Future challenges in the surgical treatment of breast cancer – Oncoplastic, prophylactic procedures and reconstructive surgery

Zukünftige Herausforderungen in der operativen Therapie des Mammakarzinoms – von der Onkoplastik, risikoreduzierenden Verfahren und rekonstruktiven Chancen

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ABSTRACT

Medical knowledge is doubling faster and faster. Surgeons are highly specialized and must be trained not only in surgery, but also in imaging and oncology to meet the modern requirements of a breast center. This article describes what has changed in the surgical treatment of breast cancer over the past 20 years since the introduction of certified breast centers in Germany, and what could change in the future. Pre- and post-operative conferences have become a central component of the interdisciplinary exchange of information. Every breast-conserving operation must be precisely planned, marked and carried out in a controlled manner. Basic anatomical knowledge is not sufficient enough to perform a prophylactic mastectomy. Implant-based reconstructions change their shape and strength over time and usually lead to follow-up operations. Tissue engineering offers interesting approaches to replace the disadvantages of conventional implants in order to achieve the durability and quality similar to autologous tissue reconstructions.

ZUSAMMENFASSUNG

Das medizinische Wissen verdoppelt sich immer schneller. Operateure arbeiten hochspezialisiert und müssen nicht nur chirurgisch, sondern auch bildgebend und onkologisch ausgebildet sein, um den modernen Anforderungen eines Brustzentrums zu entsprechen. Der Beitrag beschreibt, was sich in den vergangenen 20 Jahren, seit Einführung der zertifizierten Brustzentren in Deutschland, in der operativen Therapie des Brustkrebses verändert hat und zukünftig verändern könnte. Dabei sind die prä- und postoperativen Konferenzen zentraler Bestandteil des interdisziplinären Informationsaustausches geworden. Jede brusterhaltende Operation muss exakt geplant, markiert und kontrolliert ausgeführt werden. Anatomische Grundkenntnisse sind nicht ausreichend, um eine prophylaktische Glandektomie durchzuführen. Implantatbasierte

Rekonstruktionen verändern ihre Form und Festigkeit über die Zeit und führen meist zu Folgeoperationen. Durch Tissue Engineering gibt es interessante Ansätze, die Nachteile herkömmlicher Implantate zu ersetzen, um in den Bereich ähnlich der Lebensdauer und -qualität von Eigengewebs-Rekonstruktionen zu gelangen.

"We are senology" – This statement from by Prof. Dr. Rüdiger Schulz-Wendtland, which he coined in 2013 when he was President of the German Society for Senology (DGS), is more relevant today than ever. Even though this article focuses on the surgical treatment of breast cancer, his sentence conveys the notion that "we", regardless of which specialist discipline we belong to, can only win the fight against breast cancer together – as one interdisciplinary team. Successful senologists look beyond the immediate confines of their specialist field in order to incorporate the knowledge of other specialist disciplines into their treatment concept. For how could a surgeon operate on a breast without understanding how genetics, imaging, radiotherapy, and systemic therapy are interrelated? Modern diagnostic and therapeutic strategies merge to a single approach to ensure that patients not only survive but also enjoy a high quality of life. For 20 years now, the German Society for Senology (Deutsche Gesellschaft für Senologie, DGS) has with its publication, the journal "Senologie", been instrumental in ensuring that doctors, regardless of their specialty, speak a common language. Congratulations on this success!

And in these 20 years, a great, great deal has changed. While nothing about the disease itself has changed during this time, our understanding of breast cancer has grown continuously and senologists have modified the way they work. To imagine the future, you need to know your past – especially, if you are a senologist.

So, let's take a look back first, and then imagine what the future might hold.

Senology 20 years ago

At the turn of the millennium, there were no certified breast centres in Germany, no mammography screening program, punch biopsies were the exception, "lumps" in the breast were removed by open excision biopsy, examined by frozen section, and, depending on the findings, an indication for mastectomy with complete axillary dissection was established. Systemic therapy comprised CMF and tamoxifen and was at times recommended in a non-selective manner. Lymph node mapping, initially introduced for melanoma [1], was evaluated for breast cancer in first studies and later established [2]. These provided the evidence basis for the surgical de-escalation of axillary lymphadenectomy [3, 4]. The BrCa1 mutation was first described in 1994 [5]. There was still a long way to go before genetic testing became part of routine clinical practice. The universal availability of breast reconstruction was not something that could be taken for granted at that time. For reconstruction, mainly techniques such as implant, latissimus dorsi and TRAM reconstructions were used [6, 7, 8]. A general inclusion of patients in studies, combined with evidence-based guideline-oriented medicine, had not yet become the norm nationwide. Quality assurance as we understand it today, combined with quality indicators, only existed as an idea. Only few hospitals had any knowledge of the quality of the patient outcomes they achieved. In 2008, Brucker et al. were the first to put forward the idea that high quality of care could be achieved by specialization, centralization and interdisciplinary collaboration in German breast centres [9, 10]. However, quality does not come for free, it is associated with considerable effort and costs for the health care system in terms of staffing and administration. And the data from the mammography screening program shows that it was and still is worth the effort, given the mortality reduction found in the participating age decades [11]. What insights have been gained in the past 2 decades and what questions have emerged to inform future strategies?

Senology today

Breast-conserving therapy and oncoplastic surgery

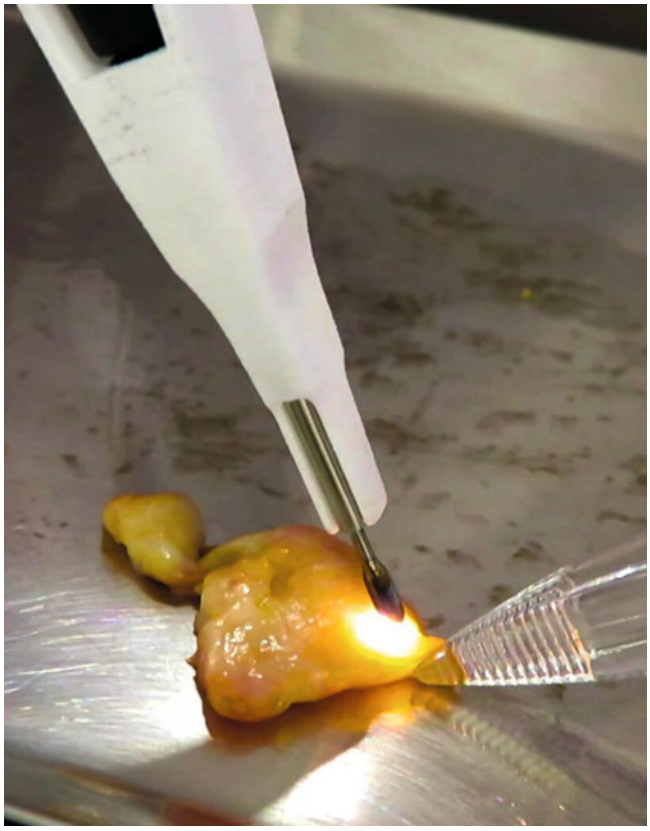
Let us first take a look at breast-conserving therapy for primary breast cancer. Breast-conserving surgery (BCS) for breast cancer is followed by radiation therapy. Only this combination is referred to as breast-conserving therapy (BCT). Provided complete histopathological removal of the described tumour burden [12], BCT is at least equivalent to mastectomy in terms of overall survival. In comparison to mastectomy, surgical planning is always an interdisciplinary challenge in breast-conserving therapy. At the same time, it requires teamwork. All-rounders are becoming rarer. Medical knowledge is doubling faster and faster. In conclusion, conferences are becoming more complex.

What are the questions addressed in a pretherapeutic conference?

- **Medical genetics:** Is a genetic mutation likely present and testing required? If so, would a positive result have an impact on surgical management?
- **Radiology**: Is it a unifocal lesion or are there other foci? If other foci are present, is it necessary to histologically confirm and mark these lesions? Is there axillary lymph node involvement and, if so, is it necessary to histologically confirm and mark these lesions? Is it necessary to mark the tumour burden prior to systemic therapy in the case of planned breast-conserving therapy? How many foci have to be marked and where are they located? How does the tumour respond to systemic therapy?
- **Oncology:** Which preoperative systemic therapy is indicated to find out about the tumour's response to drug therapy?
- **Surgery:** Is breast-conserving surgery possible and advisable? How many lesions would have to be excised during surgery? How should the foci be marked preoperatively? Which technology shall be used for specimen imaging? Which type of incision is suitable to achieve R0 resection and to preserve sym-

metry to the greatest possible extent? Would the planned type of incision also be suitable for secondary reconstruction in the case of R1 resection?

- **Pathology:** Which parameters of tumour biology have to be obtained again from the surgical specimen for comparison to preoperative histological findings to evaluate the response to systemic therapy?



▶ **Fig. 1** Prototype of an OEM-ready electrocautery device during tissue analysis in a laboratory study [rerif].

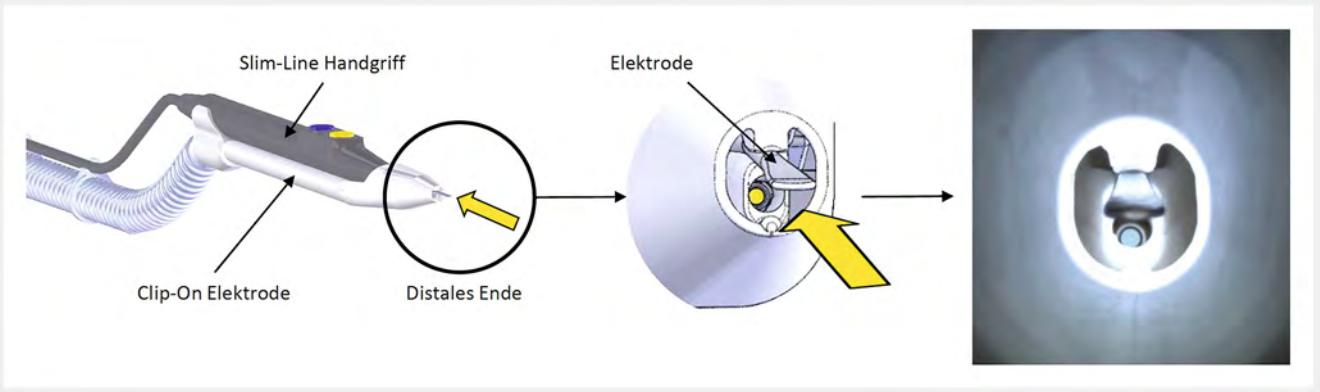
While the above questions represent only a small selection of preoperative considerations, they demonstrate the complexity of modern senology conferences. Today's senior breast surgeons are highly specialized and should always keep their knowledge up to date.

Is this effort justified? For the outcomes quality of life and recurrence rate, definitely [13]. Planning breast-conserving therapy during an interdisciplinary conference has a direct impact on the quality of a breast centre. According to the 2023 Onkozert Annual Report on breast centres, a postoperative conference was held in 100 % of cases. In the case of pretherapeutic conferences, the 100 % mark has not yet been reached. However, one can recognize a trend. While 79 % of cases were presented pretherapeutically in 2017, in 2021 it was already 90 %. It is to be hoped that this trend can be increased to 100 %, just as with the postoperative conferences.

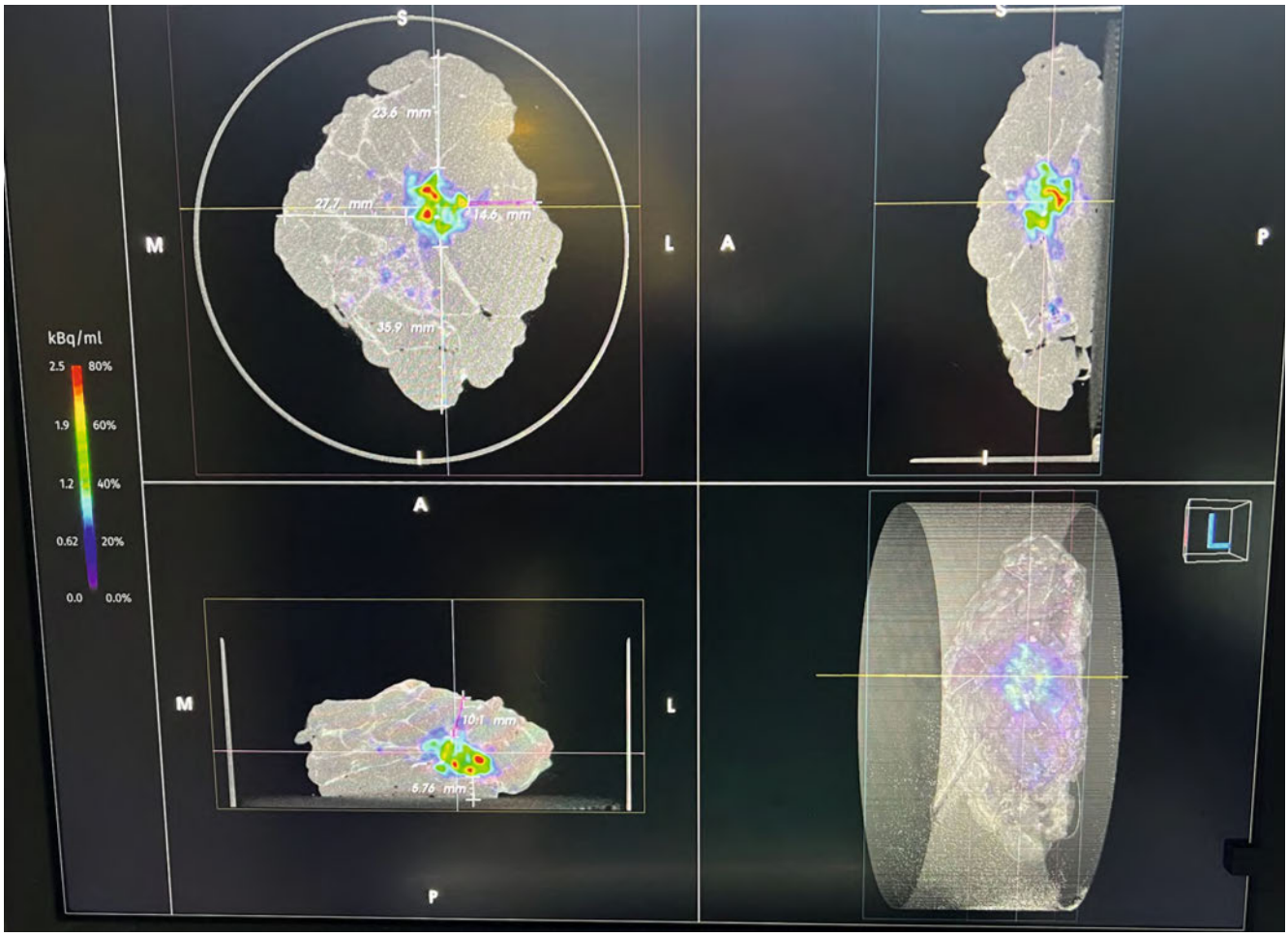
What future innovations can we expect in the field of breast-conserving, oncoplastic surgery?

It remains to be seen whether in senology robot-assisted surgery will revolutionize the operating theatre. To date, the outcome achieved with this technology is the same as that of non-robot-assisted surgery, but operating times are longer for robot-assisted surgery, as shown in a meta-analysis (7 studies/1674 patients) by Nessa et al. [14].

At the same time, **medical devices** are also becoming ever more intelligent. One example here is optical emission spectroscopy [15]. With this method, an electrocautery-induced spark at the surgical site is analysed in real-time during cutting (▶ **Fig. 1** and ▶ **Fig. 2**). By means of OEM, this "intelligent knife" informs the surgeon whether benign or malignant tissue is being cut. The preclinical studies on OEM were carried out at the University Hospital Tübingen [16]. The first translational clinical trial is expected to be completed in Tübingen at the end of 2024. The primary goal of this technology is to prevent that involvement of the margins necessitates a second surgical procedure. Another hypothesis is that in the future such techniques could significantly speed up the workflow in breast centres and already predict the pathology result in real time during the punch biopsy of a suspicious lesion.



▶ **Fig. 2** Diagram of an OEM-ready electrocautery device. The tip shows the complex miniaturized design enabling the spectroscopic analysis of the light of the spark [rerif].



▶ **Fig. 3** Specimen PET-CT scan in patient with invasive ductal carcinoma (3-plane imaging and dynamic 3 D reconstruction) [rerif].

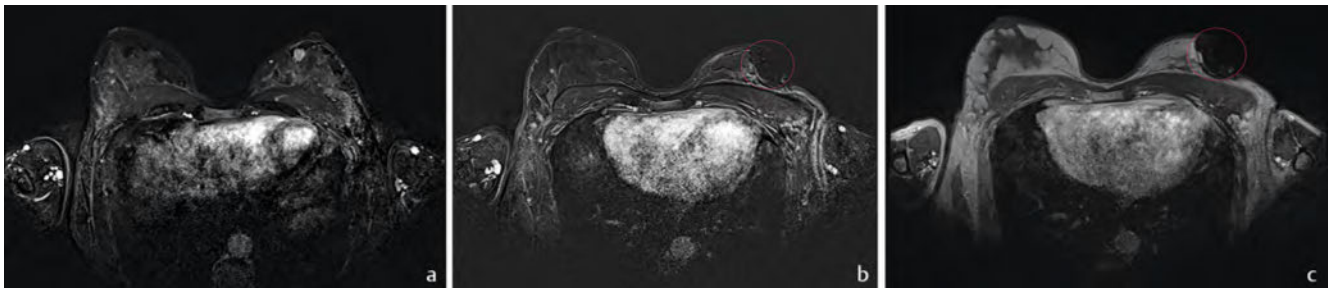
At the same time, **intraoperative imaging techniques** are increasingly finding their way into senology operating theatres. Especially after the meta-analysis by Banys-Paluchowski et al. [17] on R1-rate reduction when using intraoperative ultrasound (IOUS) guidance, it is obvious that a high-resolution ultrasound unit should be part of the standard equipment of every operating room of a breast centre in the future [18].

Nuclear medicine technologies are also being researched on surgical specimens of the future. ^{18}F-Fluordesoxyglucose (FDG) is a radioactive tracer that accumulates in tumour cells. This tracer is used in positron emission tomography (PET). Whether this technology could be used in the operating theatre to achieve an R1-rate reduction as the result of improved tumour visualization in the resected specimen is currently being examined by various working groups [19, 20]. A miniaturized PET-CT scanner is available directly in the operating theatre, allowing the surgeon to read the specimen while still at the operating table (▶ **Fig. 3**).

In comparison to conventional radiography, the advantage of this method is not limited to the fact that tumour tissue can be differentiated from benign glandular tissue with the help of the tracer. It also allows to view tomographic images with 3 D reconstruction. Especially in patients with extensive ductal carcinoma in situ (DCIS) component, 3 D tomography offers significant advantages in the assessment of microcalcifications. An international study (BrIMA) evaluating this approach is currently being conducted with the participation of the Breast Centre at the Tübingen University Hospital and the academic teaching hospital Evang. Kliniken Essen in Germany. Study recruitment is expected to end in early 2025.

However, novel medical devices must be used in a responsible manner and with full awareness of all the risks involved. Especially when new medical devices are being introduced, interdisciplinary communication is of great importance. A good example to explain this is the iron oxide tracer for sentinel lymph node biopsy. Iron-based tracers can be used to detect sentinel lymph nodes with the help of a magnetic probe. The advantage of this technique over technetium is that no radioactivity is involved, facilitating preoperative preparation at hospitals without nuclear medicine department. But the downside is that these tracers are deposited in tissue over a prolonged period of time [21, 22, 23], causing MRI artefacts which make it difficult or even impossible to read MRI images (▶ **Fig. 4**). Patients must be informed preoperatively about these artefacts and give their informed consent to the use of iron-based tracers.

Indocyanine green (ICG) is a tracer that has not yet found its way into senology operating theatres throughout the country.

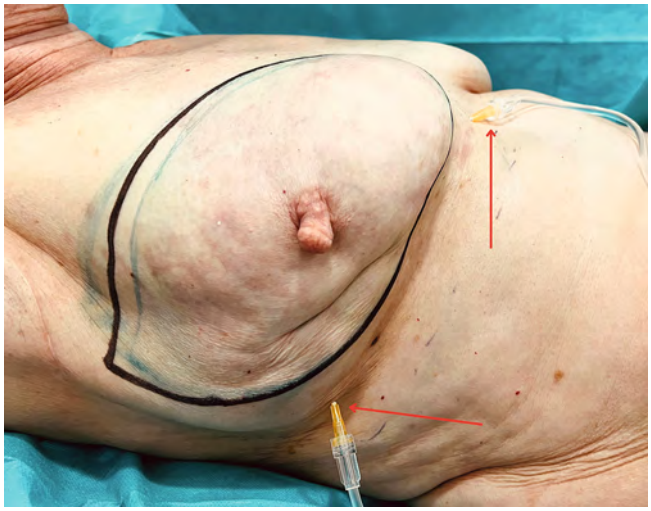


▶ **Fig. 4** Pre- and postoperative MRI images in a patient with left-sided breast cancer (T1 post sub and T1). The sentinel node was marked with an iron-based tracer (**a** preoperative, **b** + **c** postoperative). Because of the artefacts (marked in red) caused by deposited iron, diagnostic imaging of the outer quadrants is rendered impossible for a prolonged period of time [rerif].

▶ **Fig. 5** Sentinel node biopsy with ICG and infrared camera. The sentinel node contrasts with its surroundings due to its red colour [rerif].

This tracer works with a fluorescent dye and an infrared camera. This technique does not involve radioactive radiation, produces no artefacts and is extremely budget-friendly. Compared to other techniques (patent blue, iron-based tracers and technetium), the data on ICG found in the literature show at least equivalent detection rates and lower false-negative rates [24, 25, 26, 27] (▶ **Fig. 5**).

Perioperative anaesthesiology management is another area in which further innovations can be expected. During the corona virus pandemic, availability of anaesthesiology staff was limited.

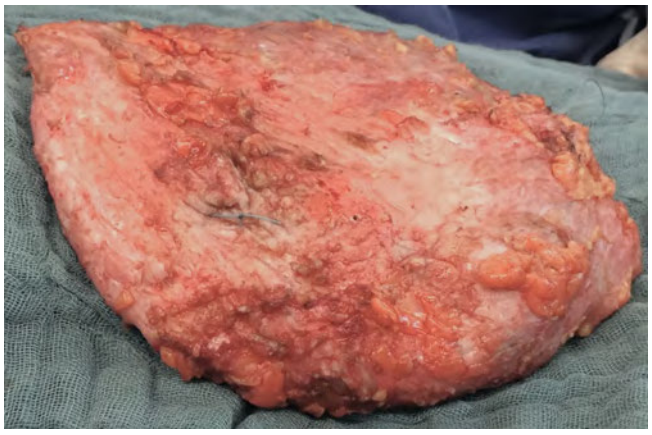


▶ **Fig. 6** Preoperative infiltration of the tumescent solution with a roll pump. The arrows show the infiltration sites [rerif].

Old concepts of pain therapy experienced a revival. Retrospectively, a high level of acceptance among patients was found for the use of tumescent local anaesthesia (TLA) or subcutaneous infiltration anaesthesia (SIA) as an alternative to general anaesthesia. Initial studies have revealed a high degree of patient satisfaction and adequate pain relief (▶ **Fig. 6**). In these studies, an unexpected effect related to the utilization of the operating theatres was observed. With this easy-to-learn technique – even though its use does not reduce the need for staff compared to general anaesthesia –, the turnover times in the operating theatre can be significantly reduced, depending on the logistics at the hospital. Due to this positive aspect and the high degree of patient acceptance, it is likely that this technique will be (and have to be) offered more frequently in the future [28].

Risk-reducing procedures in patients with high familial risk

As described above, genetic testing has become an indication-related standard component of the work-up in certified breast centres, placing special demands on the surgeons operating on the patient. Especially in Centres for Familial Breast and Ovarian



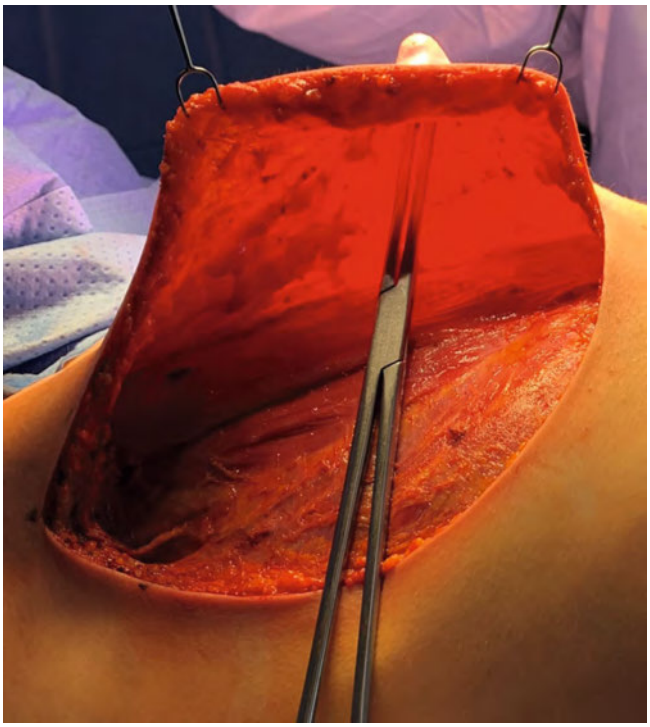
▶ **Fig. 7** Glandectomy performed in an anatomically correct manner. The mammary gland is situated between the superficial fascia (Camper) and the deep fascia (Scapa). The suture marks the retroareolar area [rerif].

Cancer (FBREK), surgeons have to be trained in risk-reducing surgical techniques and reconstructive procedures.

Risk-reducing surgery requires that the mammary gland is resected as completely as possible, but without triggering complications. Basic knowledge of breast anatomy is not sufficient to achieve this goal. As described by Rehnke in 2018 [29], the surgeon has to be familiar with the structures of the superficial fascial system of the breast, including the superficial fascia (Camper) and the deep fascia (Scapa), as the actual gland is located between these 2 layers. Why is this relevant? We know from the literature that complete resection of the mammary gland is not achieved in all cases [30, 31, 32] and that, according to the study by Rebbeck et al., breast cancer recurred in 1.9 % of patients after risk-reducing surgery within a mean postoperative period of 6.4 years (BrCa1 and 2 mutations) [33]. The mammary gland develops between the superficial fascia (lamina superficialis) and the deep fascia (lamina profunda). The 2 layers join at the inframammary ligament caudally and at the suspensory ligamentum, which extends into the platysma. Therefore, these are the layers that allow for anatomically correct glandectomy [29] (▶ **Fig. 7**). The importance of these tissue layers lies not only in the fact that the high-risk tissue can be removed to the greatest extent possible if these layers are observed, but also because surgery that takes these layers into account ensures sufficient blood supply to the skin and thus prevents flap necrosis (▶ **Fig. 8**). The challenge here is to identify these layers during surgery, thus in surgical training this is a key task for teachers and students alike.

What is the role of residual glandular tissue after risk-reducing surgery and how can it be identified?

First of all, it must be noted that, on the one hand, the imaging-based assessment of residual glandular tissue is not adequately validated in the literature by correlation with the histological findings, and that, on the other hand, the significance of residual tissue for the development of breast cancer is not yet fully understood. Certainly, further studies are needed to address the question of when and at what volume residual glandular tissue should be resected in a secondary procedure. In this regard, the

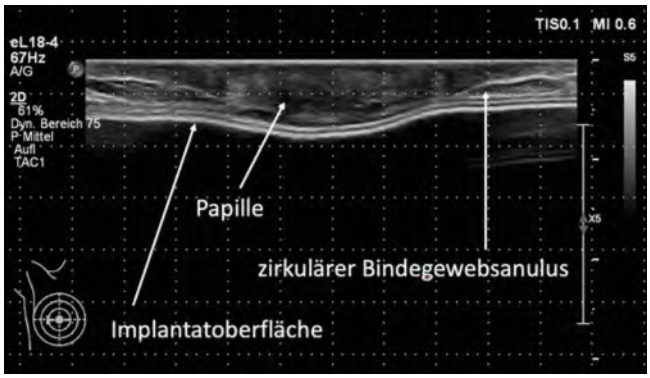


▶ **Fig. 8** Surgical site after glandectomy, subcutaneous vascular supply of the skin is preserved [rerif].

study of Andersson et al. [32] is of interest, in which both ultrasound and MRI were used to detect any residual glandular tissue. Residual glandular tissue was detected with MRI and ultrasound in 39.3 % and 44.1 % of cases, respectively. The study found that significantly more residual glandular tissue was to be expected when the ventral skin flap thickness exceeded 7 mm. However, the authors do not make any recommendations on possible consequences of their findings.

The further procedure, if residual mammary gland tissue is found in imaging studies, has to be decided on an individual basis, in discussion with the patient. Given that the clinical significance of minimal residual glandular tissue in images is still unknown, it is important to not worry the patient. Ultimately, one of the goals of primary surgery is to improve the quality of life of the patient. Small amounts of residual glandular tissue seen in MRI images should not have the effect that the patient becomes anxious again. It is reasonable to assume that the risk of developing breast cancer, which was very high before surgery, will be significantly lower after risk-reducing surgery compared to the risk in the general population [33]. Against this background, it is understandable that excessive and incorrect imaging follow-up examinations can trigger anxiety after risk-reducing surgery which is certainly not helpful. If surgery was performed in an anatomically correct manner, follow-up ultrasound examinations at annual intervals are sufficient (▶ **Fig. 9**).

However, if imaging shows considerable amounts of macroscopic residual glandular tissue as evidence that the goal of surgery was not achieved, the patient should be informed about the option of a secondary surgical procedure to resect the residual glandular tissue.



▶ **Fig. 9** Ultrasound image after risk-reducing glandectomy in the area of the papilla. The lactiferous ducts were resected in anatomically correct manner [rerif].

Breast reconstruction surgery

Breast reconstruction surgery can be categorized into primary and secondary reconstruction procedures. Both autologous and foreign tissues can be used. The procedures differ significantly from one another. While choosing the reconstruction procedure requires both establishing the indication and individual, independent and comprehensive counselling of the patient, this approach has unfortunately still not been universally adopted in everyday clinical practice. In addition, there is not yet sufficient evidence for the various reconstruction techniques available, in particular data from comparative studies with sufficiently long follow-up periods are lacking. Unfortunately, only a few centres have conducted valuable prospective studies on this topic.

While 2 decades ago, when certified breast centres started to get established, retropectoral placement of implants was the standard procedure and autologous tissue reconstruction was mainly performed as pedicle procedures, the situation has changed significantly today. Now, prepectoral implants and surgical techniques based on free transplants dominate the operating theatres and presentations at national and international congresses have shown that reconstructive techniques have advanced rapidly. There is no single right technique, and only a limited number of centres offer the full range of methods of reconstructive breast surgery. The various techniques differ in terms of operating time and effort, traumatization, learning curve, number of follow-up surgeries, indication, and also remuneration.

▶ **Table 1** provides an overview of the breast reconstructions performed in the United States in 2023.

The advantages and disadvantages of the various techniques are briefly described below, with no claim to completeness:

Implant-based reconstruction

Depending on the trainer, the surgeon can complete the implant reconstruction learning curve quite quickly compared to the learning curve with autologous reconstruction. The lifetime of implants is limited, and they undergo changes in shape over time due to capsular fibrosis. In some cases, this process can be accompanied by skin changes (thinning), suture dehiscence and pain. The body attempts to “reject or expel” the foreign body. The

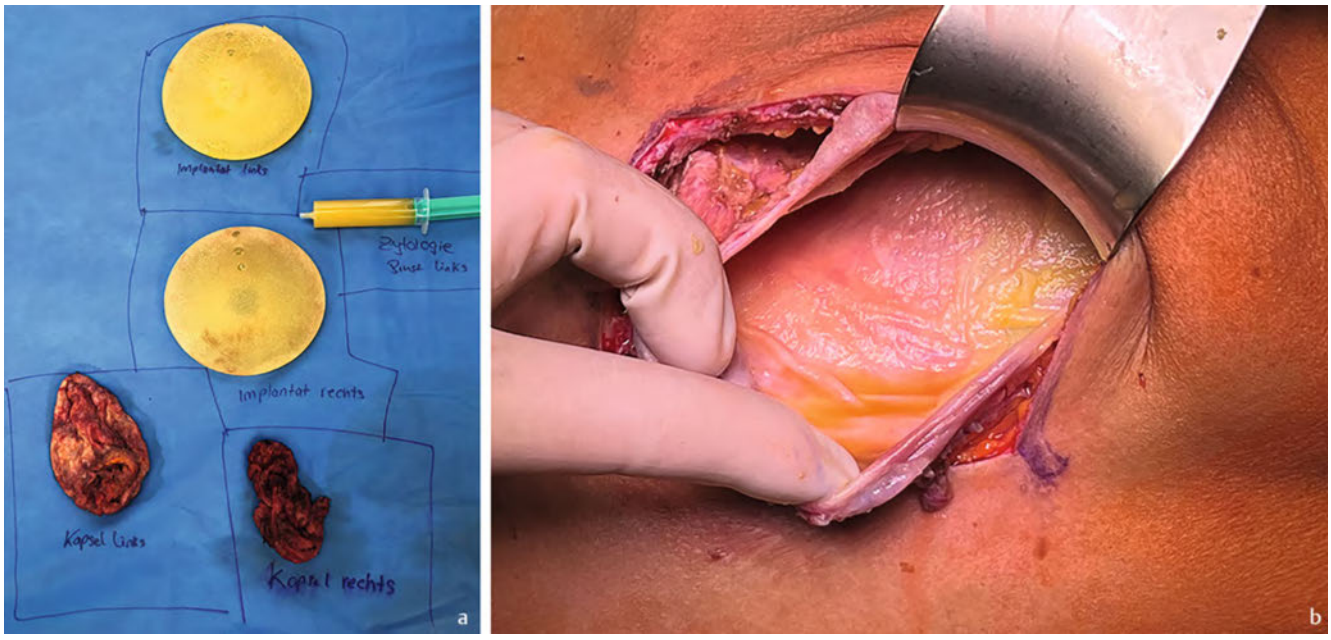
▶ **Table 1** Type and number of breast reconstructions performed in 2023. Data according to the report of the American Society of Plastic Surgeons (https://www.plasticsurgery.org/documents/news/statistics/2023/plastic-surgery-statistics-report-2023.pdf).

Reconstruction technique	Number of procedures
Breast reconstructions in total	157 740
Expander followed by implant	85 970
Immediate reconstruction with implant	36 557
Pedicle TRAM	1109
Free TRAM	2344
DIEP flap	20 703
Latissimus dorsi flap	5386
Other flaps	5671
Immediate reconstruction	117 512
Secondary reconstruction	40 228
Prepectoral position	106 380
Subpectoral position	51 360
Acellular dermal matrix	79 747
Implant removal	25 221

study by Coroneos et al. with 99993 cases provides a comprehensive overview of long-term outcomes [34]. It is crucial that all surgeons performing reconstructive breast surgery have read this paper. In patients who underwent primary implant reconstruction and were followed-up over a period of 7 years, re-operation and/or signs and symptoms were observed in 53.4 % of cases. These include implant ruptures (12.5 %), symptomatic capsular contracture (12.7 %), pain (29.6 %), as well as implant explantation (15.9 %). Why is this particular paper so very important? Prior to breast reconstruction, patients need to be fully informed, including realistic expectations with regard to the changes an implant undergoes over time. In addition, all patients must be informed about diseases which are associated with implants, including systemic diseases, breast implant illness and breast implant-associated anaplastic large-cell lymphoma (BIA-ALCL) [35, 36, 37] (▶ **Fig. 10**). Affected women with symptoms must, after differential diagnoses have been ruled out, be informed about the options for implant explantation.

In the oncological situation, implants are a good choice for the first reconstructive procedure. In the case of an R1 situation, the implant can be easily and safely explanted, and the oncological resection can be completed. An implant is very well suited to act as a placeholder for the skin in cases requiring subsequent radiation therapy.

However, one should be aware of the fact that a permanent reconstruction without the need for further surgical intervention should not be assumed for implants. Irrespective of whether round or anatomical implants are used, whether or not mesh or matrices are implanted, the surgeon should always take potential



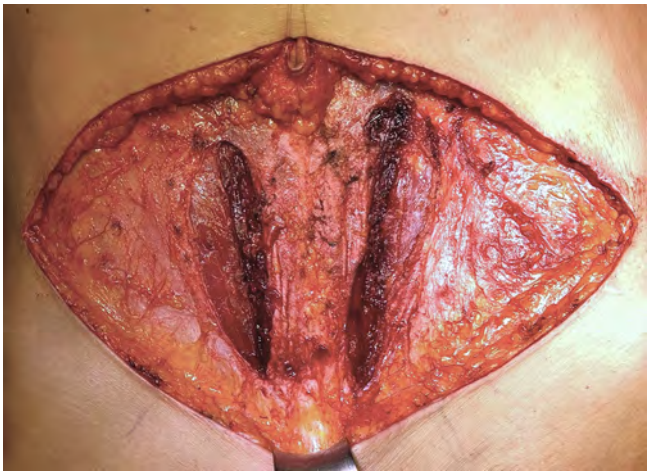
▶ **Fig. 10** Breast implant-associated anaplastic large cell lymphoma, left breast, after cosmetic breast augmentation: **a** Implants, cytology, capsule and **b** intraoperative surgical site [rerif].

reoperations into consideration and prevent problems due to implanted medical devices already at the time of primary surgery.

In the risk-reduction situation, too, implants are useful for primary reconstruction in patients with high familial risk of breast cancer. Despite intensified preoperative imaging, it can still happen that occult cancer foci are unexpectedly detected on histological examination of the surgical specimens. In the study by Yamauchi et al., such a surprise finding was observed in 11.3 % of cases [38].

Autologous tissue reconstruction

Ideally, autologous tissue reconstruction is the final step of breast cancer therapy after an ablative procedure or in the case of high familial risk to restore quality of life. As shown in ▶ **Table 1**, today reconstructions with pedicle flaps are significantly less common than free transplants with microsurgically performed anastomosis. Free transplants are superior to pedicle flaps with regard to traumatization of the region of flap lifting and forming of the breast. Free lipocutaneous transplants are part of the standard portfolio of every plastic and reconstructive surgery department. The learning curve is longer compared to implant reconstruction, the procedures require longer operating times, the transplants should not be irradiated, and ideally an oncological situation should be ruled out beforehand. The main advantage over a breast implant is that a transplant represents a lifelong permanent reconstruction. Its behaviour is similar to that of a natural breast, it is warm to touch, and the volume adapts to changes in body weight. The donor tissue can essentially be harvested from many different parts of the body. For breast reconstruction, the tissue is usually obtained from the gluteal, thigh or abdominal region. The most common type is the deep inferior epigastric perforator (DIEP) flap. For this flap, the periumbilical lipocutaneous tissue is



▶ **Fig. 11** Abdominal wall after lifting of a DIEP flap. The vessels were exposed after opening the fascia of the muscle without compromising the function of the muscle [rerif].

used as the donor. Intraoperatively, the epigastric inferior artery and vein are released from the rectus abdominis muscle and transected in the area of the external iliac artery and vein (▶ **Fig. 11**). The vascular pedicle (▶ **Fig. 12**) is long enough for establishing an anastomosis for the transplant either in the area of the internal mammary vessels or the axillary vessels, usually the thoracodorsal artery and vein or the circumflex scapula artery and vein.

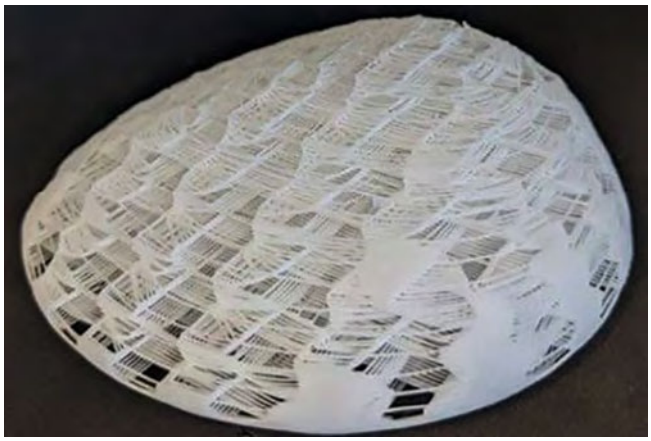
The deep inferior epigastric perforator (DIEP) vessels are also very well suited for reconstruction after bilateral risk-reducing glandectomy in a single-stage procedure. The range of possible complications of autologous tissue reconstruction is different

▶ **Fig. 12** Bipedicled DIEP flap. To provide blood supply to the tissue, an anastomosis is performed in the area of the thoracodorsal artery and vein [rerif].

from that of implant-based reconstruction. A total flap loss due to tissue necrosis must be expected in 0.5 % to 5.1 % of DIEP flap cases. Tissue necrosis requiring revision surgery occurs in 5.9 % to 19.8 % of cases. Hernias in the flap lifting region occur in 4 % of cases. Functional weakness of the abdominal wall must be expected in 0.8 % to 13.6 % of cases [39, 40, 41, 42, 43, 44, 45, 46, 47, 48]. For the treatment-providing team, transplant surgery is always associated with increased staffing requirements and a longer length of hospital stay compared to implant surgery. In addition, it can be expected that the patient will be longer absent due to illness. In the vast majority of cases, patients are offered a breast symmetry procedure after successful transplantation and a healing period of about 6–12 months. In addition to volume adaption and compensation of contralateral ptosis, a missing nipple-areola complex is reconstructed during the procedure. Minor adjustments to the lifting region can also be performed.

What might the future of breast reconstruction look like?

Working groups around the world are conducting research into ways of combining the features of implant and autologous tissue reconstruction with tissue engineering techniques, while at the same time avoiding the disadvantages of both methods. A promising approach is the manufacturing of a polycaprolactone (PCL) scaffold, using a 3 D printer; the shape of the scaffold is similar to that of a breast implant (▶ **Fig. 13**).



▶ **Fig. 13** Polycaprolactone scaffold which is already used in studies exploring the reconstruction of breast/chest defects; it is secondarily filled with autologous fat obtained by liposuction [rerif].

The material is bioresorbable and filled with autologous fat obtained by liposuction after implantation and after first blood vessels have started to grow into the material. The scaffold is then resorbed, and the adipose tissue persists. The tolerability of the product was shown both in animal models and in first studies on humans, here with pectus excavatum [49, 50]. Similar approaches are also used in the field of nipple reconstruction [51].

Conclusion

Since the introduction of the mammography screening programme and with the certification of breast centres, the diagnosis and treatment of breast cancers has continuously improved, in compliance with the guidelines. There has been an expansion of oncosurgical and reconstructive techniques and strategies. Only through specialization and interdisciplinary collaboration is it possible to work at the highest level. The resources required for this approach are enormous. To be able to be part of this development, workflows should be reconsidered, and unnecessary, sometimes pointless processes should be made less bureaucratic, especially in view of the ever-decreasing staff resources. Resources are freed up when non-medical work is transferred to non-medical staff. The challenges faced by future doctors will be even greater than those encountered to date. In order to ensure that future breast centres can continue to provide their important and good services, it is essential that sufficient time is available for training and continuing medical education. Doctors in specialist training should have the opportunity to get actively involved and so they can appreciate their good training programm. Continuous participation in visiting-doctor opportunities, congresses and external courses should already be considered in the staff planning of hospitals, as it is a common practice in other professions.

Conflict of Interest

The authors declare that they have no conflict of interest.

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