

REVIEW ARTICLE

Breast Reconstruction Following Cancer Treatment

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SUMMARY

Background: About 8000 breast reconstructions after mastectomy are performed in Germany each year. It has become more difficult to advise patients because of the wide variety of heterologous and autologous techniques that are now available and because of changes in the recommendations about radiotherapy.

Methods: This article is based on a review of pertinent articles (2005–2014) that were retrieved by a selective search employing the search terms “mastectomy” and “breast reconstruction.”

Results: The goal of reconstruction is to achieve an oncologically safe and aesthetically satisfactory result for the patient over the long term. Heterologous, i.e., implant-based, breast reconstruction (IBR) and autologous breast reconstruction (ABR) are complementary techniques. Immediate reconstruction preserves the skin of the breast and its natural form and prevents the psychological trauma associated with mastectomy. If post-mastectomy radiotherapy (PMRT) is not indicated, implant-based reconstruction with or without a net/acellular dermal matrix (ADM) is a common option. Complications such as seroma formation, infection, and explantation are significantly more common when an ADM is used (15.3% vs. 5.4%). If PMRT is performed, then the complication rate of implant-based breast reconstruction is 1 to 48%; in particular, Baker grade III/IV capsular fibrosis occurs in 7 to 22% of patients, and the prosthesis must be explanted in 9 to 41%. Primary or, preferably, secondary autologous reconstruction is an alternative. The results of ABR are more stable over the long term, but the operation is markedly more complex. Autologous breast reconstruction after PMRT does not increase the risk of serious complications (20.5% vs. 17.9% without radiotherapy).

Conclusion: No randomized controlled trials have yet been conducted to compare the reconstructive techniques with each other. If radiotherapy will not be performed, immediate reconstruction with an implant is recommended. On the other hand, if post-mastectomy radiotherapy is indicated, then secondary autologous breast reconstruction is the procedure of choice. Future studies should address patients' quality of life and the long-term aesthetic results after breast reconstruction.

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Every year in Germany, mastectomy is required for 27% of the 75 000 women newly diagnosed with breast cancer. Approximately one-third of women choose ipsilateral breast reconstruction, and a further 1000 prophylactic mastectomy with reconstruction ($n = 8000$) (e1–e3). In the USA, where there are 230 000 new cases of breast cancer every year and a falling rate of breast-conserving surgeries, approximately 100 000 breast reconstructions are performed annually (1). These may be implant-based breast reconstruction (IBR), autologous breast reconstruction (ABR), or a combination of the two. Heated discussion regarding optimal surgical procedure and time of reconstruction is currently ongoing.

This review article provides a systematic overview of current options for breast reconstruction and their indications and contraindications.

Materials and methods

We performed a selective search of the literature using the search terms “mastectomy AND breast reconstruction” for the period between 1 January 2005 and 1 January 2015 in PubMed, the German S3 guideline *Diagnosis and Treatment of Breast Cancer (Diagnostik und Therapie des Mammakarzinoms)* (e4), the treatment recommendation of the AGO Breast Committee (Arbeitsgemeinschaft Gynäkologische Onkologie, Organgruppe Mamma) (e5), the guideline of American Society of Plastic Surgeons (1), the NCCN guideline (e6), and the Cochrane Library (e7). Statements were evaluated according to the Oxford Criteria (e8).

Background

The data on each type of reconstruction—particularly the increasingly common free flap plastic surgery—timing of reconstruction, and risk factors is limited by the absence of randomized trials and is mostly based on single-center, retrospective evaluations (e9). These show evidence of considerable bias, particularly regarding the use of meshes and implants, although this seems understandable given the individual nature of breast reconstruction (e10). Differences between health systems mean that there are differences in frequency and types of breast reconstruction, even within one country (2, 3, e11, e12).

Each and every patient must be given timely, detailed, comprehensive information on all breast reconstruction procedures (*Table 1*), expected outcomes,

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TABLE 1

Advantages and disadvantages of reconstruction techniques*

Technique	Advantages	Disadvantages
Implant-based reconstruction		
Implant reconstruction	<ul style="list-style-type: none"> – Unilateral/bilateral surgery – No additional scars – No lift defects 	<ul style="list-style-type: none"> – Adjustments often necessary long-term – Radiotherapy results in 40 to 50% capsular contractures – Prosthesis-related complications (contracture, rupture, animation deformity)
Implant ± mesh/ADM ± autodermal graft	<ul style="list-style-type: none"> – Reduced muscle defects – Improved aesthetic outcome, particularly natural shape – Prosthesis reconstruction possible even with unfavorable skin status 	(Except with autodermal graft) Meshes/ADM <ul style="list-style-type: none"> – Acute local reactions – Inflammation – Expensive
LADO ± implant	<ul style="list-style-type: none"> – Natural aesthetic outcome, particularly with NSM/SSM and “small” breast – Better long-term outcomes – Suitable for reconstruction of irradiated tissue – Improved implant coverage 	<ul style="list-style-type: none"> – More expensive surgery – Additional scars – Arm/shoulder complaints (tennis, golf, swimming, etc.) – Muscle contracture
Tissue transfer from abdominal wall		
– Pedicle TRAM	<ul style="list-style-type: none"> – Autologous tissue – No implant needed – Natural appearance – Natural aging process 	<ul style="list-style-type: none"> – Weakening of abdominal wall – Hernias – Adipose tissue necrosis
– Free TRAM	<ul style="list-style-type: none"> – As for pedicle TRAM, plus: – Less adipose tissue necrosis if blood circulation good 	<ul style="list-style-type: none"> – As for pedicle TRAM, plus: – Time-intensive and staff-intensive microsurgical techniques – Expensive postoperative monitoring – Higher rate of repeat surgery, total necrosis, liponecrosis
– DIEP	<ul style="list-style-type: none"> – As for pedicle TRAM, plus: – Abdominal musculature preserved – Fewer hernias than with pedicle TRAM – Less pain – Swifter recovery 	<ul style="list-style-type: none"> – As for free TRAM
Tissue transfer from other regions		
Flaps from buttocks (SGAP, IGAP, FCI)	<ul style="list-style-type: none"> – As for TRAM – No damage to abdominal wall 	<ul style="list-style-type: none"> – As for TRAM – Impaired function of erogenous zones – Not possible bilaterally in single operation
Gracilis flaps from thigh	<ul style="list-style-type: none"> – As for TRAM – Bilateral surgery possible 	<ul style="list-style-type: none"> – As for free TRAM – Impaired function of erogenous zones

ADM, acellular dermal matrix; DIEP, deep inferior epigastric perforator; FCI, fasciocutaneous infragluteal flap; IGAP, inferior gluteal artery perforator; LADO, latissimus dorsi flap; TRAM, transverse rectus abdominis muscle flap; NSM/SSM, nipple-sparing/skin-sparing mastectomy; SIEA, superficial inferior epigastric artery; SGOP, superior gluteal artery perforator
 *Modified according to (e5)

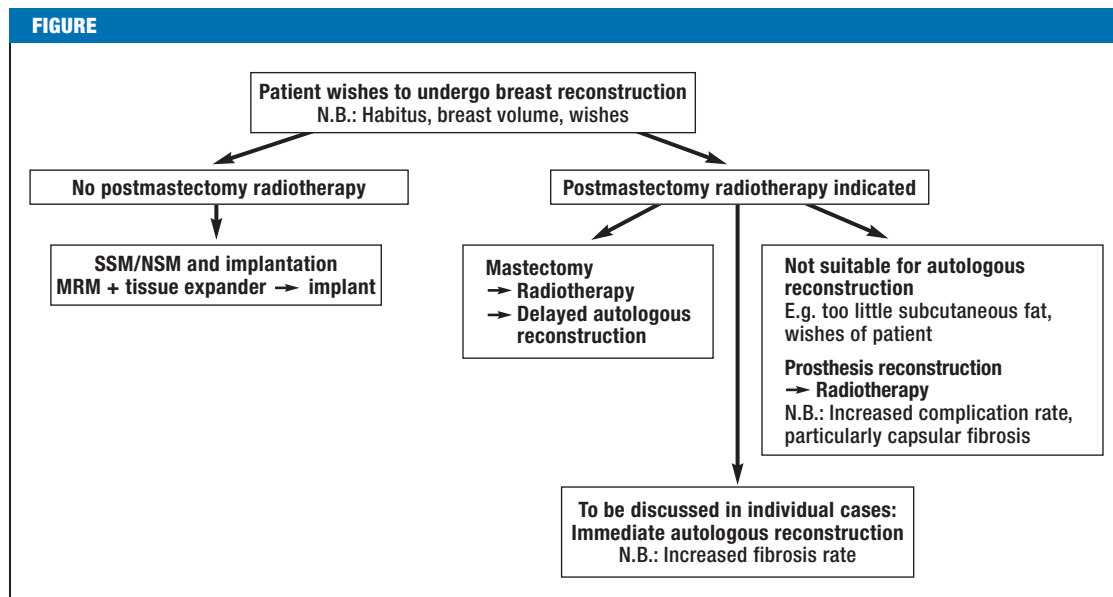
risks, and alternatives. According to the German Law on Patient Rights, this also includes the offer of a second opinion and information on surgical procedures that are not offered in the physician’s own hospital. If the tumor-to-breast volume ratio is unfavorable and chemotherapy is indicated, neoadjuvant chemotherapy must also be discussed, to improve the possibilities for breast-conserving surgery. The aim of reconstruction should be to achieve an oncologically safe and long-term aesthetically favorable outcome, with reasonable expenditure on surgery. The reconstructed breast should look natural and symmetrical and be soft and sensitive. Any surgeries necessary to achieve symmetry (reduction, lifting, etc.) must be discussed in advance. Reconstruction should never be the cause of any delay to the beginning of chemotherapy or radiotherapy, e.g. as a result of open wounds, within 8 to 12 weeks later (4, 5, e13, e14). Immediate recon-

struction and the complications associated with it cause a mean treatment delay of three weeks (6), and a delay of more than 12 weeks for 20% of these patients (e15). Perioperative complications are reported in 9.5 to 19% of cases following ABR and in 4% following implant-based breast reconstruction (7, e16).

Autologous versus heterologous reconstruction

Immediate autologous and heterologous reconstruction are procedures that complement rather than oppose each other (Figure). The choice of procedure depends on habitus, the patient’s wishes and ideas, risk factors (smoking, diabetes mellitus, obesity, previous surgeries, radiation, history of thrombosis, cardiovascular disease, etc.), possible postmastectomy radiotherapy (PMRT), and the skills of the surgeon. In the USA, 83% of all immediate reconstructions involve implants. The percentage of implant-based

Procedure for breast reconstruction
SSM, skin-sparing mastectomy; NSM, nipple-sparing mastectomy; MRM, modified radical hysterectomy



immediate reconstructions there has increased from 20.8% to 37.8% in the last 10 years, while the rate of autologous breast reconstructions has remained roughly constant (8, e17). In England, the percentage of bilateral mastectomies has doubled in the last 10 years but remains substantially lower, at 4% (9). This increase is the result of the oncological safety of skin-/nipple-sparing mastectomy (SSM/NSM) and the improved quality of silicone implants (10, 11). On the other hand, women with unilateral cancer, and healthy women with an increased risk of breast cancer (the Angelina Jolie effect), increasingly wish to undergo prophylactic (contralateral) mastectomy; this has led to an increase in bilateral implant-based breast reconstructions, from 3% in 1998 to 18% in 2007 in the USA (12, 13). In a longitudinal study conducted in California and involving approximately 190 000 patients, there was an increase in the rate of bilateral mastectomies from 2% (1998) to 12.3% (2011). The increase in women aged under 40 years was particularly large, rising from 3.6% to 33% (14).

Immediate autologous breast reconstruction is performed in 14% of cases in the USA. Most are performed in university facilities. Pedicle flaps, mainly from the abdomen, are the standard procedure, accounting for 68% of cases, while only around 28% of plastic surgeons who were questioned performed free flap plastic surgery. The most common free flap surgery is DIEP (deep inferior epigastric flap) (e17). The percentage of autologous breast reconstructions in the USA depends essentially on the local density of plastic surgeons, insurance status, financial resources, and planned radiotherapy (13, 15, e18).

The cost of free flap surgery with microsurgical anastomosis is 2.5 times higher than for implant-based reconstruction and rises further if there are compli-

cations (16). The aesthetic outcome of autologous breast reconstruction is more stable in the long term than that of implant-based breast reconstruction (17). In the long term, autologous breast reconstruction can even become more cost-effective than implant-based reconstruction (e19). On the other hand, following autologous breast reconstruction second operations are required in 100% of cases, third operations in 53%, and fourth operations in 12% (nipple reconstruction, delayed complications, surgery to achieve symmetry) (7).

Quality of life following breast reconstruction

Patient satisfaction with outcome one year after implant-based reconstruction was comparable to that of autologous (transverse rectus abdominis muscle flap, TRAM) reconstruction (satisfaction figure: 46.1% of all included patients), while after two years (satisfaction figure: 38% of patients) the figure was substantially higher (odds ratio 2.8; $p < 0.01$) for autologous breast reconstruction (e20). A recent survey, using the BREAST-Q questionnaire, of 7619 women after a median of 6.7 years found the highest satisfaction rates in women who had undergone reconstruction using autologous tissue from the abdomen (free/pedicle TRAM, DIEP). This figure was even higher than for patients who had undergone breast-conserving surgery (18, e21, e22).

Patients' quality of life and satisfaction with aesthetic outcome following reconstruction involving implants was significantly better when the following criteria were met:

- The patient was involved in the decision to perform reconstruction ($n = 325$; 66.7% versus 38.9%, $p = 0.020$) (e23, e24).
- Bilateral rather than unilateral implant-based reconstruction was performed ($n = 294$; 64.4% versus 54.9%; $p < 0.001$) (e25).

TABLE 2

Time of reconstruction—advantages and disadvantages*

	Oxford		AGO
	LOE	GR	GR
Immediate reconstruction – Preservation of skin covering, crease under breast, and natural breast shape – Compulsory with SSM/NSM – No postmastectomy syndrome – Cost-effective – Delay of oncological therapies cannot be ruled out in individual cases	3b	B	++
Delayed breast reconstruction – No difficulties caused to adjuvant therapies (CHT, RT) – Disadvantage: loss of skin covering	3b	B	++
Delayed-immediate BR	3b	B	+/-

Oxford levels of evidence (LOEs) (e9)

1a: Systematic review (SR) (with homogeneity) of randomized controlled trials (RCTs)

1b: Individual RCTs (with narrow confidence interval [CI])

1c: All or none

2a: Systematic review (with homogeneity) of cohort studies

2b: Individual cohort studies (including low-quality RCTs; e.g. <80% follow-up)

2c: Outcomes research; ecological studies

3a: Systematic review (with homogeneity) of case-control studies

3b: Individual case-control studies

4: Case series (and poor-quality cohort and case-control studies)

5: Expert opinion

Oxford grades of recommendation (GR)

A: Consistent level 1 studies

B: Consistent level 2 or 3 studies or extrapolation from level 1 studies

C: Consistent level 4 studies or extrapolation from level 2 or 3 studies

D: Level of evidence 5 or unclear or inconsistent data at any level

Grades of recommendation of AGO Breast Committee

Therapy/intervention is:

++ Of great benefit to patient, should be performed

+ Of limited benefit to patient, may be performed

+/- Of no confirmed benefit to patient but may be performed in individual cases

- Seems to be disadvantageous to patient, should not be performed

-- Clearly disadvantageous to patient, should always be avoided

RCT, randomized controlled trial; AGO, Working Group for Gynecological Oncology; BR, breast reconstruction; CHT, chemotherapy; GR, grade of recommendation; LOE, Oxford level of evidence; NSM, nipple-sparing mastectomy; RT, radiotherapy; SSM, skin-sparing mastectomy

*Modified according to (e5)

- Silicone implants were used rather than saline implants ($n = 142$; BREAST-Q score 63.8 versus 56.9; $p = 0.0083$) (e21, e26, e27).
- The nipple-areola complex was successfully conserved ($n = 108$; 97% versus 86%; $p < 0.025$) (10, e28).
- No radiotherapy was administered following implant-based breast reconstruction ($n = 633$; 64% versus 58.3%; $p < 0.01$) (19, e29).

Immediate, delayed-immediate, or delayed reconstruction

Immediate reconstruction has a number of advantages over delayed reconstruction (Table 2) (e30). Surveys of US plastic surgeons revealed that approximately 80% of breast reconstructions were immediate reconstructions (13, e17). When postmastectomy radio-

therapy was indicated, delayed reconstruction was recommended in 81% of cases. Whether reconstruction can and should be autologous or heterologous following postmastectomy radiotherapy depends on the individual circumstances (skin reaction to radiation, subcutaneous fat, arm function, etc.) and the wishes of the patient.

For delayed-immediate breast reconstruction, a placeholder prosthesis is inserted into the breast when skin-sparing mastectomy is performed. If no radiotherapy is indicated on the basis of final histology, the placeholder prosthesis is replaced with the final implant. If postmastectomy radiotherapy is indicated, the implant is replaced after radiotherapy. The complication rate was high in both groups: 32% (postmastectomy radiotherapy before implant-based breast reconstruction) and 44% (implant-based breast reconstruction before postmastectomy radiotherapy; $p = 0.176$), while satisfaction with aesthetic outcome was only 50% and 62% respectively ($p = 0.238$) (e31). In our opinion, delayed-immediate breast reconstruction is now acceptable only in exceptional cases.

Risk factors for postsurgical complications following autologous or heterologous breast reconstruction

Postmastectomy radiotherapy

Recommendations for or against postmastectomy radiotherapy as adjuvant therapy are still based on lymph node status, the significance of which must now be viewed critically (20, e32, e33).

Postmastectomy radiotherapy after or before implant-based radiotherapy increases the risk of complications (wound infections, explantation, skin necrosis, seroma formation, capsular contracture) significantly. For example, significantly more complications—in 41 to 48% of cases—were reported in patients who had undergone reconstruction involving implants and postoperative radiation than in patients who had not undergone radiotherapy (4 to 23% of cases) (10, 21–23). In the long term, after postmastectomy radiotherapy there are Baker grade III/IV capsular contractures in 7 to 22% of cases and explantations in 9 to 41%; these occurred in 0.5 to 2% and 8 to 20% respectively of cases in which no radiotherapy was administered (24–27).

Following prior irradiation of the chest wall too (e.g. following mastectomy, breast-conserving therapy, lymphoma), the risk of infection or capsular contracture following reconstruction using a tissue expander or implant is two to three times higher (e34–e36). In a multicenter Swedish cohort study with a median follow-up time of 43 months, after prosthesis reconstruction without postmastectomy radiotherapy ($n = 386$), with prior radiotherapy ($n = 64$), or with postoperative postmastectomy radiotherapy ($n = 304$) there were explantation rates of 6%, 25%, and 15% respectively ($p < 0.001$) and subsequent surgeries in 44%, 66%, and 59% of cases (28). If implant-based

breast reconstruction is indicated despite postmastectomy radiotherapy, radiotherapy should be performed before reconstruction.

In patients who have undergone prior radiotherapy, the implant loss rate of 30 to 42% can be significantly reduced using a combination of implant and autologous tissue (LADO flap: 15%, pedicle TRAM: 10%, free TRAM: 5%) (e37).

The long-term risk of complications is also significantly (four times) higher after irradiation of a tissue expander prosthesis than without irradiation (25, e38). Irradiation of tissue expander prostheses ($n = 50$) versus silicone implants ($n = 109$) led to significantly increased complication rates (40% versus 6.4%), mainly capsular fibrosis (e39). However, it should be noted that tissue expander prostheses were usually used following complete mastectomy and permanent implantation following skin-sparing mastectomy.

There is no guidance covering when a tissue expander prosthesis should be replaced with a permanent implant (delayed-immediate breast reconstruction) (e40). However, filling of the tissue expander during chemotherapy and replacement with a final implant before the beginning of radiotherapy seems to be associated with substantially fewer complications and better aesthetic outcome than replacement following radiotherapy (22, 23, 26, 28, 29).

When postmastectomy radiotherapy is indicated, autologous breast reconstruction should be performed after radiotherapy wherever possible (Table 3) (10). In a study by Berry et al. (21), there was no significant difference in severe complications following autologous reconstruction without or with radiotherapy: the rates were 17.9% and 20.5% respectively. However, the total number of complications was significantly higher with radiotherapy (31.5%) than without it (19.7%). In a meta-analysis of 13 nonrandomized trials, the rate of fibrosis following autologous breast reconstruction and radiotherapy was 36%, significantly higher than the comparator group's rate of 2.7%; the authors therefore recommend autologous breast reconstruction after postmastectomy radiotherapy (22). On the other hand, in a series of 363 patients who underwent free flap reconstruction and subsequent radiotherapy there was no significant disadvantage in comparison to patients who had not undergone radiotherapy (7).

Whether postmastectomy radiotherapy should be followed by heterologous, autologous, or combined reconstruction depends on local skin status and the wishes of the patient. However, the grade of recommendation for autologous breast reconstruction is higher than that for prosthetic reconstruction (Table 3). Breast reconstruction should be performed no earlier than six months after the end of radiotherapy (e41).

Autologous reconstruction is preferable following postmastectomy radiotherapy and explantation as a result of capsular contracture.

TABLE 3

Breast reconstruction following mastectomy, with and without PMRT*

	Oxford		AGO
	LOE	GR	GR
IBR			
- IBR with no PMRT	2a	B	++
- IBR following mastectomy and PMRT	2b	B	+/-
- IBR before PMRT/after partial breast irradiation (N.B.: high complication rate)	2a	B	+/-
- Implant replacement before radiotherapy	3a	B	+
- IBR following delayed mastectomy (after BCT)	2a	B	+/-
Breast reconstruction with ABR			
- Before radiotherapy (N.B.: blood supply of tissue, increased rate of fibrosis, wound healing problems, liponecrosis)	2a	B	+/-
- Breast reconstruction following radiotherapy	2a	B	+
- Pedicle flaps (TRAM, LADO)	3b	C	+
- Free tissue transfer			
- Free TRAM	3a	B	+/-
- DIEP	3a	B	+
- SIEA	3a	C	+/-
- SGAP/IGAP	4	C	+/-
- Free gracilis flap (TMG)	4	C	+/-

ABR, autologous breast reconstruction; AGO, Working Group for Gynecological Oncology; BCT, breast-conserving therapy; DIEP, deep inferior epigastric perforator; GR, grade of recommendation; IBR, implant-based breast reconstruction; IGAP, inferior gluteal artery perforator; LADO, latissimus dorsi flap; LOE, Oxford level of evidence; PMRT, postmastectomy radiotherapy; SIEA, superficial inferior epigastric artery; SGAP, superior gluteal artery perforator; TRAM, transverse rectus abdominis muscle flap; TGM, transverse myocutaneous gracilis

*Modified according to (e5)

Individual risk factors

Current and long-term nicotine abuse is associated with a deterioration in microcirculation and therefore a threefold to fivefold increase in the frequency of wound healing problems (e42, e43). A meta-analysis of 14 585 implant-based reconstructions following skin-sparing mastectomy showed a significant increase in the risk of early prosthesis loss for the following risk factors: age over 55 years (odds ratio: 1.66; $p = 0.013$), obesity (odds ratio: 2.14 to 3.17; $p < 0.014$), current smoking (odds ratio: 2.95; $p < 0.001$), and bilateral reconstruction (odds ratio: 1.67; $p = 0.007$) (30).

For implant-based reconstructions ($n = 9305$), in addition to the factors mentioned above, prolonged surgery time (odds ratio: 2.2; $p = 0.002$) and local wound infections (odds ratio: 4.0; $p = 0.002$) were found to increase the risk of implant loss (31). Regardless of the type of reconstruction, more surgical complications were reported when large breasts (mass over 600 g or cup size above C) were reconstructed (large breasts: 18%, medium-sized: 7%, small: 3%; $p = 0.0003$) (e44). Other risk factors for complications in all types of breast reconstruction were cardiovascular disease, intraoperative blood transfusion, American Society of Anaesthesiologists (ASA) score above 3, and major weight loss before surgery (e45, e46). In a series of 2138 autologous reconstructions, mainly DIEP flaps, the percentage of complete flap loss was 2.1%, independent of age, body mass index, smoking, prior postmastectomy radiotherapy, or chemotherapy (32). The rate of partial flap necrosis and wound healing

problems, particularly in the donator area, was significantly increased when these risk factors were present (e47).

On the other hand, there are also studies that have found no increase in the rate of complications with increased age, body mass index, acellular dermal matrix (ADM) use, or smoking (21, e48).

Systemic diseases that affect microcirculation (diabetes mellitus, collagenosis, hypertension) can increase the risk of complications following breast reconstruction in line with their duration, severity, and treatment. For example, a significantly increased rate of surgical complications (odds ratio: 1.58) has been reported for diabetic patients following autologous breast reconstruction, although the complication rate following implant-based breast reconstruction was the same (33).

Antibiotic prophylaxis, drainage

Meta-analyses have shown no advantages for the administration or duration of antibiotic prophylaxis or drainage in terms of wound infections or outcome (34, 35). Nevertheless, surveys of 4669 plastic surgeons in North America found that 81% of respondents used drainage in the reconstructed breast, and 93% did not remove the drain until after a fluid quantity of less than 30 mL per 24 hours had been achieved (35, 36). For autologous breast reconstruction, drain insertion in the donator area and in the reconstructed breast is recommended (e49). Perioperative administration of antibiotics (97% cefazolin) was reported by 98% of respondents; the duration of administration ranged from a single dose administered over administration for 24 to 48 hours to administration up to drainage removal. Following autologous breast reconstruction, longer antibiotic administration was no more effective than administration for 24 hours (19.5% versus 15.5%; $p = 0.47$) (e50). Following ADM use, antibiotic prophylaxis lasting at least 48 hours significantly reduces complications (e51). Patients can shower on the first day after breast reconstruction.

Systemic oncological therapy

Neoadjuvant chemotherapy had no detectable effect on the rate of complications provided surgery was performed two to four weeks after the patient's last chemotherapy session and thus white blood cell count nadir (e52). Breast-conserving surgeries and mastectomies four weeks after neoadjuvant administration of bevacizumab showed no significant increase in postoperative complications (37, e53), while after primary breast reconstruction there were significantly more complications, particularly protracted wound healing problems (38, e54).

When microsurgical reconstruction is performed, the increased risk of thrombosis caused by tamoxifen is important. Thus in 670 patients undergoing free flap surgery (205 receiving tamoxifen up to surgery, 465 until no later than four weeks before surgery) those

who were still receiving tamoxifen had significantly more complications (odds ratio: 1.7, $p = 0.015$). Flap complications ($p = 0.002$) up to and including total flap loss ($p = 0.041$) were particularly common (e55).

Acellular matrices, synthetic (Vicryl) meshes, dermal fat flaps

Publications on the use of meshes suffer from considerable bias, as these patients are usually negatively selected (e56).

Textile meshes are used preferentially in immediate reconstruction in order to fix the pectoral muscle and the implant in position for subpectoral implant insertion. Acellular matrices are used if the patient wishes to have reconstruction with an implant and the subcutaneous fat layer is very thin, the patient has undergone or is scheduled to undergo radiotherapy, or in surgery for complications. These patients must be informed of the options for autologous reconstruction. Because authorization by the Food and Drug Administration (FDA) for meshes is pending, in the USA acellular matrices are used almost without exception (11, e57). Rates of complications (seroma, infection, implant removal) following reconstruction involving implants were significantly higher with acellular matrices (15.3%) than without them (5.4%) (39). Following irradiation of the chest wall, in smokers, in overweight patients, and for very large prostheses (more than 600 mL) complications were more common after the use of acellular matrices (46.2% versus 22.7%) (40, e58–e61). The use of sterile, ready-to-use acellular matrices can significantly reduce the risk of complications.

As an alternative to meshes and acellular matrices, patients with breast ptosis and/or who wish to undergo breast reduction can be offered a deepithelized lower breast skin graft (autodermal graft), which covers the implant together with the pectoral muscle.

Outlook

In recent years there have been significant advances in implant-based and autologous breast reconstructions. Randomized trials on breast reconstruction will be all but impossible, for ethical reasons and due to their individual nature. Future studies should provide long-term findings on individual procedures, particularly the use of meshes, and patient satisfaction. Costs, complications, and subsequent surgeries, as well as care structures, should also be analyzed.

Conflict of interest statement

Prof. Faridi has received consultancy fees and reimbursement of conference fees from pfm medical ag, Cologne and DIZGg GmbH, Berlin.

Prof. Gerber has received consultancy and lecture fees from AstraZeneca, Novartis, Roche, TEVA, JanssenCilag, Celgene, and Pfizer.

Prof. Marx and Prof. Untch declare that no conflict of interest exists.

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KEY MESSAGES

- The aim is an oncologically safe and long-term aesthetically favorable outcome with reasonable expenditure on surgery.
- Patients must be comprehensively informed of all procedures and their advantages and disadvantages. Patient wishes, habitus, and risk factors must be taken into account when selecting a surgical procedure.
- Autologous and heterologous reconstructions complement each other in immediate breast reconstruction.
- If no postmastectomy radiotherapy is planned, immediate skin-sparing/nipple-sparing reconstruction involving implants is preferable.
- If postmastectomy radiotherapy is planned, patients must be informed in detail of the advantages and disadvantages of immediate versus delayed and heterologous versus autologous reconstruction.

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 [Supplementary material](http://www.aerzteblatt-international.de/ref3515)
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