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Oncoplastic breast surgery: A guide to good practice

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ABSTRACT

Oncoplastic Breast Surgery has become standard of care in the management of Breast Cancer patients. These guidelines written by an Expert Advisory Group; convened by the Association of Breast Surgery (ABS) and the British Association of Plastic, Reconstructive and Aesthetic Surgeons (BAPRAS), are designed to provide all members of the breast cancer multidisciplinary team (MDT) with guidance on the best breast surgical oncoplastic and reconstructive practice at each stage of a patient's journey, based on current evidence. It is hoped they will also be of benefit to the wide range of professionals and service commissioners who are involved in this area of clinical practice.

Introduction

Statement of purpose

These guidelines were developed to optimise key clinical and patient-reported outcomes experienced by patients undergoing partial and total breast reconstruction. They are designed to complement existing guidelines available on the Association of Breast Surgery (ABS) Guidance Platform [1] and the British Association of Plastic, Reconstructive and Aesthetic Surgeons (BAPRAS) clinical guidance and regulations site [2].

These oncoplastic guidelines also apply to women requesting risk reducing surgery and the very small number of men who request or require reconstructive surgery.

The purpose of these Guidelines is to provide all members of the breast cancer multidisciplinary team (MDT) with guidance on the best breast surgical oncoplastic and reconstructive practice at each stage of a patient's journey, based on current evidence. It is hoped they will also be of benefit to the wide range of professionals and service commissioners who are involved in this area of clinical practice.

Methods

A multidisciplinary working group was convened by the ABS and the BAPRAS with expertise in the diagnosis, support, treatment and follow up of patients considering Oncoplastic Breast Surgery (OPBS) to develop evidence-based recommendations. Previous guidance [3] was reviewed and updated through consensus meetings and by collaboration on a working document between meetings. A draft document was sent to the executive of the ABS and the BAPRAS for consultation and approved following finalisation. The guidelines represent a consensus opinion on the optimal management of patients having OPBS informed by peer-review publications.

The Guidelines are not intended to be prescriptive or legally

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binding but should be used to inform clinical decision making. Ultimately, members of the MDT remain responsible for the treatment of patients under their care.

Consideration of OPBS

OPBS should be considered in all patients who require surgery following a breast cancer diagnosis. OPBS includes therapeutic mammoplasty, partial breast reconstruction and total breast reconstruction (immediate or delayed). If certain procedures are not available locally then pathways should be established to ensure timely referral to an appropriate centre.

Communication with patients about Breast Reconstruction (BR) is detailed in the National Institute for Health and Care Excellence (NICE) guideline *NG101: Early and locally advanced breast cancer diagnosis and treatment* [4] and other national guidelines. For delayed breast reconstruction (DBR) there should be a clear and agreed referral pathway from primary and secondary care. No time limit should be placed on performing DBR after mastectomy.

The following should be clearly documented for all patients as part of the MDT discussion and clinic consultation:

- If a mastectomy is recommended the indication(s) should be documented.
- Consideration of oncological options (neo-adjuvant therapy) and/or oncoplastic techniques which may reduce the probability of or avoid mastectomy or a significant defect following traditional breast conservation surgery.
- BR (immediate or delayed) should be considered in all suitable patients in whom a mastectomy is recommended.
- If Oncoplastic Techniques or Breast Reconstruction are not thought to be appropriate then the rationale for this should be fully discussed and documented.
- The likely requirement for adjuvant radiotherapy.
- The likely requirement for genetic testing.

All women must have the opportunity to meet their breast team and discuss options with their surgeon and Breast Care Nurse (BCN) prior to admission.

Assessment for OPBS

The following factors should be considered when assessing patients for OPBS and may influence the timing and choice of techniques available for individual patients allowing for the patients' own preferences, expectations, goals and attitudes to risk.

Patient factors

The following patient factors should be considered:

- Local and systemic disease burden.
- Previous radiotherapy to the breast/chest wall.
- Familial and genetic risk factors.
- Co-morbidities
  - o Including BMI, Diabetes, connective tissue disorders and cardiorespiratory conditions.
- Pre-existing shoulder or musculo-skeletal problems.
- Drug history
  - oe.g. immunosuppresants and anticoagulants.
- •Smoking history
  - oIncluding nicotine containing products.
- Occupation, activities and lifestyle.
- Likely impact of recovery time on family, employment and daily activities.

Oncological factors

- Oncological principles should not be compromised, and always take precedence.
- Neo-adjuvant systemic therapy should be considered in appropriate patients. This may benefit patients by reducing requirements for mastectomy, OPBS complexity and volume of excision in patients suitable for breast conservation.
- For Immediate Breast Reconstruction (IBR), the likelihood of adjuvant treatment (in particular radiotherapy) may influence decision making.
- Overall IBR does not lead to clinically significant delays to adjuvant therapy however post-operative complications may be associated with treatment delay [5].
- Where there are concerns that IBR may lead to delays in primary treatment; systemic neoadjuvant therapy, if appropriate, or DBR may be considered. Significant delays to primary breast cancer surgery may be associated with an increased risk of mortality [6].
- Extent of planned skin resection and suitability for nipple preservation should be discussed and clearly documented in patients undergoing IBR.
- All relevant cancer treatment targets should apply and transfer with the patient if referred to another centre.
- For patients referred for OPBS from a separate unit, a full discharge summary should be sent back to the referring or treating MDT, including copies of operative notes, histopathology slides and/or reports and a post-discharge plan. A clear process for continuing care and follow-up should be agreed upon.

Radiotherapy factors

Previous or adjuvant radiotherapy will influence decision making with regards to OPBS and specific factors should be considered.

- •Oncoplastic Techniques
  - o Oncoplastic Breast Conservation Surgery with adjuvant radiotherapy is associated with high rates of disease-free survival, overall survival and low rates of local recurrence [7].
    - oPatients not suitable for adjuvant radiotherapy are usually not good candidates for oncoplastic breast conservation surgery.
- Implant Based Breast Reconstruction
  - oRadiotherapy is associated with higher rates of complications, implant loss rates and poorer cosmetic outcomes in patients undergoing implant based breast reconstruction [8].
  - oThe use of implant only reconstruction in patients with previous, or planned chest wall radiotherapy should be considered carefully.
  - oUse of expanders incorporating integrated metal ports may need to be discussed with local clinical oncology departments to ensure device compatibility with adjuvant radiotherapy protocols.
- Autologous Breast Reconstruction
  - oDespite a lack of robust evidence to support or oppose immediate autologous reconstruction in patients known to require Post Mastectomy Radiotherapy (PMRT) UK practice is varied. Many centres routinely perform immediate autologous reconstruction with planned PMRT whereas others follow the “Delayed-Immediate” [9] or “IDEAL” [10] method, whereby patients known to require PMRT undergo immediate implant/expander “spacer” reconstruction to maintain the skin envelope with subsequent switch of implant/expander to autologous tissue on completion of adjuvant

treatment. This subjects patients to further planned procedures and cost but reduces concerns of long-term irreversible radiotherapy effects on flap reconstruction.
oPMRT following Immediate Autologous Reconstruction is associated with fewer complications, fewer failures and better quality of life in comparison to PMRT following immediate implant based breast reconstruction [11].
oPMRT is detrimental to autologous reconstruction irrespective of whether performed in an immediate or delayed fashion [12].
oImmediate autologous reconstruction with PMRT may actually show lower [12] or at least similar complication rates (including fat necrosis) [13] to that of delayed autologous breast reconstruction with a history of PMRT. However, there is a higher incidence of revisional surgery in the immediate group [12]. Overall satisfaction rates are similar for all groups [13].
oDespite previous concerns that the volume of tissue may interfere with planned delivery of chest wall radiotherapy, Immediate autologous reconstruction with PMRT is oncologically safe [14].
oTherefore, these guidelines agree with recommendations that immediate autologous reconstruction should still be offered to all suitable patients expected to have PMRT [4].

Technical factors

There should be a complete assessment of breast morphology which may include the measurement and documentation of:

- Bra cup size/volume/ptosis of both breasts.
- Notch to nipple distance, nipple to inframammary distance.
- Base width/ height.
- Nipple sensation (particularly if considering mammoplasty).
- Breast/ chest wall asymmetry.
- Skin quality.
- Records from previous surgery.
- Record and assessment of damage from previous radiotherapy.

Assessment of technical factors should include:

- Breast cancer location and any skin involvement including tumour proximity to nipple).
- Tumour to breast ratio (when considering mammoplasty/ perforator flaps).
- Suitability for nipple preservation in mastectomy and IBR.
- Assessment of donor sites and suitability (IBR and perforator flaps).
- Options for contralateral surgery.

Photographic assessment

- Medical photography must be available in all units. A full and tiered consent process must be followed with each patient. Pre-operative and successive post-operative views (including longer term) should be taken for consenting patients undergoing OPBS. A standard set of views should be acquired in a studio setting for each patient.
- All digital images must be stored securely with limited access.
- Photographic images should be made available for the oncoplastic breast MDM.
- Patient consent must be obtained to use Images for teaching and or publication. *The Institute of Medical Illustrators guidelines* should also be followed [15].

Consideration of contralateral symmetrisation surgery

- Symmetrising surgery should be offered to patients (immediate or delayed) regardless of time of original surgery.
- If restrictions to contralateral surgery are apparent within the host hospital area, the patients should be informed of local restrictions at the outset.
- Where possible consider immediate contralateral symmetrisation surgery, with specific attention paid to the likelihood of adjuvant chemotherapy and whether surgical complications could result in any delay with the delivery of chemotherapy (a delay of over 8 weeks may lead to increased mortality) [16].
- In bilateral cases, a two-team approach is recommended to shorten operating time which has been shown to reduce complication rates [17].

Considerations specific to delayed breast reconstruction

When DBR is considered, full clinical assessment should be performed when indicated and the results should be available to inform decision-making.

- A mammogram of the contralateral breast should have been performed within the preceding 12 months.
- Consider re-staging in high risk patients prior to undertaking major delayed total breast reconstruction surgery.
- Tamoxifen therapy is associated with a 2.3 fold increased risk of venous thrombo-embolism(VTE) [18], this risk is exacerbated in patients undergoing surgery after recent chemotherapy [19] or those undergoing longer procedures [20]. Surgical procedures lasting longer than 90 min (total anaesthetic + surgical time) are considered an indepenent risk factor for VTE [21]. Discontinuing Tamoxifen for a period of 3 weeks results in 98% of the active drug being eliminated from plasma [22]. A proposed management algorithm based on current evidence stratifying risk of VTE in patients on Tamoxifen suggests the following [22].
  - oIn low risk patients (i.e. undergoing short procedures (<90mins) with no/minimal other risk factors for VTE)
  - Tamoxifen therapy can be continued pre and post operatively.
  - oIn moderate risk patients (i.e. undergoing longer procedures (>90mins) or recent chemotherapy without other risk factors for VTE)
  - Tamoxifen should be discontinued for 3 weeks prior to surgery but that it can be restarted immediately post-operatively at the standard dose.
  - oIn the high risk patients (those with other associated risk factors for VTE, obesity, family history, comorbidities)
  - Tamoxifen should be stopped for 3 weeks pre-operatively and not restarted until 3 weeks post-operatively.
- At least 6 months should elapse before DBR following adjuvant radiotherapy. Carrying out DBR >12 months after radiotherapy may result in fewer post-operative complications [23].

There should be no time limit on DBR, however if such restrictions exist, the patient should be informed so plans can be made to ensure a DBR is possible.

Considerations specific to contralateral risk reducing mastectomy (CRRM)

Contralateral risk reducing mastectomy when a breast cancer has been diagnosed is a complex and emotive area for the patient and the responsible team.

- There needs to be a clear discussion with the patient about the definition of risk reduction, ie. reducing risk of death from a contralateral breast cancer or the risk reduction of a new primary breast cancer in the contralateral breast.
- A patient is likely to substantially over-estimate risk of dying from a contralateral breast cancer following diagnosis of the ipsilateral cancer [24].
- There is very little evidence to support contralateral risk reducing mastectomy as a tool to reduce the risk of breast cancer death in all but the highest risk patients (ie. carriers of breast cancer related pathogenic varient genes for example BRCA1).
- When considering such surgery in the immediate setting, the patient is required to have the request discussed at an MDT with rapid psychology review.
- The oncologial factors need to be considered with the option of delayed CRRM if there is a possibility of complications delaying adjuvant treatments.
- When considering lifetime risk of a contraleteral breast cancer, it is useful to consider the Manchester guidelines with a 25% or over lifetime risk, used to sanction such surgery [25].
- Non surgical treatments (eg. endocrine therapy) for the index cancer must be considered with the associated risk reduction in contralateral breast tumour risk.
- If a patient is considering contralateral mastectomy with/ without reconstruction for symmetry purposes, discussion at an oncoplastic MDT and psychological opinion prior to such surgery should be sought [26].
- If the patient warrants a contralateral risk reducing mastectomy but only wishes surgery on the symptomatic side and abdominal flap reconstruction then they should be informed that abdominal flap reconstruction can only be utilised once and may be better served for a bilateral procedure if donor options limited.

Patient information, decision making and psychosocial support

Information provision

Patients differ in the amount and type of information they need and the extent they wish to be involved in treatment decision making. Compassionate, patient-centred care is essential and patient support and counselling may require more than one consultation.

Discussions should take place in a private setting avoiding emotive or persuasive language and the patient's understanding of information received should be checked. Poor or inadequate preoperative information provision is associated with regret and dissatisfaction with outcome [27]. Support and information should also be available to partners and family members if required.

All patients should have easy access to:

- Information in languages other than English, and/or interpreters if necessary
- Information that meets their changing needs over time in a choice of formats (e.g. written information, multimedia resources).
- Photos representing a range of procedures, outcomes, donor sites with a variety of different patients at different time intervals.
- Opportunities to discuss experiences with other patients (e.g. through Breast Cancer Now's Someone Like Me service) [28].
- Details of local and national support/information services (see Appendix).
- Contact details
  - oOut of hours care.
  - oPsychological and emotional support.

All women should be informed about:

- All relevant oncological options for which they are suitable, irrespective of whether they are available locally.
- If OPBS is contraindicated, this should be documented in the patient's records.
- The full range of external prostheses available, with time scales of when they can be utilised should be discussed.
- The number of procedures that may be needed to achieve an acceptable outcome.
- Possible outcomes of OPBS including:
  - oThe look and feel of a reconstructed breast and the fact that the exact aesthetic outcome cannot be predicted prior to surgery.
  - oThe impact of surgery on the appearance of donor sites, if appropriate
  - oThe time taken to adjust to a reconstructed breast and an altered body image (typically 1 year or more), and the potential impact on quality of life, emotional well-being and intimacy.
  - oThe range of physical and psychological impacts of surgery (e.g. discomfort, lack of sensation, self-consciousness, body image issues) which contribute to (dis)satisfaction with outcome.
- Planned additional procedures (e.g. nipple reconstruction, lipomodelling and contralateral surgery) which may be required and the possibility of unplanned procedures.
- Their risks of complications associated with specific procedures.
- How to recognise and act on concerns about potential complications post-surgery.
- Whether implants will need to be routinely replaced in the absence of concerns.
- Whether revision or replacement may be required for adverse symptoms or to improve cosmetic outcomes in the longer term.
- The type of implant or expander to be used (if relevant), and advised to retain this information.
- Possible longer-term outcomes, including:
  - oLocal and regional recurrence.
  - oAsymmetry.
  - oThe effects of weight changes and of contralateral ptosis.
  - oChronic seroma.
  - oChronic pain.
  - oShoulder stiffness and pectoral girdle disability.
  - oAbdominal hernias and other sequelae of abdominal flaps.
  - oFasciculation (muscle twitching) with muscle flaps.
  - oHypertrophic/ Keloid scarring.
  - oAxillary fullness following Latissimus Dorsi reconstruction.
  - oRevisional surgery including lipomodelling, flap, scar and implant revisions.
  - oQuality of life, physical, cosmetic and psychological well-being reported by patients undergoing different types of reconstruction over time.
- Their hospital stay and the post-surgical period, including:
  - oThe likely length of stay.
  - oWhat they should take with them into hospital.
  - oLikelihood of post-surgical drains.
  - oWhen they are first likely to be able to look at their reconstruction/ donor site(s) and what they can expect to see at this time. They should be warned about any potential swelling or shape abnormalities which may be present initially and the likely duration this can take to settle [29].

oFollow-up arrangements including the first follow up appointment where the histopathology results will be discussed, if appropriate, and a treatment plan will be agreed.
- Their post-operative recovery period regarding:
  oExercise and physiotherapy.
  oThe likely recovery time, time to return to normal activities, work and driving, lifting, sport, exercise.
  oPost-operative underwear/garments.
  oContact details for difficulties arising out-of-hours or at weekends.
- Ongoing research including, but not limited to, trials, national audits, and registries
- Consent should follow established NHS and General Medical Council (GMC) guidelines.

Early post-discharge phase:

- Discharge plans should be discussed as part of the consent process with details of out-of-hours contacts, and arrangements for nursing support and removal of drains, which should be provided as locally as possible to the patient.
- A copy of the discharge letter should be sent to the GP and patient with their agreement.

Supporting patients' decision making

Decisions about OPBS are often complex and every effort must be made to give all patients sufficient time and support to consider their options with the operating surgeon(s) and reach a shared decision [30]. A clinical nurse specialist should be available for discussions about surgical options.

Shared decision making requires an understanding of what matters to each patient, providing information that meets their individual needs and is understood by them (see GMC guidelines 2020 [31]. Patients should be helped to consider what they want to achieve from OPBS (i.e. their own goals), and their expectations about outcomes should be clarified [32].

Decision aids/tools can be useful additions to the standard provision of care and support for women considering OPBS [33,34].

Patients who are finding it particularly difficult to make a decision should be identified and referred for additional support, through clear referral routes.

Psychological assessment and support

- The OPBS service should have a documented strategy for psychological assessment and support if needed.
- Patients should:
  obe reassured that discussions about psychosocial aspects of OPBS is a standard, routine part of care.
  ohave easily available support if they experience complications, since these can be particularly distressing [35].
- The psychological well-being of each patient and their potential need for further support should be assessed at key points including pre-operatively, during their hospital stay, prior to discharge and during routine follow-up appointments by a suitably trained member of the MDT (e.g. a Specialist Breast Care Nurse (BCN) and/or Breast Reconstruction Nurse Specialist with expert knowledge and skills in OPBS for Level 2 support).
- Where complex psychological difficulties are identified, referral to specialised psychology services (Level 3 and 4) will be required. Patients at high risk (previous psychiatric history, poor coping skills, limited social support) should be monitored post-operatively and further contact to establish psychological recovery should be negotiated and agreed with the patient. This arrangement should be documented in the hospital notes.
- Established screening tools (e.g. HADS or PHQ9/GAD7) should be considered to assess psychological morbidity and adjustment to OPBS.

Surgical factors

Marking

- Appropriate pre-operative markings should be undertaken in a suitable private space that has an examination couch and mirror. A chaperone should be present.

Margins in breast conservation surgery

- ABS advises a 1 mm (1 mm) minimum clear radial margin is achieved after breast conservation surgery for early invasive breast cancer and for in situ cancer [36].
- Further surgery (re-excision or mastectomy) should be offered where required to achieve clear margins.
- Routine excision of skin overlying tumour in breast conservation surgery is not routinely recommended. Where tumours are superficial however (close to or at the anterior margin) pre-operative oncoplastic planning should consider the appropriateness of oncoplastic excision of the overlying skin to facilitate achieving a clear anterior margin.

Mastectomy

Oncological outcomes following SSM & NSM

A number of observational studies have reported on the short to medium term oncological outcomes of SSM and NSM in women undergoing therapeutic or risk reducing mastectomies [37–42]. They report low rates of subsequent breast cancer development. However a Cochrane review of NSM reported the evidence to be of low quality and was inconclusive due to high risk of selection bias [43]. Given the unlikely reporting of any randomised data long term follow up studies in this cohort are essential to ensure low rates of loco-regional breast cancer incidence are maintained.

NSM and SSM are contraindicated in patients with inflammatory breast cancer and caution should be applied in considering these techniques in more locally advanced cancers (e.g. T4 tumours) [44].

Skin sparing mastectomy (SSM)

The aim of SSM in patients is removal of all breast glandular tissue, whilst preserving the native skin envelope which involves preserving a viable blood supply to the entirety of the envelope of the breast.

Therefore, precise surgical technique is required to dissect exactly within the plane between subcutaneous fatty tissue carrying blood supply to the skin envelope and the underlying paranchyma ("the mastectomy plane") [45–47]. Such technique allows for maximal removal of breast glandular tissue and minimal incidence of mastectomy flap necrosis.

Thicker mastectomy flaps are more likely to prevent damage to subcutaneous vessels but risk of leaving breast tissue in situ. Studies examining the presence of residual breast tissue following SSM have shown a greater prevalence of breast terminal ductal lobular units in the presence of thicker mastectomy skin flaps [46,48]. Certain areas of the mastectomy plane may harbour greater risk of residual breast epithelium, in particular the lower outer

quadrant of the breast [49].

The incidence of mastectomy skin flap necrosis is increased in the presence of smoking, previous radiotherapy, diabetes, obesity and multiple comorbidities [50,51].

Choice of incision can also affect incidence of mastectomy flap necrosis but there is no evidence that use of differing electrocautery devices or scalpel dissection affect necrosis rates [52,53].

SSM is considered oncologically safe in the following clinical settings; risk reduction surgery in high risk patients, early stage, biologically favorable, invasive breast cancer or Ductal Carcinoma In-Situ (DCIS) [54].

Recommendations:

The optimal thickness of a SSM flap should be judged for each individual patient.

Special consideration should be given to maintaining dissection in the plane between subcutaneous adipose tissue and underlying breast parenchyma, particularly in the lower outer quadrant of the breast. If there is concern intra-operatively about potential proximity of malignant tissue at the anterior mastectomy margin, the relevant area on the mastectomy skin flap should be marked with a radiologically visible subcutaneous clip or a percutaneous non-absorbable suture. This will facilitate reoperative surgery to remove involved dermis should this be noted at the postopertive MDT.

Wise pattern incisions ("inverted T incisions") may increase rates of skin flap necrosis in some circumstances.

Nipple sparing mastectomy (NSM)

The technique for NSM is similar to SSM in the development of uniform thickness mastectomy flaps with precise adherence to surgery within the mastectomy plane. However, in NSM, the nipple-areolar complex is left in situ. The presence of the natural nipple-areolar complex is associated with psychological and aesthetic benefits for women [55,56]. The process of nipple preservation requires a balance between two competing factors; removing the maximum amount of retro-areolar breast tissue whilst maintaining a viable blood supply to the nipple.

Whilst the ducts of the breast should be excised during surgery, there is no clear evidence on how aggressively ducts should be excised from the nipple and retroareolar area.

Capturing occult malignancy can be done by sending retro-areolar/ nipple core tissue for histological examination separately to the main mastectomy specimen [42,57,58].

Leaving a 3 mm rim of tissue at the nipple areolar complex preserves at least 66% of the nipple microvessels [59]. Rates of nipple necrosis are increased with transareolar or circumareolar incisions, in smokers and patients undergoing previous breast irradiation [47,60].

NSM is considered oncologically safe in the following clinical settings; risk reduction surgery in high risk patients, early stage, biologically favorable, invasive breast cancer or DCIS at least 2 cm from the nipple, imaging findings indicating no nipple involvement, no nipple discharge and no Paget's disease [44].

Recommendations:

Tissue excised from the nipple areolar complex should be sent for histological examination separately from the main mastectomy specimen. In NSM performed for risk reduction purposes, there is no evidence that intraoperative frozen section analysis of retro-areolar tissue is of benefit.

The mastectomy specimen itself should have the site of the recently detached nipple areolar complex clearly marked in order for accurate localisation of any occult malignancy should this be discovered. If there is concern about potential proximity of malignant tissue at the anterior mastectomy margin (abutting the skin), the relevant area on the mastectomy skin flap should be marked with a radiologically visible subcutaneous clip or a percutaneous non-absorbable suture. This will facilitate reoperative surgery to remove involved dermis should this be noted at the postopertive MDT.

Transareolar and circumareolar incisions are associated with higher rates of nipple areolar complex necrosis in comparison to radial and inframammary fold incisions [61–64].

NSM should be used with caution in women who smoke or have had previous breast/ chest wall irradiation [65].

Breast conservation with oncoplastic techniques

Where it is oncologically safe, breast conservation should be considered in all patients. Techniques have evolved to increase the availability of breast conservation.

Equipment required for oncoplastic breast surgery within the operating theatre includes:

- Mammographic quality monitor(s). The resolution should be sufficient to enable satisfactory visualisation of fine micro-calcifications (eg 5 megapixel) [66]. Such monitors are usually of a higher resolution than standard monitors used for viewing CT images.
- Equipment or facilities to enable immediate intraoperative specimen radiography [67].
- Equipment for sentinel lymph node localisation.
- Equipment, according to local protocols, for localisation and surgery of impalpable and screen detected lesions.

All equipment should be regularly serviced and there should be contingency planning in the event of failure of a piece of equipment (eg back-up equipment).

When performing volume displacement or replacement procedures the tumour bed should be localised with titanium clips to aid accurate delivery of radiotherapy according to local protocol.

Volume displacement techniques

- In the larger, more ptotic breast, breast reduction techniques in the form of therapeutic mammoplasties facilitate removal of large areas of tissue, with concomitant reshaping of the breast. Therapeutic mastopexies can also produce a similar result in smaller breasts.
- Care should be taken to reduce potential wound healing complications/fat necrosis which could potentially delay adjuvant treatment(s). Examples include considering longer vertical limb lengths, narrower wise patterns, wider pedicle bases and lower tension closure in comparison to aesthetic breast reduction/ uplift surgery.
- Technically in nipple preserving therapeutic mammoplasty/ mastopexy it is often easier to base the nipple on a separate pedicle from that used to fill the defect (secondary pedicle) as it allows greater freedom of inset with less risk of nipple compromise.

  •Where the nipple has to move a long distance or looks compromised on table one option to consider is converting the nipple-areolar complex to a free nipple graft.

Volume replacement techniques

- Volume replacement techniques enable breast conservation for larger tumours in smaller breasts. For lateral defects, the lateral intercostal artery perforator (LICAP) and lateral thoracic artery perforator (LTAP) flaps can be used. Caudal defects can be filled

using the anterior intercostal artery perforator (AICAP) flap. Whereas medial, and even upper inner quadrant defects, can be filled using the medial intercostal artery perforator (MiCAP) flap.
- Do not compromise potential total breast reconstruction donor sites in high risk patients with few donor site options. I.e. extended LICAP flaps may compromise the ability to perform (or volume available) in an extended LD flap.

Partial breast reconstruction

- In patients with larger defects (I.e. one-quarter to one-half of the breast) other options could be considered such as the Thoracodorsal Artery Perforator (TDAP) flap or free mini-transverse upper Gracilis (TUG) flap.
•Where larger excisions are performed and more complex reconstructive techniques are used, clear margins should be ensured, prior to reconstruction (i.e. fill cavity with water and await formal pathology prior to reconstruction as second stage within a few weeks or fresh frozen section).

Total breast reconstruction

When a mastectomy is oncologically dictated, there are various methods used to perform total breast reconstruction. These can either be entirely implant based, autologous or a mixture of both techniques.

Implant based breast reconstruction

Implant based reconstruction can be used, with either a fixed volume implant or tissue expander being placed in the subpectoral or prepectoral position, with support from an acellular dermal matrix or dermal flap. These techniques can be used as a permanent solution to breast reconstruction, or as a delayed-immediate solution, with a view to preserving the skin envelope and performing a delayed autologous reconstruction.

Patients should be informed:

- Modern breast implants do not have a specific lifespan and do not need to be routinely replaced in the absence of concerns.
- Revision or replacement may be required for adverse symptoms or cosmetic deformity in the longer term. Patients should ask their GP to refer them back to their original provider for assessment.
- That there are differences between tissue expanders and fixed volume implants, between saline and silicone-based devices and between textured and smooth coatings.
- Of the type of implant or expander used, which they should be advised to retain.
- Up to 1 in 10 patients experience loss of their implant in the first 3 months after surgery [68].
- Up to 1 in 4 patients may require revisional surgery in the first 10 years [69].

Patients should also receive information about other potential complications of implants/expanders and this should be documented including:

- Infection.
- Extrusion.
- Capsular contracture.
- Rupture.
- Silicone granuloma.
- Silicone bleed.
- Implant malposition.
- Breast Implant Associated – Anaplastic Large Cell Lymphoma (BIA-ALCL).

Acellular dermal/ synthetic matrices (ADM's). The use of implant based reconstruction accounts for 53% of immediate reconstructions following mastectomy in the UK [70]. The majority of these are now being performed with a biological or synthetic mesh [68]. The advantages of biologic or synthetic mesh used as an adjunct for implant based breast reconstruction over traditional total submuscular techniques are to improve lower pole projection, the potential to go straight to permanent breast implant, reduced postoperative pain, improved aesthetic outcome, and decreased operative time [71]. Despite widespread adoption in the UK, these procedures are associated with morbidity [68].

There is no clear consensus on the ideal biologic or synthetic mesh.

Specific points for discussion are.

- The origin of the specific mesh should be discussed.
- Whether the mesh remains permanently or is expected to be absorbed.
- Patients should be informed of local and global experience with the mesh used including uncertainty regarding long term outcome.
- Knowledge and acceptance that the reconstruction involves a breast implant.
- Patients should be aware that revisional surgery is frequent in the early stages following reconstruction.
- That a drain may be left in-situ for up to two weeks.

Patients need to be aware of the risks of complications, local and personal complication rates. Complications are common in implant only mesh assisted or dermal sling procedures. By 3 months national rates are [68].

- Readmission - 18%.
- Infection - 25%.
- Reoperation - 18%.
- Implant loss - 9%.

Patients opting for a single-stage procedure must be informed preoperatively of the possibility of a two-stage procedure using an expander because of possible impaired vascularisation of the skin flaps.

Patients should be aware that long term results of implant-based reconstruction may deteriorate and subsequent planned surgery for cosmetic concerns may be required. Funding for further procedures may become limited. Cosmetic outcome of further procedures may be limited.

Surgeons should be familiar with and adhere to the ABS & BAPRAS Guidelines on ADM based breast reconstruction [1,2].

Strategies to decrease implant related complications. Implant based reconstruction techniques inevitably carry some risk, most notably implant failure and explantation which is costly to both the patient and providers [71]. The National Mastectomy and Breast Reconstruction Audit demonstrated an implant loss rate of 9% at 3 months in IBR and 7% in delayed reconstruction [72]. However, the current national target is to have less than 5% implant loss rate at 3 months post-operation.

Factors shown to increase implant failure include:

- Smokers (consider using nicotine replacement therapy).
- Patient BMI>30.

- Pre-existing Diabetes Mellitus.
- Concomitant axillary clearance.
- Using implants >500 cc.
- Neo-adjuvant chemotherapy.
- Pre-operative radiotherapy.

Pre-, intra- and post-operative protocols [17,73] have been developed and shown to reduce implant loss rates at 3 months [73].

Pre-operative risk reducing measures include:

- Careful patient selection to minimise patient risk factors.
- Single dose of prophylactic intravenous antibiotic at induction.

Intra-operative risk reducing measures include:

- Reduce personnel in theatre and avoid opening doors (use of locks and signs).
- Reduce operative time- use 2 surgical teams for bilateral cases.
- Consider using laminar air flow if available.
- All theatre personnel to wear facemasks when implant is opened.
- Patient to be warmed for the duration of surgery.
- Nipple shields to be applied for unilateral cases.
- Patient to be prepped with alcoholic chlorhexidine.
- Surgeons and scrub staff to double glove, surgeons and scrub staff to change outer gloves to a clean pair prior to handling the implant.
- Clean drape to be placed before implant insertion.
- Implant only handled by the surgeon (following glove change).
- Trim skin edges.
- Use bacteriostatic sutures and skin glue to seal the wound.
- Tunnel drains.
- Consider using tissue expanders and negative pressure dressings in high risk patients.

Post-operative risk reducing measures include:

- Consider selective use of extended antibiotic prophylaxis in those patients deemed “high risk” for infection.
- Drains to be removed when draining <30 mls on 2 consecutive day.
- Early debridement for small wound problems and early outpatient review.

Radiotherapy

- Patients requiring post-operative chest wall radiotherapy have an increase in complications.

- There is an increased risk of capsular contracture post radiotherapy. ADM does not increase the risk of capsular contracture post radiotherapy and there is emerging data to suggest it may potentially reduce the severity of capsular contracture [74] however, there is no definitive data.

- Those who have received radiotherapy prior to reconstruction have an increased risk of major complications and implant loss [75].

Information about implants. The Medicines and Healthcare products Regulatory Agency (MHRA) has reviewed literature on the safety of breast implants and has concluded that implants do not increase the risk of connective tissue disorders [76] or the risk of breast cancer [77].

Breast Implant Associated Anaplastic Large Cell Lymphoma (BIA-ALCL)

- In 2016 the World Health Organisation (WHO) described BIA-ALCL as a provisional entity with specific diagnostic criteria [78]. The UK incidence is regularly updated by the MHRA and FDA. Cases of BIA-ALCL have occurred between 2 and 28 years after breast implant insertion with the average time being 8 years. It is most likely to present as a seroma.

- Most of the cases worldwide have occurred with textured breast implants as opposed to smooth. There are however benefits of textured implants in reconstruction which can be considered.

Further information is available at.

- www.gov.uk/guidance/breast-implants-and-anaplastic-large-cell-lymphoma-alcl
- www.fda.gov/medical-devices/breast-implants/risks-and-complications-breast-implants

Breast Implant Illness

- Breast Implant Illness (BII) is a term used by patients who have breast implants and experience a variety of symptoms that they feel are directly connected to their silicone breast implants. Breast Implant Illness is not a medical diagnosis and there is no proven association with breast implants. The symptoms include tiredness, “brain fog”, joint aches, immune-related symptoms, sleep disturbance, depression, hormonal issues, headaches, hair loss, chills, rash, hormonal issues and neurological issues.

- There is currently no scientific evidence to confirm this proposed link or any diagnostic test to show that a patient suffers from such a condition. Research continues in this area to establish if all of the symptoms that patients describe can be brought together into a single diagnosis. Some patients do report that their symptoms improve if their implants are removed but this is not true for all.

More guidance on BII can be found at these websites.

- www.gov.uk/guidance/symptoms-sometimes-referred-to-as-breast-implant-illness
- www.fda.gov/medical-devices/breast-implants/risks-and-complications-breast-implants

ABS, BAAPS and BAPRAS advise that if individuals with breast implants experience breast swelling, lumps or change in shape they should seek medical advice. They also state: “If you think your breast implants are causing general health problems you should seek the advice of your original implanting surgeon or the hospital/clinic where the implant operation took place. If you cannot contact either of those, please consult your GP.” [79].

- All patients having BR with Implants must have this discussed as part of informed consent.

Breast and Cosmetic Implant Registry. The Breast and Cosmetic Implant Registry (BCIR) was opened on 10 October 2016. It captures the details of all breast implant procedures completed in England and Scotland by both the NHS and private providers [80].

The Department of Health and Social Care directed NHS Digital to carry out this work in response to recommendation 21 of the Keogh Review of the Regulation of Cosmetic Interventions [81].

The registry records the details of any individual who has breast implant surgery, for any reason, so they can be traced in the event of a product recall or other safety concern relating to a specific type of implant. It also allows the identification of possible trends and complications relating to specific implants.

All providers of breast implant surgery are expected to participate. This is mandatory in the NHS.

Total autologous breast reconstruction

Total autologous reconstruction includes pedicled and free flaps. The most commonly used pedicled flap is the extended latissimus dorsi flap. Whilst the deep inferior epigastric artery perforator (DIEP) flap accounts for the most commonly used free flap. Other autologous options for women who are not suitable for DIEP flaps include the muscle sparing transverse rectus abdominis myocutaneous (MS-TRAM), transverse upper gracilis (TUG), profunda artery perforator (PAP), lumbar artery perforator (LAP), superior gluteal artery perforator (SGAP) and inferior gluteal artery perforator (IGAP) flaps.

Many surgeons now consider the DIEP flap as the gold standard in free autologous total breast reconstruction with the literature supporting low (2.2% total/ 3.1% partial) flap failure rates in unilateral flaps [82] and re-operation for any complication as 15.9% [83].

In addition, autologous techniques can be augmented with lipofilling, or implants can be used to augment the volume of autologous reconstructions, such as Latissimus Dorsi flaps.

UK National Flap Registry. The UK National Flap Registry (UKNFR) is a registry for all pedicled and free flaps including breast.

The registry has been live since August 2015 and offers the 'Surgeon Dashboard' (launched in July 2017) allowing users to download personal data (numbers, case mix, gender, age, success rate, return to theatre).

Lipomodelling

Delayed lipomodelling has been shown to be oncologically safe for the correction of breast conservation defects; though good results can be difficult to achieve following radiotherapy. A delay of 6 months after radiotherapy or until the first annual surveillance mammogram is suggested [84]. Enrichment of the fat grafts using adipose-derived regenerative cell (ADRCs) has also been shown to be safe and efficacious for this purpose [85].

Immediate lipomodelling at the time of breast conservation may reduce the incidence of postoperative deformity but should be considered experimental until long term results are published [86,87].

Lipomodelling can improve volume and contour in implant or autologous total breast reconstruction [88,89]. Lipomodelling has been shown to improve the quality of irradiated tissues, especially in implant based procedures [90].

Care should be taken in the selection of donor sites for fat harvest in patients who may require subsequent total autologous reconstruction (i.e. don't use the lower abdomen as a donor site for fat harvest to improve implant coverage in a patient highly likely to require switch to autologous tissue such as a DIEP flap in future).

The use of lipomodelling as the sole technique for breast reconstruction has been limited to selected patients because of the number of procedures required to achieve a satisfactory volume [91]. It is best suited to small-breasted women with suitable donor sites in whom other types of reconstruction may not be possible or desired.

Radiological surveillance after OPBS and total breast reconstruction

Bilateral annual surveillance mammography is recommended after OPBS. During the first 6–12 months after surgery and radiotherapy post treatment changes are most likely to occur and can be difficult to accurately assess radiologically [92]. A 12 month delay following OPBS is recommended. Radiology should be informed of any patient who undergoes lipomodelling as a secondary procedure.

There is no indication for ipsilateral imaging following mastectomy and either implant or autologous reconstruction, recurrence occurring in the mastectomy flaps. Patients should undergo contralateral annual mammographic surveillance.

Routine breast MRI scanning is not recommended unless women carry additional risk factors [93].

Surgical ERAS considerations

As partial and total breast reconstruction techniques have improved, surgical teams have aspired to reduce perioperative effects, such as starving, increased catabolism, nausea, vomiting and dependence on opiates whilst reducing length of stays and reducing complication rates by implementing enhanced recovery after surgery (ERAS). These evidence based changes can be made to patient pathways to improve patient care [94,95]. Teams should aspire to perform much of their implant based breast reconstruction as day case procedures and aim to safely discharge DIEP patients on day 3.

- Optimisation of patients: stop smoking/using nicotine containing products for a minimum of a month, reduce body mass index, optimise diabetic control [96].
- Preoperative imaging for perforator flaps has been shown to reduce flap harvest time, operation time and significantly reduce complications in DIEP flap breast reconstruction [97].
- Fasting: Patients should stop solid food intake and be encouraged to drink clear fluids according to local protocols prior to the procedure to minimise pre-operative dehydration.
- Carbohydrate loading; for longer procedures using maltodextrin based drinks may be considered to reduce the catabolic effects of surgery [98].
- Venous thromboembolism (VTE) prophylaxis: VTE complications in patients undergoing DBR (0.41%) and mastectomy with immediate reconstruction (0.52%) are higher than those undergoing wide local excision (0.13%) and mastectomy (0.29%) alone [99]. Unless contraindicated, patients should receive low molecular weight heparin with intermittent pneumatic compression until mobile.
- Surgical Site Infection can be reduced by:
  - o Chlorhexidine based skin preparations [100,101].
  - oProphylactic antibiotics [102,103].
  - oAntibiotic washout of the breast cavity [104].
- The length of use of preventative antibiotics is harder to quantify. Many units ask patients with implant based reconstruction to continue oral antibiotics until the drains are out, however no randomised controlled trial has been carried out to assess this [17].
- Perioperative nausea and vomiting: 5-hydroxytyptamine-3 antagonists (e.g.ondansetron) reduce post-operative nausea and vomiting, whilst dexamethasone reduces nausea, vomiting and pain.
- Multimodal analgesia: Paracetamol and non-steroidal anti-inflammatory drugs can be given pre-,intra- and post-operatively [95]. Pregabalin reduces post-operative analgesia requirements and pain in mastectomy patients [105]. Analgesia should aim to

be opiate sparing wherever possible. Paravertebral blockade is recommended as the first-choice regional analgesic technique, whilst pectoral nerves block may be used as an alternative to paravertebral block [95]. Local anaesthetic wound infiltration may be added to regional analgesia techniques. Transversus abdominal plane (TAP) blocks have been used successfully in DIEP patients [106].

- Reducing Bleeding/Haematoma: Tranexamic acid, an anti-fibrinolytic agent, reduces mortality in bleeding trauma patients when administered early [107]. There is increasing evidence that tranexamic acid reduces bleeding in the elective surgical setting (particularly orthopaedic surgery) and subsequent need for post-operative transfusion. [108,109] It is now increasingly used in both elective oncological and aesthetic surgery due to the potential benefits of decreased drain output, decreased swelling, decreased bruising [110] and decreased haematoma rate [111].
- Reducing Seroma: The placement of "quilting" or "progressive tension sutures" evenly distributes tension over the whole wound rather than at the incision site, decreases shearing forces and reduces dead space. It reduces drain volumes and incidence of post-operative seroma formation in extended LD [112] and DIEP donor sites [113]. In established seromas the use of intracavity Triamcinolone instilled after aspiration reduces re-accumulation [114].
- Prevention of hypothermia: Methods should be employed to warm operating rooms, tables and the patient to prevent hypothermia.
- Peri-operative fluids: Fluid balance should be carefully monitored. Fluid overload can be as detrimental as underload. The use of Vasopressers to maintain adequate mean arterial pressure in already well hydrated patients, are not associated with major flap complications such as thrombotic events and total flap loss. Although they may be associated with an increase in minor complications such as delayed healing, fat necrosis, seroma and infection [115].
- Early feeding: encourage fluids and return to a normal diet within 24 h. Prescribing laxatives can help counteract any effects of opiates, if used.
- Incisional Negative Pressure Wound Therapy (iNWPT): There is randomised control evidence looking at the use of iNWPT in breast reduction surgery but not in oncoplastic breast surgery. In breast reduction surgery iNPWT is associated with a significant reduction in wound breakdown and improved scar quality [116]. In oncoplastic breast surgery iNPWT reduces seroma, rates of skin necrosis, time for wound healing and surgical site infection [117–119]. There are also reports of reduction in implant loss rates in prepectoral breast reconstruction when iNPWT is utilised and resultant cost-savings in comparison to management of total reconstructive failures to justify their use [120,121]. There is NICE guidance advocating the use of iNPWT in high risk patients and wounds [122].
- Mobilise early and remove urinary catheters in the early post-operative course.
- Each unit should have post-operative flap monitoring protocols and policy for takeback.
- Post discharge: Early physiotherapy, supervised exercise and early follow up phone call from breast care nurse. Consider bra/support garments 24/7 for 6/52
- *A nominated theatre team* with expertise in the preparation and use of equipment and materials required for microvascular surgery and other major reconstructive procedures including primary, revision and salvage surgery.
- *A nursing team* which should include a BCN or Breast Reconstruction Nurse Specialist appropriately trained in supportive care with specialist knowledge of OP techniques. In addition, a specialist nurse with plastics training will also be involved in managing complex dressings and nipple tattooing.
- *A nominated ward team* with expertise in monitoring, management and mobilisation of patients following microvascular surgery.

Training in oncoplastic breast surgery in the UK

Oncoplastic breast surgery is incorporated in both the General Surgery Curriculum and the Plastic Surgery Curriculum.

- Surgeons in training via the General Surgery pathway wishing to pursue a career in Oncoplastic Breast Surgery currently must declare a subspecialist interest in Breast Surgery. Their final years of training are dedicated to Breast Surgery and they are expected to obtain experience in Oncoplastic Breast Surgery prior to the award of Certificate of Completion of Training (CCT).
- Surgeons in training via the Plastic Surgery pathway wishing to pursue a career in Oncoplastic Breast Surgery would normally dedicate their final years of training to gaining additional experience in Breast Reconstruction within their programme with many undertaking an additional fellowship in Breast Microsurgery. Additional training in breast Oncology may also be undertaken by some trainees.

Advanced training in Oncoplastic Breast Surgery has been available in the UK via competitive application to the Oncoplastic Breast Surgery Training Interface Group (TIG) Fellowship since 2002. These National Fellowships; overseen by both ABS and BAPRAS via the Oncoplastic Breast surgery TIG committee; are open to applicants from General Surgery trainees with a subspecialist interest in Breast Surgery and Plastic Surgery Trainees. The nine 12-month fellowships are designed to give the senior trainee immersive inter-speciality exposure and experience in Oncoplastic Breast Surgery in one of the approved specialist oncoplastic breast surgery training units throughout the UK. During this time trainees are supernumerary. As well as focusing on gaining the background knowledge and operative skills required by an Oncoplastic Breast Surgeon, trainees are encouraged and supported in obtaining skills requisite for independent Consultant practice through compulsory courses and events. The fellowships were traditionally undertaken Pre-CCT award but as from 2021 applications will only be open to Post-CCT trainees.

Data collection and audit requirements

On-going, prospective audit is essential for the provision and maintenance of a high-quality OP surgical service and as a minimum, individual patient care should be audited against agreed performance indicators and target standards including clinical, cosmetic, and patient-reported outcomes.

Each unit should identify an oncoplastic audit lead and have a data manager who assumes overall responsibility for this process.

There should be a secure system in place to accurately record complications (early and late)

All patients should be asked to report outcomes, at agreed time intervals, using validated measures e.g. the 'Breast Q' questionnaire.

Summary audit data relating to key performance indicators should be presented at department audit meetings. These results should be available for scrutiny by NHS performance monitoring organisations eg the Care Quality Commission (CQC), Safety and Quality Assessment for Sustainability (SQAS), Getting it Right First Time (GiRFT) and other similar bodies.

Conclusion

Patients must be supported through decision making, surgery and recovery if they are to have good outcomes that meet their needs and expectations. Since the first UK oncoplastic guidelines were published in 2007 [123], OPBS has become standard for the surgical management of breast cancer providing good oncological outcomes and acceptable aesthetic results. Oncoplastic surgery is complex and not indicated for every patient. Careful patient selection and the most appropriate surgical technique must be considered to minimise complications and ensure low rates of local recurrence.

Complete list of quality criteria

The complete list of quality criteria set out in this guideline are provided below:

No.	Quality criteria
1	Breast Reconstruction is discussed with all suitable patients requiring a mastectomy *Target:* Breast Reconstruction is discussed in >90% of all suitable patients requiring a mastectomy
2	When a referral for OPBS is made from one MDT to another MDT, full clinical, radiological and histopathological information is made available at the time of the referral and reciprocated with a clear plan for ongoing care responsibility *Target:* Full information is available in 100% of patients referred and following treatment
3	The oncological and reconstructive management is discussed at the MDM. *Target:* The oncological and reconstructive strategy is discussed at the MDM in 100% of patients suitable for OPBS
4	Medical photography (pre- and post-operative) is part of the clinical record *Target:* Medical photography is offered in 100% of BR patients
5	Patients have access to a BCN or equivalent key worker with expertise in OPBS *Target:* Access to a key worker with expertise in OPBS and psychological assessment is available in 100% of patients
6	Patients receive information in a format and level of detail that meets their individual needs. *Target:* Information about the risks and benefits of breast reconstruction/ oncoplastic procedures are provided to 100% of patients undergoing OPBS
7	Clinical Specialist and psychological reviews take place at key points *Target:* Review by the Clinical Specialist occurs in 100% of cases
8	Physiotherapy services should be available for patients undergoing OPBS *8*: 100% availability of Physiotherapy services
9	Implant loss at 3 months following BR is assessed and audited (over 12 month period) *Target:* Complications leading to implant loss occur in <5% of cases at 3 months
10	Flap loss following BR is assessed and audited (over 3 year period) *Target*: Total free flap loss occurs in <5% of cases Pedicled Flap Loss occurs in <1%
11	Unplanned return to theatre following BR/OPBS is assessed and audited *Target:* Unplanned return to theatre occurs in <5% of cases for non-free flap IBR, and <10% of cases for free-flap IBR
12	Unplanned re-admission is assessed and audited for BR/OPBS *Target:* Unplanned readmission occurs in less than 10% of cases within 3 months
13	Post-operative complications, return to theatre and length of stay are audited *Target:* There is a regular audit and discussion of all patients with post-operative complications
14	Patients' are invited to report their satisfaction with BR/OPBS using validated outcome measures *Target:* At 18 months, > 90% of BR/OPBS patients are invited to report their satisfaction with BR/OPBS using validated outcome measures
15	Margins should be clear following OPBS/BR and this should be assessed and audited (over a 12-month period) *Target:*. Excision margins should be monitored in 100% of cases
16	Eligible patients are invited to take part in local and national clinical trials of OPBS/BR *Target:* Screening for eligibility for clinical trials and national audits occurs in 100% of OPBS/BR patients
17	Implant Breast Reconstruction patient details should be entered into the Breast Implant Registry* *Target:* 100% of Implant Based Breast Reconstruction patient details are entered into the Breast Implant Registry *(where access to registry exists)
18	Flap-based Breast Reconstruction patient details should be entered into the UK National Flap Registry* *Target:* 100% of Flap Based Breast Reconstruction patient details are entered into the UK National Flap Registry *(where access to registry exists)
19	ERAS should be adopted by all units to reduce length of stay *Target:* All units should adopt ERAS methodology

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CRediT authorship contribution statement

A. Gilmour: Study concepts, Study design, Data analysis and interpretation, Manuscript preparation, Manuscript review, Manuscript editing. **R. Cutress:** Study concepts, Study design, Data analysis and interpretation, Manuscript preparation, Manuscript review. **A. Gandhi:** Study concepts, Study design, Data analysis and interpretation, Manuscript preparation, Manuscript review, Manuscript editing. **D. Harcourt:** Study concepts, Study design, Data analysis and interpretation, Manuscript preparation, Manuscript review. **K. Little:** Study concepts, Study design, Data analysis and interpretation, Manuscript preparation, Manuscript review. **J. Mansell:** Study concepts, Study design, Data analysis and interpretation, Manuscript preparation, Manuscript review. **J. Murphy:** Study concepts, Study design, Data analysis and interpretation, Manuscript preparation, Manuscript review. **E. Pennery:** Study concepts, Study design, Data analysis and interpretation, Manuscript preparation, Manuscript review. **R. Tillett:** Study concepts, Study design, Data analysis and interpretation, Manuscript preparation, Manuscript review. **R. Vidya:** Study concepts, Study design, Data analysis and interpretation, Manuscript preparation, Manuscript review. **L. Martin:** Study concepts, Study design, Data analysis and interpretation, Manuscript preparation, Manuscript review, Manuscript editing.

Declaration of competing interest

None.

APPENDIX. SUPPORT SERVICES AND PATIENT INFORMATION

- *BAPRAS guide to breast reconstruction:* http://www.bapras.org.uk/docs/default-source/Patient-Information-Booklets/web_2018-bapras-abs-breast-recon-guide.pdf?sfvrsn=2
- *Breast Cancer Now*: https://breastcancernow.org/
- *Cancer Research UK*: https://www.cancerresearchuk.org/about-cancer/breast-cancer/treatment/surgery/breast-reconstruction
- *Healthtalkonline*: http://www.healthtalkonline.org/cancer/Breast_Cancer/Topic/1537/
- *Keeping Abreast:*
- https://www.keepingabreast.org.uk/

- Macmillan Cancer Support: https://be.macmillan.org.uk/Downloads/CancerInformation/TestsAndTreatments/MAC11660breast-recone13NlowresPDF20190425.pdf?_ga=2.121147914.34961574.1601746232-1093118154.1600159231
- Maggie's Cancer Caring Centres: www.maggiescentres.org
- Breast reconstruction: your choice. Rainsbury R. Straker V. (Eds) (2008). Class Publishing

References

[1] Guidance Platform. https://associationofbreastsurgery.org.uk/professionals/clinical/guidance-platform.
[2] Clinical guidance and regulations. https://www.bapras.org.uk/professionals/clinical-guidance.
[3] Cutress RI, Summerhayes C, Rainsbury R. Guidelines for oncoplastic breast reconstruction. Ann R Coll Surg Engl 2013;95:161–2.
[4] National Guideline A. National Institute for health and care excellence: clinical guidelines. Early and locally advanced breast cancer: diagnosis and management. London: National Institute for Health and Care Excellence (UK) Copyright © NICE; 2018.
[5] O'Connell RL, Rattay T, Dave RV, et al. The impact of immediate breast reconstruction on the time to delivery of adjuvant therapy: the iBRA-2 study. Br J Canc 2019;120:883–95.
[6] Hanna TP, King WD, Thibodeau S, et al. Mortality due to cancer treatment delay: systematic review and meta-analysis. BMJ 2020;371:m4087.
[7] De La Cruz L, Blankenship SA, Chatterjee A, et al. Outcomes after oncoplastic breast-conserving surgery in breast cancer patients: a systematic literature review. Ann Surg Oncol 2016;23:3247–58.
[8] Jagsi R, Momoh AO, Qi J, et al. Impact of radiotherapy on complications and patient-reported outcomes after breast reconstruction. J Natl Cancer Inst 2018;110:157–65.
[9] Kronowitz SJ, Hunt KK, Kuerer HM, et al. Delayed-immediate breast reconstruction. Plast Reconstr Surg 2004;113:1617–28.
[10] Fertsch S, Munder B, Hagouan M, et al. Immediate-DElayed AutoLogous (IDEAL) breast reconstruction with the DIEP flap. Chirurgia (Bucur) 2017;112:387–93.
[11] Yun JH, Diaz R, Orman AG. Breast reconstruction and radiation therapy. Canc Contr 2018;25:1073274818795489.
[12] Barry M, Kell MR. Radiotherapy and breast reconstruction: a meta-analysis. Breast Canc Res Treat 2011;127:15–22.
[13] Schaverien MV, Macmillan RD, McCulley SJ. Is immediate autologous breast reconstruction with postoperative radiotherapy good practice?: a systematic review of the literature. J Plast Reconstr Aesthetic Surg : JPRAS 2013;66:1637–51.
[14] Maalouf C, Bou-Merhi J, Karam E, Patocskai E, Danino AM. The impact of autologous breast reconstruction using DIEP flap on the oncologic efficacy of radiation therapy. Ann Chir Plast Esthet 2017;62:630–6.
[15] National guidelines. https://www.imi.org.uk/resources/professional-resources/national-guidelines/.
[16] Yung R, Ray RM, Roth J, et al. The association of delay in curative intent treatment with survival among breast cancer patients: findings from the Women's Health Initiative. Breast Canc Res Treat 2020;180:747–57.
[17] Barr SP, Topps AR, Barnes NL, et al. Infection prevention in breast implant surgery - a review of the surgical evidence, guidelines and a checklist. Eur J Surg Oncol 2016;42:591–603.
[18] Cuzick J, Forbes J, Edwards R, et al. First results from the international breast cancer intervention study (IBIS-I): a randomised prevention trial. Lancet 2002;360:817–24.
[19] Andtbacka RH, Babiera G, Singletary SE, et al. Incidence and prevention of venous thromboembolism in patients undergoing breast cancer surgery and treated according to clinical pathways. Ann Surg 2006;243:96–101.
[20] Kim JY, Khavanin N, Rambachan A, et al. Surgical duration and risk of venous thromboembolism. JAMA Surg 2015;150:110–7.
[21] NICE. Venous thromboembolism in over 16s: reducing the risk of hospital-acquired deep vein thrombosis or pulmonary embolism. NG89; 2018.
[22] Hussain T, Kneeshaw PJ. Stopping tamoxifen peri-operatively for VTE risk reduction: a proposed management algorithm. Int J Surg 2012;10:313–6.
[23] Baumann DP, Crosby MA, Selber JC, et al. Optimal timing of delayed free lower abdominal flap breast reconstruction after postmastectomy radiation therapy. Plast Reconstr Surg 2011;127:1100–6.
[24] Abbott A, Rueth N, Pappas-Varco S, Kuntz K, Kerr E, Tuttle T. Perceptions of contralateral breast cancer: an overestimation of risk. Ann Surg Oncol 2011;18:3129–36.
[25] Basu NN, Ross GL, Evans DG, Barr L. The Manchester guidelines for contralateral risk-reducing mastectomy. World J Surg Oncol 2015;13:237.
[26] Guideline for the role of practitioner psychologists in the assessment and support of women considering risk-reducing breast surgery. https://www.bps.org.uk/sites/www.bps.org.uk/files/Policy/Policy%20-%20Files/Guidelines%20for%20the%20role%20of%20practitioner%20psychologists%20in%20the%20assessment%20and%20support%20of%20women%20considering%20risk-reducing%20breast%20surgery.pdf; 2018.
[27] Sheehan J, Sherman KA, Lam T, Boyages J. Association of information satisfaction, psychological distress and monitoring coping style with post-decision regret following breast reconstruction. Psycho Oncol 2007;16:342–51.
[28] Someone like me. https://breastcancernow.org/information-support/support-you/someone-me.
[29] Paraskeva N, Herring B, Tollow P, Harcourt D. First look: a mixed-methods study exploring women's initial experiences of their appearance after mastectomy and/or breast reconstruction(☆). J Plast Reconstr Aesthetic Surg : JPRAS 2019;72:539–47.
[30] Grabinski VF, Myckatyn TM, Lee CN, Philpott-Streiff SE, Politi MC. Importance of shared decision-making for vulnerable populations: examples from postmastectomy breast reconstruction. Health Equity 2018;2:234–8.
[31] Decision making and consent. https://www.gmc-uk.org/ethical-guidance/ethical-guidance-for-doctors/decision-making-and-consent.
[32] Harcourt D, Griffiths C, Baker E, Hansen E, White P, Clarke A. The acceptability of PEGASUS: an intervention to facilitate shared decision-making with women contemplating breast reconstruction. Psychol Health Med 2016;21:248–53.
[33] Paraskeva N, Guest E, Lewis-Smith H, Harcourt D. Assessing the effectiveness of interventions to support patient decision making about breast reconstruction: a systematic review. Breast 2018;40:97–105.
[34] Berlin NL, Tandon VJ, Hawley ST, et al. Feasibility and efficacy of decision aids to improve decision making for postmastectomy breast reconstruction: a systematic review and meta-analysis. Med Decis Making 2019;39:5–20.
[35] Mahoney B, Walklet E, Bradley E, et al. Experiences of implant loss after immediate implant-based breast reconstruction: qualitative study. BJS Open 2020;4:380–90.
[36] Association of breast surgery consensus statement: margin width in breast conservation surgery. https://associationofbreastsurgery.org.uk/media/64245/final-margins-consensus-statement.pdf; 2015.
[37] Jakub JW, Peled AW, Gray RJ, et al. Oncologic safety of prophylactic nipple-sparing mastectomy in a population with BRCA mutations: a multi-institutional study. JAMA Surg 2018;153:123–9.
[38] Manning AT, Wood C, Eaton A, et al. Nipple-sparing mastectomy in patients with BRCA1/2 mutations and variants of uncertain significance. Br J Surg 2015;102:1354–9.
[39] Valero MG, Moo TA, Muhsen S, et al. Use of bilateral prophylactic nipple-sparing mastectomy in patients with high risk of breast cancer. Br J Surg 2020;107:1307–12.
[40] Valero MG, Muhsen S, Moo TA, et al. Increase in utilization of nipple-sparing mastectomy for breast cancer: indications, complications, and oncologic outcomes. Ann Surg Oncol 2020;27:344–51.
[41] van Verschuer VM, Maijers MC, van Deurzen CH, Koppert LB. Oncological safety of prophylactic breast surgery: skin-sparing and nipple-sparing versus total mastectomy. Gland Surg 2015;4:467–75.
[42] Yao K, Liederbach E, Tang R, et al. Nipple-sparing mastectomy in BRCA1/2 mutation carriers: an interim analysis and review of the literature. Ann Surg Oncol 2015;22:370–6.
[43] Mota BS, Riera R, Ricci MD, et al. Nipple- and areola-sparing mastectomy for the treatment of breast cancer. Cochrane Database Syst Rev 2016;11:1465–858.
[44] Gradishar WJ, Anderson BO, Balassanian R, et al. Invasive breast cancer version 1.2016, NCCN clinical practice guidelines in oncology. J Natl Compr Canc Netw 2016;14:324–54.
[45] Rinker B. A comparison of methods to assess mastectomy flap viability in skin-sparing mastectomy and immediate reconstruction: a prospective cohort study. Plast Reconstr Surg 2016;137:395–401.
[46] Torresan RZ, dos Santos CC, Okamura H, Alvarenga M. Evaluation of residual glandular tissue after skin-sparing mastectomies. Ann Surg Oncol 2005;12:1037–44.
[47] Robertson SA, Rusby JE, Cutress RI. Determinants of optimal mastectomy skin flap thickness. Br J Surg 2014;101:899–911.
[48] Cao D, Tsangaris TN, Kouprina N, et al. The superficial margin of the skin-sparing mastectomy for breast carcinoma: factors predicting involvement and efficacy of additional margin sampling. Ann Surg Oncol 2008;15:1330–40.
[49] Griepsma M, de Roy van Zuidewijn DB, Grond AJ, Siesling S, Groen H, de Bock GH. Residual breast tissue after mastectomy: how often and where is it located? Ann Surg Oncol 2014;21:1260–6.
[50] Bennett KG, Qi J, Kim HM, Hamill JB, Pusic AL, Wilkins EG. Comparison of 2-year complication rates among common techniques for postmastectomy breast reconstruction. JAMA Surg 2018;153:901–8.
[51] Padubidri AN, Yetman R, Browne E, et al. Complications of postmastectomy breast reconstructions in smokers, ex-smokers, and nonsmokers. Plast Reconstr Surg 2001;107:342–349; discussion 50-1.
[52] Davies K, Allan L, Roblin P, Ross D, Farhadi J. Factors affecting post-operative complications following skin sparing mastectomy with immediate breast reconstruction. Breast 2011;20:21–5.
[53] Meretoja TJ, von Smitten KA, Kuokkanen HO, Suominen SH, Jahkola TA. Complications of skin-sparing mastectomy followed by immediate breast reconstruction: a prospective randomized study comparing high-frequency radiosurgery with conventional diathermy. Ann Plast Surg 2008;60:24–8.
[54] González EG, Rancati AO. Skin-sparing mastectomy. Gland Surg 2015;4:

541–53.
[55] Didier F, Arnaboldi P, Gandini S, et al. Why do women accept to undergo a nipple sparing mastectomy or to reconstruct the nipple areola complex when nipple sparing mastectomy is not possible? Breast Canc Res Treat 2012;132:1177–84.
[56] Didier F, Radice D, Gandini S, et al. Does nipple preservation in mastectomy improve satisfaction with cosmetic results, psychological adjustment, body image and sexuality? Breast Canc Res Treat 2009;118:623–33.
[57] Tokin C, Weiss A, Wang-Rodriguez J, Blair SL. Oncologic safety of skin-sparing and nipple-sparing mastectomy: a discussion and review of the literature. Int J Surg Oncol 2012;2012:921821.
[58] Manning AT, Sacchini VS. Conservative mastectomies for breast cancer and risk-reducing surgery: the Memorial Sloan Kettering Cancer Center experience. Gland Surg 2016;5:55–62.
[59] Rusby JE, Brachtel EF, Taghian A, Michaelson JS, Koerner FC, Smith BL. George Peters Award. Microscopic anatomy within the nipple: implications for nipple-sparing mastectomy. Am J Surg 2007;194:433–7.
[60] Orzalesi L, Casella D, Santi C, et al. Nipple sparing mastectomy: surgical and oncological outcomes from a national multicentric registry with 913 patients (1006 cases) over a six year period. Breast 2016;25:75–81.
[61] Algaithy ZK, Petit JY, Lohsiriwat V, et al. Nipple sparing mastectomy: can we predict the factors predisposing to necrosis? Eur J Surg Oncol 2012;38:125–9.
[62] Shimo A, Tsugawa K, Tsuchiya S, et al. Oncologic outcomes and technical considerations of nipple-sparing mastectomies in breast cancer: experience of 425 cases from a single institution. Breast Cancer 2016;23:851–60.
[63] Ahn SJ, Woo TY, Lee DW, Lew DH, Song SY. Nipple-areolar complex ischemia and necrosis in nipple-sparing mastectomy. Eur J Surg Oncol 2018;44:1170–6.
[64] Park S, Yoon C, Bae SJ, et al. Comparison of complications according to incision types in nipple-sparing mastectomy and immediate reconstruction. Breast 2020;53:85–91.
[65] Galimberti V, Vicini E, Corso G, et al. Nipple-sparing and skin-sparing mastectomy: review of aims, oncological safety and contraindications. Breast 2017;34(1). S82-s4.
[66] Perry N, Broeders M, de Wolf C, Törnberg S, Holland R, von Karsa L. European guidelines for quality assurance in breast cancer screening and diagnosis. Office for Official Publications of the European Communities, Luxembourg: European Commission; 2006.
[67] Layfield DM, May DJ, Cutress RI, et al. The effect of introducing an in-theatre intra-operative specimen radiography (IOSR) system on the management of palpable breast cancer within a single unit. Breast 2012;21:459–63.
[68] Potter S, Conroy EJ, Cutress RI, et al. Short-term safety outcomes of mastectomy and immediate implant-based breast reconstruction with and without mesh (iBRA): a multicentre, prospective cohort study. Lancet Oncol 2019;20:254–66.
[69] Coroneos CJ, Selber JC, Offodile 2nd AC, Butler CE, Clemens MW. US FDA breast implant postapproval studies: long-term outcomes in 99,993 patients. Ann Surg 2019;269:30–6.
[70] Mennie JC, Mohanna PN, O'Donoghue JM, Rainsbury R, Cromwell DA. National trends in immediate and delayed post-mastectomy reconstruction procedures in England: a seven-year population-based cohort study. Eur J Surg Oncol 2017;43:52–61.
[71] Ho G, Nguyen TJ, Shahabi A, Hwang BH, Chan LS, Wong AK. A systematic review and meta-analysis of complications associated with acellular dermal matrix-assisted breast reconstruction. Ann Plast Surg 2012;68:346–56.
[72] England R. National mastectomy and breast reconstruction audit. 2011.
[73] Knight HJ, Musgrove JJ, Youssef MMG, Ferguson DJ, Olsen SB, Tillett RL. Significantly reducing implant loss rates in immediate implant-based breast reconstruction: a protocol and completed audit of quality assurance. J Plast Reconstr Aesthetic Surg : JPRAS 2020;73:1043–9.
[74] Heidemann LN, Gunnarsson GL, Salzberg CA, Sørensen JA, Thomsen JB. Complications following nipple-sparing mastectomy and immediate acellular dermal matrix implant-based breast reconstruction-A systematic review and meta-analysis. Plast Reconstr Surg Glob Open 2018;6:e1625.
[75] Dave RV, Vucicevic A, Barrett E, et al. Risk factors for complications and implant loss after prepectoral implant-based immediate breast reconstruction: medium-term outcomes in a prospective cohort. BJS (British Journal of Surgery);n/a.
[76] Agency MaHpR. Symptoms sometimes referred to as breast implant illness. 2020.
[77] Group Ir. Silicone gel breast implants: the report of the Independent Review Group. 1998.
[78] Swerdlow SH, Campo E, Pileri SA, et al. The 2016 revision of the World Health Organization classification of lymphoid neoplasms. Blood 2016;127:2375–90.
[79] Advice regarding breast implant safety - joint statement. http://www.bapras.org.uk/docs/default-source/alcl-guidance/25_11_final-joint-statement.pdf?sfvrsn=2; 2018.
[80] Breast and cosmetic implant registry (BCIR). https://digital.nhs.uk/data-and-information/clinical-audits-and-registries/breast-and-cosmetic-implant-registry; 2016.
[81] Care DoHaS. Review of the regulation of cosmetic interventions: final report. In: Care DoHaS; 2013.
[82] Wormald JC, Wade RG, Figus A. The increased risk of adverse outcomes in bilateral deep inferior epigastric artery perforator flap breast reconstruction compared to unilateral reconstruction: a systematic review and meta-analysis. J Plast Reconstr Aesthetic Surg : JPRAS 2014;67:143–56.
[83] Unukovych D, Gallego CH, Aineskog H, Rodriguez-Lorenzo A, Mani M. Predictors of reoperations in deep inferior epigastric perforator flap breast reconstruction. Plastic Reconstruct Surg Global Open 2016;4:e1016-e.
[84] Delay E, Guerid S, Meruta AC. Indications and controversies in lipofilling for partial breast reconstruction. Clin Plast Surg 2018;45:101–10.
[85] Pérez-Cano R, Vranckx JJ, Lasso JM, et al. Prospective trial of adipose-derived regenerative cell (ADRC)-enriched fat grafting for partial mastectomy defects: the RESTORE-2 trial. Eur J Surg Oncol 2012;38:382–9.
[86] Khan LR, Raine CR, Dixon JM. Immediate lipofilling in breast conserving surgery. Eur J Surg Oncol 2017;43:1402–8.
[87] Biazus JV, Falcão CC, Parizotto AC, et al. Immediate reconstruction with autologous fat transfer following breast-conserving surgery. Breast J 2015;21:268–75.
[88] Delay E, Guerid S. The role of fat grafting in breast reconstruction. Clin Plast Surg 2015;42:315–23.
[89] Masià J. The largest multicentre data collection on prepectoral breast reconstruction: the iBAG study. J Surg Oncol 2020;122:848–60.
[90] Rigotti G, Marchi A, Galiè M, et al. Clinical treatment of radiotherapy tissue damage by lipoaspirate transplant: a healing process mediated by adipose-derived adult stem cells. Plast Reconstr Surg 2007;119:1409–22.
[91] Delay E, Meruta AC, Guerid S. Indications and controversies in total breast reconstruction with lipomodeling. Clin Plast Surg 2018;45:111–7.
[92] Krishnamurthy R, Whitman GJ, Stelling CB, Kushwaha AC. Mammographic findings after breast conservation therapy. Radiographics 1999;19:S53–62.
[93] Guidance on screening and symptomatic breast imaging. https://www.rcr.ac.uk/publication/guidance-screening-and-symptomatic-breast-imaging-fourth-edition; 2019. fourth ed.
[94] Temple-Oberle C, Shea-Budgell MA, Tan M, et al. Consensus review of optimal perioperative care in breast reconstruction: enhanced recovery after surgery (ERAS) society recommendations. Plast Reconstr Surg 2017;139:1056e-71e.
[95] Jacobs A, Lemoine A, Joshi GP, Van de Velde M, Bonnet F. PROSPECT guideline for oncological breast surgery: a systematic review and procedure-specific postoperative pain management recommendations. Anaesthesia 2020;75:664–73.
[96] Ilonzo N, Tsang A, Tsantes S, Estabrook A, Thu Ma AM. Breast reconstruction after mastectomy: a ten-year analysis of trends and immediate postoperative outcomes. Breast 2017;32:7–12.
[97] Fitzgerald O'Connor E, Rozen WM, Chowdhry M, Band B, Ramakrishnan VV, Griffiths M. Preoperative computed tomography angiography for planning DIEP flap breast reconstruction reduces operative time and overall complications. Gland Surg 2016;5:93–8.
[98] Bilku DK, Dennison AR, Hall TC, Metcalfe MS, Garcea G. Role of preoperative carbohydrate loading: a systematic review. Ann R Coll Surg Engl 2014;96:15–22.
[99] Nwaogu I, Yan Y, Margenthaler JA, Myckatyn TM. Venous thromboembolism after breast reconstruction in patients undergoing breast surgery: an American college of surgeons NSQIP analysis. J Am Coll Surg 2015;220:886–93.
[100] Craft RO, Damjanovic B, Colwell AS. Evidence-based protocol for infection control in immediate implant-based breast reconstruction. Ann Plast Surg 2012;69:446–50.
[101] Berry AR, Watt B, Goldacre MJ, Thomson JW, McNair TJ. A comparison of the use of povidone-iodine and chlorhexidine in the prophylaxis of postoperative wound infection. J Hosp Infect 1982;3:55–63.
[102] Hardwicke JT, Bechar J, Skillman JM. Are systemic antibiotics indicated in aesthetic breast surgery? A systematic review of the literature. Plast Reconstr Surg 2013;131:1395–403.
[103] Huang N, Liu M, Yu P, Wu J. Antibiotic prophylaxis in prosthesis-based mammoplasty: a systematic review. Int J Surg 2015;15:31–7.
[104] Drinane JJ, Bergman RS, Folkers BL, Kortes MJ. Revisiting triple antibiotic irrigation of breast implant pockets: a placebo-controlled single practice cohort study. Plast Reconstr Surg Glob Open 2013;1:e55.
[105] Kim SY, Song JW, Park B, Park S, An YJ, Shim YH. Pregabalin reduces postoperative pain after mastectomy: a double-blind, randomized, placebo-controlled study. Acta Anaesthesiol Scand 2011;55:290–6.
[106] Gatherwright J, Knackstedt RW, Ghaznavi AM, et al. Prospective, randomized, controlled comparison of bupivacaine versus liposomal bupivacaine for pain management after unilateral delayed deep inferior epigastric perforator free flap reconstruction. Plast Reconstr Surg 2018;141:1327–30.
[107] Roberts I, Shakur H, Coats T, et al. The CRASH-2 trial: a randomised controlled trial and economic evaluation of the effects of tranexamic acid on death, vascular occlusive events and transfusion requirement in bleeding trauma patients. Health Technol Assess 2013;17:1–79.
[108] Oertli D, Laffer U, Haberthuer F, Kreuter U, Harder F. Perioperative and postoperative tranexamic acid reduces the local wound complication rate after surgery for breast cancer. Br J Surg 1994;81:856–9.
[109] Ker K, Edwards P, Perel P, Shakur H, Roberts I. Effect of tranexamic acid on surgical bleeding: systematic review and cumulative meta-analysis. BMJ Br Med J (Clin Res Ed) 2012;344:e3054.
[110] Rohrich RJ, Cho MJ. The role of tranexamic acid in plastic surgery: review and technical considerations. Plast Reconstr Surg 2018;141:507–15.

[111] Knight H, Banks J, Muchmore J, Ives C, Green M. Examining the use of intraoperative tranexamic acid in oncoplastic breast surgery. Breast J 2019;25:1047–9.
[112] Daltrey I, Thomson H, Hussien M, Krishna K, Rayter Z, Winters ZE. Randomized clinical trial of the effect of quilting latissimus dorsi flap donor site on seroma formation. Br J Surg 2006;93:825–30.
[113] Mohan AT, Rammos CK, Gaba P, et al. Modified aesthetic abdominoplasty approach in perforator free-flap breast reconstruction: impact of drain free donor site on patient outcomes. J Plast Reconstr Aesthetic Surg 2015;68:800–9.
[114] Taghizadeh R, Shoaib T, Hart AM, Weiler-Mithoff EM. Triamcinolone reduces seroma re-accumulation in the extended latissimus dorsi donor site. J Plast Reconstr Aesthetic Surg : JPRAS 2008;61:636–42.
[115] Nelson JA, Fischer JP, Grover R, et al. Intraoperative vasopressors and thrombotic complications in free flap breast reconstruction. J Plast Surg Hand Surg 2017;51:336–41.
[116] Galiano RD, Hudson D, Shin J, et al. Incisional negative pressure wound therapy for prevention of wound healing complications following reduction mammaplasty. Plast Reconstr Surg Glob Open 2018;6:e1560.
[117] Matusiak D, Wichtowski M, Pieszko K, Kobylarek D, Murawa D. Is negative-pressure wound therapy beneficial in modern-day breast surgery? Contemp Oncol 2019;23:69–73.
[118] Holt R, Murphy J. PICO™ incision closure in oncoplastic breast surgery: a case series. Br J Hosp Med 2015;76:217–23.
[119] Gabriel A, Sigalove SR, Maxwell GP. Initial experience using closed incision negative pressure therapy after immediate postmastectomy breast reconstruction. Plast Reconstr Surg Glob Open 2016;4:e819.
[120] Gabriel A, Maxwell GP. Economic analysis based on the use of closed-incision negative-pressure therapy after postoperative breast reconstruction. Plast Reconstr Surg 2019;143:36s–40s.
[121] Irwin GW, Boundouki G, Fakim B, et al. Negative pressure wound therapy reduces wound breakdown and implant loss in prepectoral breast reconstruction. Plastic Reconstruct Sur Global Open 2020;8:e2667.
[122] PICO negative pressure wound dressings for closed surgical incisions Medical technologies guidance [MTG43]. https://www.nice.org.uk/guidance/mtg43; 2019.
[123] Baildam A, Bishop H, Boland G, et al. Oncoplastic breast surgery–a guide to good practice. Eur J Surg Oncol 2007;33(1):S1–23.