. Spear et al. studied the safety of RRM in 74 high-risk patients who underwent 101 surgeries. Of the surgeries, 64% were after breast cancer on the contralateral breast and 36% due to bilateral breast cancers, with SSM in 73 cases, and with NSM in 28 cases. The reconstructions were performed using expanders/implants in 70%, 20% with TRAM flap and 10% with LDmc flap and expander/implant. Patient satisfaction with the cosmetic result were; 81% very/well satisfied (78% unilateral vs. 91% bilateral) and 14% moderately/ barely (16% vs. 9%), while 5% were not satisfied (6% vs. 0%). Complications occurred in 10%. 98% of the patients were willing to undergo surgery again (96% vs 100%). During the 1-5 years' follow-up, no cancers were detected.

At the Mayo Clinic (McDonnell SK et al. 2001), results of 745 high-risk primary breast cancer females with contralateral prophylactic mastectomy (41% NSM) were reported. At an average 10 years' follow-up, 6 cases instead of 115 (as would be expected using the Anderson statistical model) had breast cancer out of 388 premenopausal female patients, which corresponds to a 96% risk reduction. The total of 8 tumours (1%) were equally (50-50) divided between SM and NSM and not once was the NAC affected.

Rebbeck et al. published the result of a prospective multicentre Prevention and Observation of Surgical End Points (PROSE) Study Group in 483 BRCA 1/ 2 positive patients. In one arm 105 patients had a bilateral RRM (29 NSM), of which 2 (1.9%) had breast cancer at an average follow up of 6.4 years, compared to the 184 tumours (48.7%) in the 378 patients in the control group. Prophylactic mastectomy achieved 95% risk reduction with ovarian removal and 90% on its own. There was no significant difference between the groups of NSM and SM in breast cancer formation, and the 2 cancers that developed were away from the NAC.

Metcalfe analysed the oncological and aesthetic results of NSM in the prophylactic setting. In her opinion, a 75-year-old BRCA 1/2 positive woman in the USA has 80% chance of developing breast cancer, while in the average population it is only 9% in Canada, 10·7% in the USA (whites), and 8·2% in the UK. The risk of breast cancer can be reduced by 95-99% with traditional bilateral mastectomy and by 95% with NSM according to the Mayo clinic's findings. In theory the breast cancer risk can be reduced to even half of an average population risk; however, the aesthetic result after NSM is significantly better with more than 80% patient satisfaction. The authors predicted that the number of high-risk women requesting the RRM will rise from 20% to 50% if NSM were offered. Assuming that 20% of women would choose SM anyway, wishing for the greatest possible decrease in risk, and assuming that women with intact breasts will have a 40% lifetime risk of breast cancer (ie, that they will have had tamoxifen or oophorectomy and thereby reduced their risk by half from the baseline of 80%), then the expected numbers of breast cancers in a cohort of 1000 women would fall from 320 to 215, if the NSM option were made available. (see also Manning et al. in section 11.7.2.).

In summary, risk reduction with NSM is the same as with SM, but with significantly better aesthetic outcomes, and this may lead to an increase in high-risk patients undertaking prophylactic surgery.

11.7.8. Oncological safety in breast cancer therapeutic surgeries

In comparison with RRM, there are significantly more reservations about the use of NSM in cancer cases. Most of the oncology-related doubts regarding SSM and NSM concern the possibility of leaving TDLUs behind the nipple and local control (see INSPIRE study goals).

Figure 11.7.10. Insufficient NSM and IBR in 2009 because of pT2 pN0(sn) M0 ILC, followed by removal of the subcutaneously placed silicone implant due to complications. Four years after the surgery, ulcerated recurrent ILC (rpT4bpN0 M0) in the nipple (Photo by Z. Mátrai, NIO)

From the local control point of view, a free surgical margin is fundamental, but in high-risk patients PMRT can also be recommended to improve results. The rate of LR characterises effective local control. The results of SSM should be compared with those of SM.

Based on 20-year follow-up of the NSABP B06 study, LR rate following a SM was 10.5%, which means approximately 0.5% per year, implying that despite maximum radicality, recurrences will occur due to the biological properties of the tumour. Following SSM, the main risk to local control was considered to be parenchyma left behind on the preserved skin (see Chapter 10.6). This, of course, may happen due to poor surgical technique. These surgeries should in practical terms be considered as BCS; however, in most cases adjuvant RT is not offered. Several studies have shown no significant difference in the incidence of local recurrence in invasive and in situ breast cancer after SSM and SM carried out using best practice.

Based on the popularity and clinical results of SSM, in recent years several major oncology centres, in selected patients (often in clinical trials), have been critically evaluating NSM in the treatment of breast cancer. See Table 11.7.1.

The fundamental difference between the two procedures is the preservation of the NAC. The results were generally reported in a small number of retrospective studies, mostly with short follow-up, with the primary endpoint as LR. The other problem is that the surgeries are not standardised, and the scientific publications cannot control their technical accuracy. The reason publications in the 80s showed high levels of tumour involvement of the nipple and contralateral breast or local recurrence was mainly due to more advanced tumour stages and different histological examinations of the nipple and their interpretations. Over the last two decades, more relevant studies have been published, but there are still considerable differences in patient selection, surgical technique, adjuvant RT and period of follow-up, which makes a meaningful comparison with SM even more complicated.

According to the meta-analysis of Garcia-Etienne et al., which included 1826 NSM cases from recent years, and only 3 LRs (0.16%) were in the NAC. In their opinion, SM and SSM achieve equal results for local control in well-selected patients, and the pathophysiology of the disease is more dependent on tumour biology than keeping or removing the NAC. Gerber and Krause at average 101-month follow-up found no significance when comparing NSM, SSM and SM in terms of local recurrence (11.7% in NSM, 10.4% in SSM and 11.5% in SM), distant metastases and tumour-related mortality rates. There was no recurrence in the NAC.

In the prospective randomised ELIOT study (Petit JY et al, 2009), the effectiveness of intraoperative RT was investigated after NSM (82% invasive and 18% in situ carcinoma). The endpoints of the trial were oncological, psychological, aesthetic results and complications. 800 patients were treated with ELIOT, and 201 received delayed „one-shot" RT on the day after surgery. The median follow up time was 20 months (range 1-69) for a follow up performed in 83% of the patients. The NAC necrosed totally in 35 cases (3.5%) and partially in 55 (5.5%) and was removed in 50 (5%). Twenty infections (2%) were

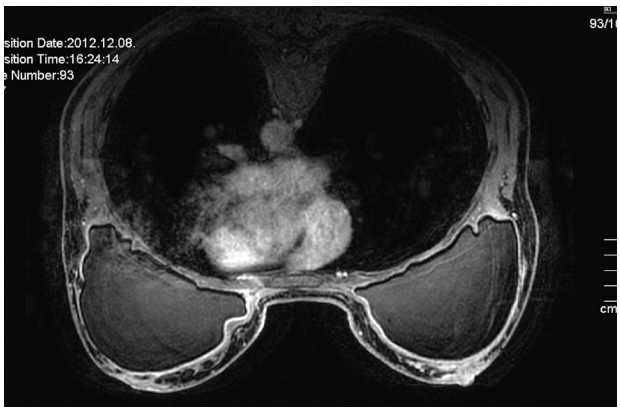


Figure 11.7.11. In another institute, insufficient NSM and IBR with subcutaneous silicone implant reconstruction from the IMF incision. Follow-up MRI showed a significant amount of residual parenchyma retroareolarly in the right breast. (Photo by Z. Mátrai, NIO)

observed and 43 (4.3%) implants removed. The median rate of the patients for global cosmetic result on a scale ranging from 0 (worst) to 10 (excellent) was 8. Only 15% of the patients reported a partial sensitivity of the NAC. Of the fourteen (1.4%) local recurrences, ten occurred close to the tumour site, all far from the NAC corresponding to the field of radiation. No recurrences were observed in the NAC. In a group of patients characterized by a very close free margin under the areola, no local recurrence was observed. Overall, 36 cases of metastases and 4 deaths were observed. No significant outcome difference was observed between the 800 patients receiving intraoperative radiotherapy and the 201 patients receiving delayed irradiation.

The primary endpoint of the prospective controlled trial of the Karolinska Institute was survival. The study included 216 cases with an average of 13 years of follow-up. The T1-T3 tumours were multicentric in 73%, and 40.3% had metastases in the axillary lymph nodes. 47 patients received adjuvant RT, 53 CHT and 122 endocrine therapy (ET). The 10-year summary of LR rate was 20.8%, DFS was 51.3%, OS was 76.4%. The LR rate showed a significant difference between irradiated (8.5%) and non-irradiated (28.4%) patients. There was no recurrence in the NAC. The authors considered the results to be comparable with the published results for SSM and SM and suggested the use of adjuvant RT.

The largest meta-analysis was described by Mallon et al. included 29 NSM publications with an analysis of 2314 cases. At an average 49.3-month follow-up, the total NAC tumour recurrence rate was 0.9%, while the relapse rate in the skin flaps was 4.2%. Rate of total and partial NAC necrosis was 2.9% and 6.3% respectively.

The importance of a precise technique for NSM is referred to by Cont et al.'s publication. Primary tumour location predicts the site of local relapse after NSM. Between 2010 and 2015, 518 breast cancer patients were submitted to NSM. Breast MR and intraoperative assessment of the subareolar (SA) and proximal (ND) nipple ducts were performed to predict NAC involvement. Significant associations between pre- and postoperative variables with SA/ND involvement and with the risk of LR were retrospectively investigated. SA/ND were involved in 26.1% of the cases. Tumour-NAC distance predicted final pathology of SA/ND at MR and intraoperative pathology with 75 and 93% accuracy, respectively. NAC involvement was more frequent in case of positive ND than positive SA (68.3 vs 38.3%; p=0.003). Fourteen (2.7%) local relapses developed over a mean follow-up of 33 months. Ki-67 ≥25% (p=0.002) and a high tumour grade (p=0.027) correlated with increased local recurrence. Most relapses developed in the subcutaneous tissue of the quadrant where the primary tumour was located (12/14; 85.7%). No local relapses occurred in patients who received PMRT as compared to patients who did not, although they had a higher rate of positive surgical margins (40.5 vs 16.2%; p=0.000). NAC involvement can be predicted by MR and intraoperative pathology of ND/SA. Local recurrences after NSM almost invariably develop in the same quadrant where the primary tumour was located and in highly proliferative tumours.

The importance of surgical technique for NSM is also highlighted by Donovan et al. in their publication "Oncological and Surgical Outcomes After Nipple-Sparing Mastectomy: Do Incisions Matter?". In the introduction, they stated that while NSM for the treatment of breast cancer is becoming more accepted, technical aspects are still evolving. Data regarding risk factors contributing to complications after NSM are limited. This study evaluated technical aspects of outcomes of NSM. They reviewed 201 patients identified from their database, who had NSM during the period from January 2012 to June 2015. They compared the effect of operative techniques on surgical outcomes. A total of 351 NSM were performed in 201 patients. Inframammary (47%) or periareolar (35%) incisions were most frequent. Tumescence was used in 203 (58%) NSM. Skin flaps were created using sharp dissection in 213 (61%) and electrocautery in 138 (39%) breasts. Nipple-areola complex necrosis was seen in 56 (16%) breasts, of which 7 were severe (2%). A higher rate of NAC complications was seen with periareolar incisions (p=0.02). Sharp dissection did not result in significant rates of flap necrosis compared with electrocautery. Ten patients (3%) had a positive anterior/deep margin, of which 7 (64%) had an inframammary approach. Twenty-two (11%) patients had an infection that required intravenous antibiotics. Fourteen (7%) patients had implant loss. Dissection technique was not associated with implant loss (p=1.0) or infection (p=0.84). Forty-two (12%) patients had radiation, and seven (16%) required implant removal. They concluded that NSM has an acceptable complication rate. NAC necrosis requiring excision or implant loss is rare. The PMRT is a significant risk factor for implant loss. Inframammary incisions have fewer ischaemic complications but may result in tumour-involved margins.

De La Cruz et al. published a systematic literature review in 2015. Studies with internal comparison arms evaluating therapeutic NSM versus SSM and/or modified radical mastectomy (MRM) were included in a meta-analysis of OS, DFS, and LR. Studies lacking comparison arms were only included in the systematic review to evaluate mean OS, DFS, LR, and nipple-areolar recurrence (NAR). The search yielded 851 articles. Twenty studies with 5594 patients met selection criteria. The meta-analysis included eight studies with comparison arms. Seven studies that compared OS found a 3.4% risk difference between NSM and MRM/SSM, five

studies that compared DFS found a 9.6% risk difference between NSM and MRM/SSM, and eight studies that compared LR found a 0.4% risk difference between NSM and MRM/SSM. Risk differences for all outcomes were not statistically significant. The systematic review included all 20 studies and evaluated OS, DFS, LR, and NAR. Studies with follow-up intervals of <3 years, 3-5 years, and >5 years had mean OS of 97.2, 97.9, and 86.8%; DFS of 93.1, 92.3, and 76.1%; LR of 5.4, 1.4, and 11.4%; and NAR of 2.1, 1.0, and 3.4%, respectively. The authors concluded that the meta-analysis did not detect adverse oncologic outcomes of NSM in carefully selected women with early-stage breast cancer. Use of prospective data registries, notably the NSM registry, will add clarity to this important clinical question (see INSPIRE).

Santoro S et al. published data in 2015 about NSM implemented after neo-adjuvant chemotherapy. Among 275 NSMs performed from January 2007 to January 2015, 186 cases, with a minimum follow-up of 12 months, were carried out for invasive or intraductal carcinoma. Patients were considered for NSM if there were no clinical and/or radiological evidence of invasion or close proximity (<1 cm) to NAC. They compared patients operated with NSM after neoadjuvant CHT (Group I N = 51) with those who underwent primary surgery (Group II, N = 135). At a median follow-up of 35 months, 166/186 patients were alive and disease-free (89.7%). Three LRs (1.6%) were observed, all in the skin flap outside the NAC in Group I: (6%; p<0.01). No NAC recurrences have been recorded, in either group. Nipple loss due to full thickness necrosis or resection for insufficient margins was recorded in 31 cases (17%); 12 in Group I (24%) and 19 in Group II (14%) (p=0.1). This event decreased by half in the second part of the study (21/93 vs 10/93) (p=0.03). The authors concluded that NSM after neoadjuvant CHT is not associated with a statistically significant difference in terms of postoperative complications, total nipple loss for necrosis or margins, and results improve with experience. The LR rate was higher after neoadjuvant CHT, yet it was consistent with traditional mastectomy in the high-risk setting. There is no need to avoid NSM after neoadjuvant CHT for locally advanced cancers if the retro-areolar margins of resection are clear at the time of surgery. I n 2016 Mota et al., published the results of the Cochrane Database Systematic Review to assess the efficacy and safety of NSM and ASM for the treatment of DCIS and invasive breast cancer in women. They searched the Cochrane Breast Cancer Group's Specialised Register, the Cochrane Center Register of Controlled Trials (CENTRAL), MEDLINE (via PubMed), Embase (via OVID) and LILACS (via Biblioteca Virtual em Saúde [BVS]) using the search terms "nipple sparing mastectomy" and "areola-sparing mastectomy". They also searched the World Health Organization's International Clinical Trials Registry Platform and ClinicalTrials.gov. All searches were conducted on 30th September 2014 for RCTs; however, if there were no RCTs, they expanded their criteria to include non-randomised comparative studies (cohort and case-control studies). Studies evaluated NSM and ASM compared to modified radical mastectomy or SSM for the treatment of DCIS or invasive breast cancer. They included 11 cohort studies, evaluating a total of 6502 participants undergoing 7018 procedures: 2529 underwent NSM, 818 underwent SSM, and 3671 underwent traditional mastectomy, also known as MRM. No participant underwent ASM. There was a high risk of confounding for all reported outcomes. For OS, the hazard ratio (HR) for NSM compared to SSM was 0.70 (95% CI 0.28 to 1.73; 2 studies; 781 participants) and the HR for NSM compared to MRM was 0.72 (95% CI 0.46 to 1.13; 2 studies, 1202 participants). LR was evaluated in two studies, the HR for NSM compared to MRM was 0.28 (95% CI 0.12 to 0.68; 2 studies, 1303 participants). The overall risk of complications was different in NSM when compared to other types of mastectomy in general (RR 0.10, 95% CI 0.01 to 0.82, 2 studies, p=0.03; 1067 participants). With respect to skin necrosis, there was no evidence of a difference with NSM compared to other types of mastectomy, but the confidence interval was wide (RR 4.22, 95% CI 0.59 to 30.03, p=0.15; 4 studies, 1948 participants). There was no difference among the three types of mastectomy with respect to the risk of local infection (RR 0.95, 95% CI 0.44 to 2.09, p=0.91, 2 studies; 496 participants). Meta-analysis was not possible when assessing cosmetic outcomes and quality of life, but in general, the NSM studies reported a favourable aesthetic result and a gain in quality of life compared with the other types of mastectomy. The quality of evidence was considered very low for all outcomes due to the high risk of selection bias and wide confidence intervals. The authors concluded that that the findings from these observational studies of very low-quality evidence were inconclusive for all outcomes due to the high risk of selection bias.

In summary, at the moment there is no study available about NSM that has long-term follow-up and a high level of evidence. The comparability of the available studies is questionable, but it seems that with proper patient selection and precise surgical technique the oncological results are no different from those seen with SSM, and local control can be comparable with SM.

11.7.9. Aesthetic results and patient satisfaction

The most important benefit of NSM is its excellent cosmetic result, which is achieved by the total preservation of the natural skin of the breast, coupled with over 80%

patient satisfaction. However, it can be said that objective presentations of the aesthetic results of NSM are rare.

Didier et al. examined cosmetic result, body image, sexual, psychological and oncological well-being with a questionnaire one year after NSM and IBR and SSM/ SM and IBR and nipple reconstruction. The study was able to demonstrate significant benefit in body image, satisfaction with the nipple and nipple sensitivity in the NSM group, although the nipple sensitivity is decisively also harmed after NSM. Breast form and, especially, nipple position also change after NSM. It is well known that a preserved nipple in malposition is worse than a well-located but reconstructed nipple. Nahabedian et al. found that after unilateral NSM, nipple symmetry was only present in 50% of cases. Petit JY et al. showed nipple radiodystrophy after intraoperative RT: 7.5% had hyper-pigmented secondary circular contour around the areola, 24% asymmetry in the pigmentation of the areolas.

The nipple after NSM usually becomes insensitive. Petit et al. used a scale of 1 to 10 to determine the nipple sensitivity; they touched the areola with a strip of paper and compared it with the contralateral, normal nipple. The sensation was an average 2. A year later 15% of the patients had some feeling.

An undesirable result of NSM, which is caused by NAC malposition and the resulting asymmetry with the contralateral NAC and which significantly affects the cosmetic outcome should also be mentioned. NAC malposition is more common in D-IBR cases. Prevention is easier than the correction, so in D-IBR with expander, it is suggested that the skin of the breast, especially the NAC, be medialised by around 10 mm before the vacuum drains are applied. If a vacuum drain system is not used, then in the early postoperative phase the NAC position can be optimised during a dressing change with a gentle caress of the skin envelope. If the NAC malposi-

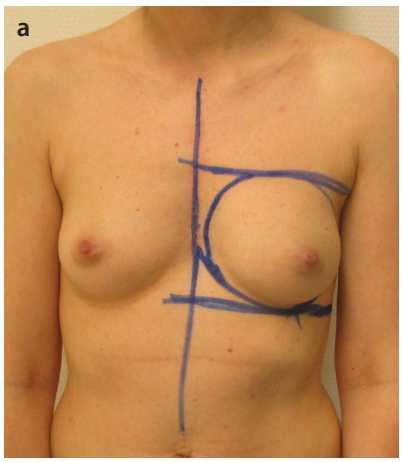


Figure 11.7.12a. 34-year-old patient with extensive DCIS in her left breast. NSM is marked up

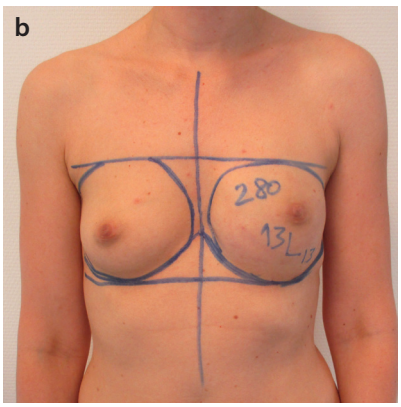


Figure 11.7.12b. Status at 3 months postoperatively. The volume of the expander is 280 cm^3. Patient is marked up for expander to silicone implant exchange on the left side, and contralateral symmetrisation with silicone implant augmentation

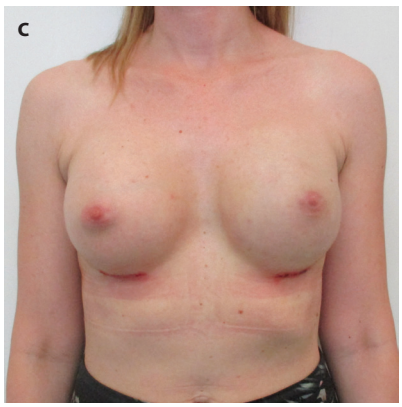
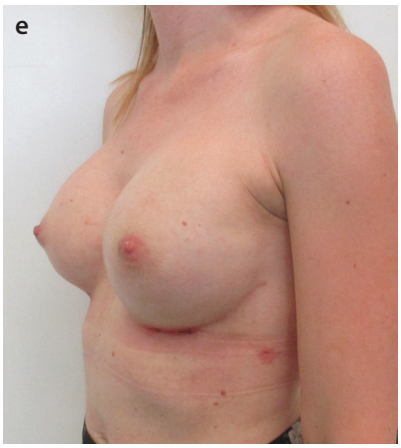


Figure 11.7.12c-f. Cosmetic outcome at 6 weeks postoperatively. A 495 cm^3 anatomical, textured, medium height, high-projection silicone implant was placed on the left side, and a 325 cm^3 round, textured, high profile silicone implant was placed submuscularly on the right side. (Photos by Z. Mátrai, NIO)



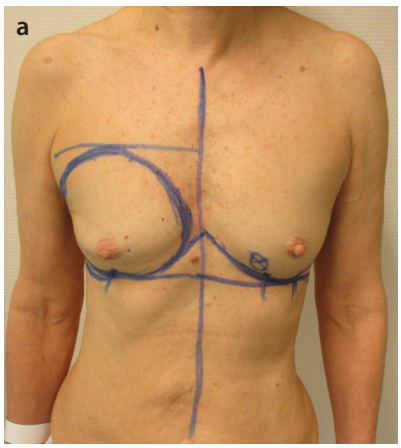


Figure 11.7.13a. 58-year-old patient with bra cup size A had a multicentric breast cancer in her right breast and benign lesion in the left breast. NSM and SNB followed by D-IBR on the right side and lumpectomy with retroglandular OPS were planned

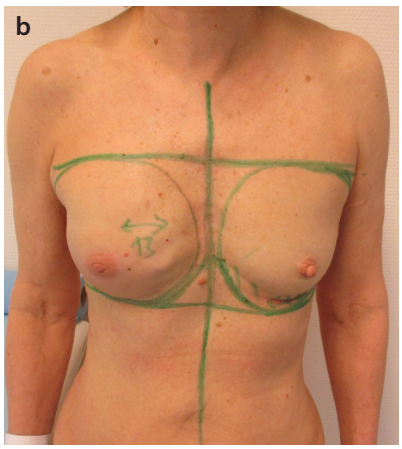


Figure 11.7.13b. Status at 3 months postoperatively

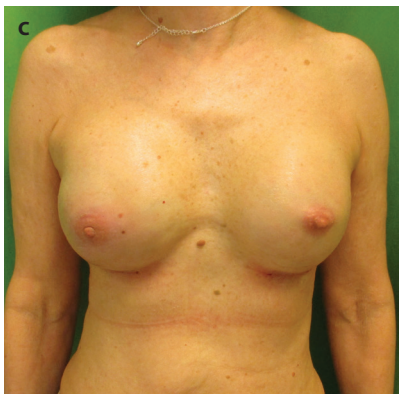


Figure 11.7.13c. Cosmetic outcome at 4 weeks postoperatively after expander to silicone implant exchange (495 cm3 anatomical, textured, medium height, high-projection silicone implant) on the right side, and contralateral symmetrisation with submuscular silicone implant augmentation (300 cm^3 round, textured, moderate-plus-profile silicone implant)

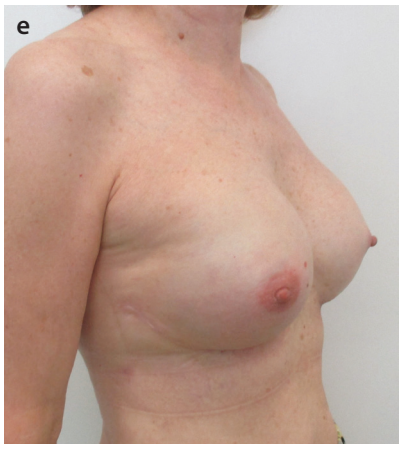


Figure 11.7.13d-g. Cosmetic outcome 3 months after expander to silicone implant exchange (Photos by Z. Mátrai, NIO)

tion is already established, the nipple can be transferred using transposition flap techniques (see Chapter 11.15., maximum 10 mm correction can be achieved).

Nipple excision and reconstruction from the pigmented areola in the proper place, rather than additional areola tattooing, or even total NAC successive (multi-step) excision and delayed nipple reconstruction in the optimal position can be performed, with tattooing later.

In 2017 Choi et al. published a retrospective review of NSMs from 2006 to 2016 performed at a single institution. Incidence, risk factors and corrective techniques of NAC malposition were analysed. 1037 cases of NSM were identified, of which 77 (7.4%) underwent NAC repositioning. All of these were performed as a delayed procedure. The most common techniques included crescentic periareolar excision (25; 32.5%) and directional skin excision (10; 13.0%). Cases requiring NAC repositioning were significantly more likely to have preoperative radiation (p=0.0008), a vertical or Wise pattern incision (p=0.0157), autologous reconstruction (p=0.0219), and minor mastectomy flap necrosis (p=0.0462). Previous radiation (OR=3.6827, p=0.0028), vertical/ radial mastectomy incisions (OR=1.8218, p=0.0202), and autologous reconstruction (OR=1.77, p=0.0053) were positive

independent predictors of NAC repositioning, whereas implant-based reconstruction (OR=0.5552, p<0.0001) was a negative independent predictor of repositioning. BMI (p=0.7104) and adjuvant radiation (p=0.9536), among other variables, were not predictors of NAC repositioning. The authors concluded that NAC malposition after NSM can be successfully corrected with various techniques. Previous radiation, vertical mastectomy incisions, and autologous reconstruction are independently predictive of NAC malposition.

11.7.10. Summary

Based on the available data, definitive conclusions about the oncological safety of NSM cannot be established, so the procedure has not been widely accepted as an alternative to SM. The procedure has the greatest justification in RRM, as it may help high-risk patients to accept surgical prophylaxis. It is also tempting to carry out NSM to meet patients' high aesthetic expectations in modern reconstructive breast surgery – this is clearly illustrated by its increasing popularity, but it is important to remember that the main priority is oncological safety. The procedure can be used in accordance with international recommendations in well-selected patients, with proper pre- and intraoperative checks, precise technique and with comprehensive patient information. In the future, with a more substantial number of cases and longer follow-up, and with ongoing prospective randomised trials, evidence will be forthcoming to supply answers to the currently unanswered questions.

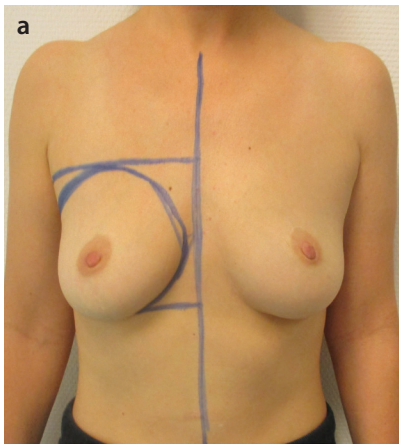


Figure 11.7.14a. 48-year-old patient with and extended DCIS in the right breast. NSM and D-IBR is planned

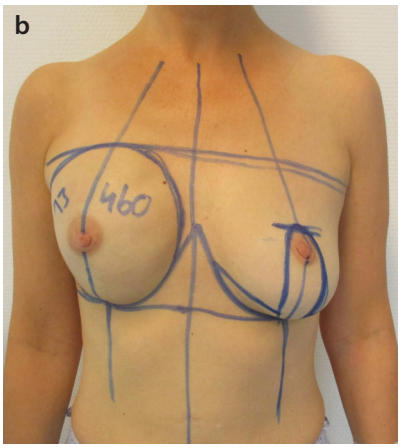


Figure 11.7.14b. Status at 3 months post-operative. Expander to silicone implant (535 cm^3 round, textured, ultra-high-projection silicone implant) exchange and contralateral symmetrisation with mastopexy and silicone implant (300 cm^3 round, textured, moderate-profile silicone implant) augmentation is planned

Figure 11.7.14c. Cosmetic outcome 4 weeks after the expander to implant exchange and symmetrisation

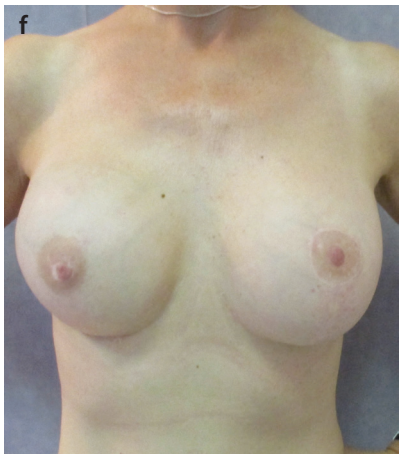


Figure 11.7.14d-f. Cosmetic outcome 3-6-9 months after the expander to implant exchange. Change of shape of the breasts over time are clearly visible. Asymmetry increases unavoidably with time, because of the different types of breast reconstructions bilaterally (Photos by Z. Mátrai, NIO)

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