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Review

Breast imaging for aesthetic surgery: British Society of Breast Radiology (BSBR), Association of Breast Surgery Great Britain & Ireland (ABS), British Association of Plastic Reconstructive and Aesthetic Surgeons (BAPRAS)



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Aesthetic/cosmetic breast surgery; Imaging guidance; Mammography; Breast ultrasound; Breast implants; Reduction mammoplasty

Summary This is an overview of the guidelines for breast imaging before and after aesthetic (cosmetic) breast surgery, which includes but is not limited to implants, lipomodelling and mammoplasty procedures. The guidelines are based on a review of the literature and consensus of breast imaging and aesthetic breast surgery specialists.

1. Pre-aesthetic surgery

- All women should undergo a full breast history and clinical examination.
- Abnormal or uncertain clinical assessment (e.g. family history or other related risk, breast symptoms and uncertain examination findings) requires specialist breast assessment in a recognised breast facility.
- Normal clinical assessment in women with no personal or family history of breast cancer or other related risk:
 - < 40 years: Routine preoperative imaging not recommended.
 - ≥ 40 years: Two-view mammography of both breasts recommended provided no mammography in the preceding 12 months. Adjunctive ultrasound (US) may be considered in women with dense breasts.
- In general, men do not require preoperative breast imaging unless there is a clear clinical indication at the initial assessment.

2. Post-aesthetic surgery

- Routine breast imaging (e.g. annual breast US or MRI of implants) is not indicated.
- If clinical concerns arise during aesthetic follow-up, specialist breast assessment in a recognised breast facility is recommended.
- Mammographic screening should follow National Health Service (NHS) guidelines and be appropriate for a woman's age and breast cancer risk.

If breast imaging or breast assessment is required, it should be performed in a designated breast facility with access to specialist breast imaging and a complete breast multidisciplinary team in accordance with national guidelines and recommendations.

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Introduction

Aesthetic breast surgery is now performed routinely throughout the UK. The main aesthetic breast procedures offered are:

- Breast augmentation (enlargement) with either implants or a patient's own fat
- Breast mammoplasty: usually breast reduction with an uplift (mastopexy), sometimes with insertion of a supporting mesh.

The past decade has overall seen an increasing demand for aesthetic procedures; in 2015, more than 9600 breast augmentations and 5450 breast reductions were performed by BAAPS surgeons, with increases of 12% and 13%, respectively, on the previous year.¹ The most recent figures, however, show a decline in demand for these procedures during 2016, and this has been attributed to multiple factors.²

Most aesthetic breast surgeries are performed on women, but a significant number of men also seek aesthetic surgery including breast reduction for gynaecomastia; in 2015, 796 breast reduction procedures were performed on men in the UK, with an increase of 13% on the previous year.¹ Again, 2016 saw a decline in the number of males undergoing aesthetic surgery, but the proportion of males to females undergoing aesthetic surgery has remained stable.²

A potential complicating factor associated with aesthetic surgical procedures is the incidental discovery of significant breast pathology such as breast cancer or 'risk' lesions (lesions of uncertain malignant potential). Breast cancer is a common female malignancy and occurs in approximately 55,000 women each year in the UK³ but is rare in men, occurring in approximately 400 men each year in the UK.⁴ It

is important that any surgeon performing aesthetic breast surgery has clear guidance on how to manage incidental breast disease.

If changes in the breast are detected by the clinician during preoperative clinical assessment, then these changes should be investigated and managed before any aesthetic procedure takes place. But if clinical assessment is normal and an abnormality is discovered during the surgical procedure, or post-operatively on breast tissue histology (usually after breast reduction surgery), this can complicate subsequent oncological and aesthetic management, particularly if the pathology is malignant or falls into the grey area of 'benign but of uncertain malignant potential'.

Although identifying incidental cancers intraoperatively is rarely reported, there are a number of reports of breast pathology being identified in the early post-operative period, usually because of routine pathological analysis of reduction mammoplasty specimens.⁵

The intention of breast imaging before aesthetic surgery is to diagnose or exclude clinically occult breast cancer or lesions of uncertain malignant potential. Routine imaging before aesthetic surgery has been advocated in the past, but there is currently little supporting evidence and no consensus with regard to timing or appropriate imaging modalities.

Concerns about the increasing incidence of breast cancer,³ increasing number of aesthetic breast procedures and difficulties in post aesthetic surgery imaging have created the need to provide guidance. However, the rate of incidental cancer detection in patients undergoing aesthetic breast procedures is small, and the potential benefits of routine imaging before the procedure need to be weighed against the drawbacks.

Statement of purpose

This guidance has been produced on behalf of the British Society of Breast Radiology (BSBR), Association of Breast Surgery (ABS) and British Association of Plastic Reconstructive and Aesthetic Surgeons (BAPRAS). The guidance is based on a review of the limited evidence available together with specialist expert opinion (level IV) in breast imaging and aesthetic breast surgery.

It is intended to provide aesthetic breast surgeons and breast radiologists with consensus recommendations for appropriate breast imaging both before and after cosmetic breast surgery, either in the private sector or in the National Health Service (NHS). Some of the recommendations may be relevant outside of the UK.

The guidance draws on the available literature to estimate the incidental detection of breast cancers (and lesions of uncertain malignant potential) in women and men undergoing different types of aesthetic breast surgery and considers how this may complicate further management of such lesions. It also considers the indications for, and challenges of, routine breast imaging following aesthetic breast surgery. The guidance focuses mainly on breast reduction surgery and breast implant augmentation, the most commonly performed aesthetic breast operations. Such cosmetic surgery is no longer freely available through the NHS but commissioned on an individual exceptional funding request. Most cosmetic breast surgery now takes place in the private sector.

By standardising the indications for breast imaging before and after aesthetic surgery, the aims of the guidance are:

1. To optimise identification of incidental breast cancers or lesions of uncertain malignant potential prior to aesthetic surgery, thereby minimising the discovery of such lesions during or shortly after aesthetic breast surgery.
2. To ensure cross-specialty agreement on the indications for breast imaging after aesthetic breast surgery.

This document complements the Keogh Review of The Regulation of Cosmetic Interventions published in April 2013⁶ and the Royal College of Surgeons (England) Professional Standards for Cosmetic Surgery published in April 2016,⁷ both of which aim to protect patients and raise standards in cosmetic surgery.

Estimated breast cancer prevalence in those undergoing aesthetic surgery

Breast cancer risk is linked to many factors such as parity and lactation, a positive family history and breast density, but incidence is most strongly associated with age. Between 2011 and 2013, the breast cancer incidence in UK women aged 35-39 years was 0.6/1000, increasing to 2.2/1000 between ages 45 and 49 years and reaching 4.5/1000 by ages 85-89 years.³

The risk of incidentally detected breast cancer in women undergoing reduction mammoplasty has been estimated in a recent UK study of 1400 patients.⁵ This procedure was carried out in relatively young women; the average age of women in this study was 39 years, with 40% under 35 years.

The overall rate of incidental cancers (invasive disease and ductal carcinoma in situ; DCIS) in the pathological specimens was 0.65%, and all cancers occurred in patients older than 35 years. Those with a previous history of breast cancer were 4.3 times more likely to have an incidental breast cancer than those with no previous history. The authors also reviewed 14 other studies and found an incidental cancer detection rate in reduction mammoplasty specimens of between 0.05% and 1.8%.⁵ The wide range in incidental cancer detection rates in mammoplasty specimens may reflect variations in study methodology, small sample sizes and inconsistent definitions of what constitutes cancer. Some reviewed studies restricted the term cancer to mean invasive disease only and therefore excluded DCIS, which, in the UK, is regarded as a malignant lesion. Other studies included lobular carcinoma in situ (LCIS) as a malignant lesion, whereas in the UK, this is managed as a risk lesion of 'benign but of uncertain malignant potential'.

Another recent study, from the United States, evaluated 595 patients undergoing reduction mammoplasty.⁸ The average age of patients was 44.6 years, and 3% of women were younger than 40 years. 'Significant pathologic findings' (carcinoma and atypical hyperplasia) were found in 9.8% of patients, with carcinoma found in 2.4% of all patients. No cancer was identified in patients younger than 40 years, with a carcinoma detection rate of 3.6% in patients aged 40 years or older, and 4.3% in patients aged 50 years or older.

The above figures may be an underestimate because, owing to the large volume of tissue excised, only a small proportion is actually examined under the microscope.⁹

Cancer prevalence for those undergoing augmentation procedures is more difficult to estimate, but given that women undergoing augmentation are generally younger than those undergoing breast reduction, one would expect, if anything, cancer prevalence to be lower.

Women with a personal history of breast surgery and/or breast radiotherapy for breast cancer may also seek aesthetic breast surgery, and this may affect recommendations regarding these procedures. The surgeon is encouraged to ensure that they have full information detailing the specifics of cancer histology, stage, treatments and surveillance programme. It would be reasonable to seek patient permission to communicate with the treating unit so that the surgeon can better advise about the risks and benefits of aesthetic surgery. Patients should have had a surveillance mammogram within the last 12 months.

Male aesthetic breast surgery

Men may also seek cosmetic breast surgery, typically breast reduction for gynaecomastia. Although there are a myriad of recognised causes for gynaecomastia, it is commonly idiopathic. Among the recognised causes, men may develop excessive tissue in the breast area owing to the side effects of hormonal treatments for prostate cancer and/or obesity. Those men who seek breast reduction surgery after prostate cancer treatments tend to be considerably older than women who undergo similar procedures, so require the same careful clinical assessment. But with rising obesity, younger men may increasingly seek breast reduction surgery

after bariatric surgery. Breast cancer in males is rare, so routine pre-surgery imaging is not justified.

Challenges in breast cancer diagnosis before, during and after aesthetic breast surgery

There are a number of potential challenges in detecting and/or managing breast cancers in patients who are either undergoing, or who have undergone, aesthetic breast surgery. The specific challenges may be influenced by the type of surgery carried out.

Issues related to mammoplasty surgery

Breast reduction surgery removes the breast tissue and skin to reduce the size of the breast. The practice of sending the excised breast tissue for routine pathological analysis varies across centres, but if tissue is sent, an incidental cancer or lesion of uncertain malignant potential may be found.¹⁰

Breast reduction usually results in major tissue displacement and rearrangement such that subsequent oncological management can be complicated and may even limit options for breast-conserving surgery because:

- The excised breast tissue may not have been orientated; therefore, accurate disease location, or location of any potential residual disease, may not be known.¹⁰ This may result in more radical surgery than would have otherwise been necessary if the disease had been diagnosed preoperatively.¹⁰⁻¹²
- The remaining native breast tissue may have been rearranged and the vascularity disrupted, potentially making timely surgery for cancer challenging and more prone to complications such as wound infections, bleeding, fat necrosis and nipple necrosis.
- Assessing residual disease extent on imaging following any type of aesthetic breast procedure can be difficult owing to the alteration in appearances of the breasts, particularly if no preoperative imaging is available for comparison.

Although breast reduction may decrease the risk of breast cancer (albeit by a very small amount),¹³ breast imaging following breast reduction may be complicated owing to tissue displacement and disruption and any associated tissue ischaemia. This can lead to a variety of changes on mammography, including densities, tissue distortion and calcifications. Some of these imaging features can be nonspecific and create diagnostic uncertainty, although in practice, this does not seem to increase recall rates or compromise analysis of screening mammograms.¹³

Issues related to breast augmentation with implants

Implants may be placed in a subpectoral/dual plane or subglandular position. In general, the breast tissue is not removed, but the breast skin envelope may be reduced.

Augmentation-mastopexy is a complex procedure combining breast reduction principles and augmentation, either as a single or a two-stage procedure.

Augmentation is usually carried out in two age groups; young nulliparous women with breast hypoplasia and slightly older women who seek to rejuvenate the 'empty' breast associated with multiparity, lactation and involution.

Challenges of image interpretation in breasts with implants

A specific issue with interpretation of post-implant augmentation mammography is that implants are radiopaque and can obscure a significant proportion of the breast, potentially masking lesions. Patients should be informed of this in their preoperative consultations. Implants cause displacement and compression of the native breast tissue, which can make it difficult to identify more subtle features of malignancy such as architectural distortion. Methods to improve mammographic imaging of the implanted breast include displacement (Eklund) views, which involve displacing the implant posteriorly against the chest wall, allowing more breast tissue to be pulled in front of the implant, increasing the amount of visible breast tissue and allowing a greater degree of compression.¹⁴ Despite this, there is still a risk that significant lesions can be obscured by implants, with factors such as capsular contracture making displacement views difficult.¹⁵ Furthermore, the extra displacement views are done in addition to standard views, increasing radiation exposure and examination time. In the UK, some mammographers may be inexperienced in obtaining displacement views; however, in the NHS Breast Screening Programme (NHSBSP), it is now mandatory to offer Eklund views to all women with breast implants.¹⁶

Breast implants and breast cancer

Women with breast implants who present with symptoms or signs potentially related to the breast tissue should be managed according to published guidelines¹⁷ and local protocols.

In terms of breast screening, there is no indication to offer more frequent screening to women after breast augmentation surgery, as cosmetic implants are not associated with an increased risk of breast cancer,^{18,19} and despite concerns that implants may obscure the mammographic detection of small lesions, women with implants who subsequently develop breast cancer do not seem to have worse cancer outcomes.²⁰ The findings of a recent meta-analysis and systematic literature review do suggest later stage presentation and reduced survival in those with implants;²¹ however, this review is limited by its retrospective analysis of small studies with significant selection bias; therefore, the results should be interpreted with caution.

Imaging for breast implant integrity

Approximately 10% of implants will have leakage or rupture by 10 years and the majority by 20 years.²² Silicone leak is not thought to be harmful; hence, in the absence of symptoms, breast implants do not require routine imaging to check their integrity.

However, if there is clinical concern regarding possible implant rupture, ultrasound should be performed in the first instance. If ultrasound assessment is not definitive, or if

there is persisting clinical concern, non-contrast implant protocol breast MRI is appropriate. Unless there is unequivocal ultrasound evidence of implant rupture, breast MRI should be performed before surgery to replace or remove implants for implant rupture.

Safety of mammography following implant breast augmentation

There is a very small chance that mammography may cause implant rupture or exacerbate implant leak or gel bleed, although there is no current reliable evidence to support this.¹⁶ All women with breast implants who are of screening age should be encouraged to attend their screening appointment. Recent guidance from the NHSBSP provides information to mammographers on how to approach mammography in women with implants and provides advice on the degree of compression to be used during the examination to minimise the possibility of damage.¹⁶ Women with specific concerns that they may have a ruptured implant are advised not to undergo screening and to consult their GP in the first instance, although screening mammography is not contraindicated in women with a known implant rupture.¹⁶

Breast implant-associated anaplastic large cell lymphoma (BIA-ALCL)

BIA-ALCL is a rare T-cell lymphoma of the implant capsule (not the breast) first reported in 1997 with an estimated annual incidence of 0.1-0.3 per 100,000 women with implants.²³ In recent years, the number of cases of BIA-ALCL reported in the literature has increased, thus suggesting that either this disease was underdiagnosed in the past or the incidence is increasing. The aetiology is poorly understood but may be the result of chronic T cell stimulation secondary to subclinical sepsis²⁴ and biofilm formation around the implant. It is most strongly associated with textured rather than smooth implants. Clinical presentation in a series of 87 patients demonstrated a median age of 54 years (28-87 years) with a median interval from implantation to diagnosis of 8 years (2-25 years). Fifty-two (59.8%) patients presented with an effusion around the implant (so-called seroma), 17 (19.5%) had a breast mass and effusion, 15 (17.2%) a breast mass only, and three (3.5%) had neither.²⁵

Establishing the diagnosis of BIA-ALCL can be challenging, with the most important factor being patient and physician awareness of the condition so that investigations can be prompt and targeted appropriately; an expert multidisciplinary approach (surgeon, radiologist and pathologist) is essential. Ultrasonography is the most effective tool to investigate late-onset effusions.²⁶ The capsule surrounding the implant may be thickened and fibrous and associated with a mass lesion or may be deceptively normal in appearance with a normal breast parenchyma. The effusion should be aspirated under ultrasound guidance and the fluid sent for cytological analysis as well as microscopy, culture and sensitivity, which can exclude other causes such as poorly differentiated carcinoma, other lymphomas and chronic inflammation. Biomarker analysis may be carried out in cases where cytology shows abnormal/atypical cells. BIA-ALCL cytology is CD30-positive and ALK-negative.

Breast augmentation with fat transfer

The transfer of autologous fat to the breasts, usually from the thighs and/or abdomen, may cause changes to the breast architecture, although it does not alter breast density significantly.²⁷ The transfer of fat results in varying degrees of fat necrosis within the breast, which can create diagnostic uncertainty for the clinician and the radiologist in subsequent breast assessments. Veber et al. found that at mammography after fat transfer augmentation, 16% of patients had microcalcifications, 9% had macrocalcifications, 25% had cystic lesions (presumed oil cysts) and 12% had features of tissue remodelling.²⁷

An experienced breast radiologist will usually recognise the classical benign imaging changes of fat transfer. Occasionally, microcalcifications and/or scar tissue may create sufficient uncertainty requiring additional investigations such as additional mammography views, ultrasound and needle biopsy. Patients should be made aware of the potentially higher likelihood of recall from screening, and the potentially increased need for biopsy, after fat transfer.

Fat transfer after breast cancer surgery

There is a hypothetical risk that injecting lipoaspirate containing adipose-derived stem cells into a breast that has already been treated for cancer could increase the risk of local recurrence, but evidence for this is weak.²⁸ Surgeons undertaking fat transfer to a breast that has previously been treated for breast cancer should be aware of and follow the lipomodelling guidelines.²⁹

Adjuncts to mammoplasty and augmentation: Acellular dermal matrices (ADMs) and meshes

There are various adjunctive materials used in cosmetic breast surgery with the potential to alter the appearance of the breasts on subsequent imaging. The two most commonly used materials are acellular dermal matrices (ADMs) and meshes. ADMs are biological decellularised soft tissue (animal or human) matrices that are typically used in breast reconstruction³⁰ and may also be used for supporting implants in aesthetic surgery.³¹ Synthetic meshes are an alternative to human or animal-derived ADMs.³² ADMs and meshes can also be used to support breast tissue following reduction mammoplasty and mastopexy to improve long-term outcomes.³³⁻³⁵

There is a paucity of published data on how these materials may affect image interpretation, but radiologists should be aware of their increasing use. AlloDerm®, a human-derived ADM, is reportedly isodense to glandular tissue on mammograms and has been found not to obscure microcalcification.^{36,37} A study on breast radiotherapy planning involving a titanium-coated polypropylene mesh (TiLoop®) found that the mesh did not produce metallic artefacts on CT and did not significantly influence the quality of the images obtained.³⁸ There is a need for a greater understanding of the impact of these materials on breast imaging.

Patients should be informed when these materials are used as part of their breast surgery and should be encouraged to be proactive in informing radiographers or radiolo-

gists at any subsequent breast imaging to reduce the risk of misinterpretation of imaging findings.

Basis for recommending breast imaging before aesthetic breast surgery

Intended advantages

The main advantage of detecting malignancy or other significant findings preoperatively is that it allows appropriate investigation and management before any aesthetic surgery is performed. Although the incidence of breast cancer is low in the generally younger cohort of patients who undergo aesthetic breast surgery, there are significant implications if a cancer is diagnosed. Apart from receiving an unexpected cancer diagnosis, further oncological management may be complicated and more radical than would have been required if diagnosed preoperatively. There are also aesthetic implications: for example, a recently implanted augmented breast may require radiotherapy after breast conservation with increased risk of capsular contracture and further surgery.³⁹

Furthermore, the fact that it is widespread practice to send reduction mammoplasty samples for pathology reflects an acceptance that a small proportion will contain an incidental cancer. An advantage of imaging before reduction mammoplasty is that it allows optimal preoperative planning should a breast cancer be detected, with potential for techniques such as therapeutic mammoplasty.

Image interpretation after aesthetic surgery may be more difficult; therefore, an additional potential benefit of imaging before surgery is to provide a baseline that may be useful for subsequent comparison to reduce additional unnecessary investigation in the future.

Disadvantages

The negative aspects of routine preoperative imaging to some extent mirror those from population-based screening programmes, for example, the risk of false-positive results, overdiagnosis and overtreatment, additional radiation exposure and other variable and subjective factors such as anxiety and pain.⁴⁰

For the women undergoing regular breast screening, many of these issues may provide little additional concern; the additional radiation exposure for most women would be limited to standard two-view mammography, a low-dose exposure.

As part of the consent process for aesthetic procedures, patients should be counselled regarding the possible outcomes of preoperative breast imaging, including the potential need for breast biopsies and the potential diagnoses.

As most aesthetic surgeries take place in the private healthcare sector and are usually funded by the patient rather than by private medical insurance, the additional cost of pre-aesthetic surgery imaging has to be considered. The actual number of healthy women requiring preoperative imaging is likely to be small, and any women who have a concerning family history and/or breast symptoms or signs, or positive findings on a pre-surgery mammogram, may be entitled to specialist NHS breast assessment. How-

ever, women who potentially require private imaging before aesthetic surgery must be made aware of any cost implications.

Age for commencing pre-surgery imaging

One of the key considerations in recommending imaging before aesthetic breast procedures is the age at which this should start. At present, there is no clear evidence to support any specific age.

In the UK-based study of reduction mammoplasty specimens,⁵ malignancies were found only in women older than 35 years. However, with regard to mammography, the risk-benefit ratio alters with advancing age as breast density decreases, sensitivity and specificity of mammography improve and radiation risk reduces. Whilst the NHSBSP currently commences routine screening from 50 years of age, the risk-benefit considerations in this population are different from those for patients who are about to undergo surgical intervention to the breast, given the potential consequences of the surgery as described above. The UK Age Trial data do in fact suggest that mammographic screening from 40 years of age reduces mortality,⁴¹ and the 2010 Best Practice Diagnostic Guidelines for Patients Presenting with Breast Symptoms,¹⁷ the NICE familial breast cancer guidelines CG164⁴² and the Royal College of Radiologists' Guidance on Screening and Symptomatic Breast Imaging,⁴³ all opt for 40 years as the age cut-off for the majority of women for whom mammography is recommended. It therefore seems reasonable to use the same cut-off for mammography before aesthetic procedures, until further evidence is available.

Breast density

Dense breast tissue is more strongly associated with an increased risk of developing malignancy than fatty breasts,^{44,45} and mammographic detection of cancers is more difficult because the dense background parenchyma can obscure lesions. In a screening population, ultrasound has been shown to increase early breast cancer detection rate and decrease interval cancer rate when used in conjunction with mammography; however, ultrasound is not recommended for use as a screening method on its own.⁴⁶ In women with dense breasts, it seems reasonable to consider adjunctive ultrasound with mammography as part of the pre-aesthetic surgery imaging package. It is acknowledged that visual assessment of breast density is subjective and prone to inter-observer variability, including when BI-RADS scoring is used;⁴⁷ however, the reporting radiologist should document in their report whether the breasts are dense.

The guidance

Section 1: Breast assessment and imaging before aesthetic breast surgery

Clinical assessment

All women, regardless of age, being considered for a breast aesthetic procedure, including lipomodelling, should

undergo a full breast history and clinical examination. Any breast symptoms or signs, e.g. breast lump, bloody nipple discharge or skin or nipple distortion, require referral for further assessment in a specialist breast unit in accordance with existing guidance for managing patients with breast symptoms.¹⁷

Family history of breast cancer or other related high-risk group

Please refer to the NICE Guidance CG164 and NHSBSP publication numbers 73 and 74 when considering women from high-risk groups.^{42,48-50}

Personal history of breast cancer

Women with a personal history of breast cancer should undergo mammography if they have not had a previous mammogram or surveillance imaging within the last 12 months.

Women 39 years or younger with no personal or family history of breast cancer, or other related high risk

If there are no breast symptoms, and clinical examination is normal, pre-surgery imaging is not required.

Women 40 years or older with no personal or family history of breast cancer, or other related high risk

If there are no breast symptoms, and clinical examination is normal, two-view mammography of both breasts is recommended before proceeding to aesthetic breast surgery if a mammogram has not been performed within the preceding 12 months.

Men

Men usually do not require pre-surgery breast imaging unless there is a clear clinical indication at the initial assessment.

Standards and utilisation of different breast imaging modalities

Mammography. Should be performed according to UK quality standards.⁵¹ All reporting radiologists should comply with the standards set by the Royal College of Radiologists.⁴³

The reporting radiologist should include a comment on breast density.

If any indeterminate or suspicious abnormalities are documented in the report, the patient should be referred for further assessment to a recognised specialist breast clinic.

Ultrasound. Ultrasound is not recommended as a routine screening tool. Ultrasound may be utilised in situations where mammography is not possible and may be considered as an adjunctive examination in women with mammographically dense breasts.

Magnetic resonance imaging. MRI is a highly sensitive imaging modality for detecting breast malignancy. However, it is not recommended for routine preoperative imaging for aesthetic breast surgery.

In women formally assessed as having a family history that confers a high risk of breast cancer (e.g. BRCA1/2 gene mutation carriers or high-risk family history), breast MRI may be reasonable if the woman is not already part of a high- or moderate-risk screening programme (see above).

Section 2: Breast imaging after aesthetic surgery

Immediate/early post-operative period

The most likely need for breast imaging in the immediate post-operative period, and during the first 12 months, will be for complications such as swelling or lumps. These are most likely to be seroma, haematoma or fat necrosis; therefore, ultrasound is the appropriate first-line imaging tool in the vast majority of cases; however, if there is clinical uncertainty, advice should be sought from a breast radiologist.

Mammography

Routine post-operative baseline mammography is not recommended, as there is no supporting evidence. Mammography is generally best avoided for at least 6 months after aesthetic surgery. Mammographic screening should follow NHSBSP guidance and be appropriate for a woman's age and breast cancer risk.

With regard to breast implants, the NHSBSP currently recommends the use of Eklund displacement views.¹⁶

Patients with breast cancer who have undergone aesthetic breast surgery should continue clinical and mammographic follow-up in line with their local MDT and unit policies. There is no indication for enhanced breast screening.

Imaging to check implant integrity

Breast implants do not require routine imaging to check the integrity of the implant.

If there is clinical concern regarding implant integrity, ultrasound should be the first-line tool.

If the ultrasound findings are equivocal, or if there is persisting clinical concern, then MRI is indicated.

Imaging and assessment for breast implant-associated anaplastic large cell lymphoma (BIA-ALCL)

Women presenting more than 12 months following implant insertion with a recent-onset fluid collection around the implant must have assessment for BIA-ALCL. Ultrasound is the most appropriate first-line investigation. Fluid must be aspirated and sent to a specialist pathology laboratory for cytological analysis as well as microscopy, culture and sensitivity. When cytology is abnormal, and suspicion of BIA-ALCL is raised, CD30 and ALK analysis should be carried out. MRI may be required to assess the presence of a mass lesion in the capsule and or surrounding tissues. PET/CT imaging is currently a standard staging investigation for those with a positive diagnosis.

Section 3: Aesthetic surgery: Consenting and counselling with regard to breast imaging

Women in the NHS screening age group should be encouraged to attend for their routine screening mammography as offered by the NHSBSP.

If imaging is required before aesthetic surgery, patients should be counselled regarding the possible outcomes including the potential need for further imaging (additional mammography, ultrasound, or MRI) as well as the potential for breast needle biopsy. They must be aware of the low

chance that an incidental cancer or lesion of uncertain malignant potential may be detected.

Anyone considering aesthetic breast surgery needs to be aware that surgery may cause changes that can make future breast assessment more complex and may increase recall and biopsy rates.

Women should be aware that mammography may be less effective in an augmented breast and breast ultrasound may also be required. There is a very small risk that mammography may damage an implant. Breast biopsy in women with implants may pose a risk of implant damage.

Women with implants must be informed of the rare risk of BIA-ALCL⁵² and the need to promptly report any breast swellings and/or lumps of sudden onset a year or more after surgery. Women should be made aware that they may need to alert their doctor to the potential for BIA-ALCL as this is not yet a commonly recognised condition.

If materials such as ADM or meshes are employed as part of the aesthetic procedure, the patients need to be aware to inform radiology staff at the time of any future imaging.

A suggested Patient Information Leaflet is given in the [Appendix](#).

Conflict of interest statement

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Appendix

Suggested Patient Information Leaflet

Breast tests and aesthetic breast surgery

You have received this leaflet because you are considering undergoing an aesthetic (cosmetic) breast procedure. These procedures include the following:

- **Breast enlargement (augmentation)**
 - Using breast silicone or saline implants, or your own fat (lipomodelling/fat transfer),
 - This may also involve the insertion of meshes or acellular dermal matrices (ADM).
- **Breast reduction (mammoplasty) or augmentation/reduction mammoplasty.**

You may be recommended a breast X-Ray (mammogram) and/or breast ultrasound scan before your surgery. This leaflet explains more about these tests and why they are carried out.

You may need a breast test before your surgery

As part of the assessment for your aesthetic surgery, you will be asked some questions about your breast health and any family history of breast cancer or other cancers. You will also undergo a physical examination of your breasts.

If there are any concerns or breast changes, you may be referred to a Breast Unit for further tests. Breast changes and lumps are very common and are usually simple changes that need not be worried about. However, it is important that such changes are checked before you have your aesthetic breast surgery.

If you have no breast problems or family history of breast cancer and your breast examination is normal, we simply recommend that **if you are older than 40 years, you have a mammogram, unless you have had one in the previous 12 months.**

Why should women older than 40 years have a mammogram before aesthetic breast surgery?

The chance of breast cancer under the age of 50 years is low. However, we recommend that women older than 40 years have a mammogram so that any breast changes that require investigation can be dealt with before their aesthetic breast surgery.

What is a mammogram and what other tests might I need?

Mammograms

A mammogram is an X-ray image of the breast. Two different views of each breast are taken. Because mammograms are a type of X-ray, they involve a small amount of radiation.

The mammograms are examined by a healthcare professional who is trained in reporting mammograms. For most women who are asked to have a mammogram, this will be the only test they need. However, if there are areas the mammogram reporter would like to examine more closely, you may be asked to have further investigations.

Ultrasound

An ultrasound scan uses special high-frequency sound waves (not heard by the human ear) to produce pictures of the breast. A small amount of gel is applied to the skin, and a probe is pressed gently against the breast allowing the images to be seen on a screen.

This procedure will be carried out by a healthcare professional who is trained in performing breast ultrasound. If an abnormal area is found, the operator may need to carry out a needle test (biopsy) of the area to allow a diagnosis to be made.

Needle biopsies

If an abnormal area is seen on the ultrasound scan or mammogram, a needle biopsy may be necessary. This involves taking some cells or a small amount of the breast tissue to be sent to the pathology laboratory for examination by a histopathologist (a medically qualified doctor specialising in tissue diagnosis). Needle biopsies are minor procedures

performed under local anaesthesia to numb the area. Using either ultrasound or the mammogram machine, a biopsy needle is guided into the area of concern. The results of these biopsies usually take several days, but your surgeon will discuss the results with you once they are available.

Special circumstances

If you have a strong family history of breast cancer or other known increased risk for breast cancer, or if you have had breast cancer in the past, this should be discussed with your surgeon, as it may affect the types of imaging tests you have to undergo.

Breast tests after aesthetic breast surgery

Usually, you will not need any routine mammograms or ultrasound to check your breasts after the surgery unless you develop problems. If you have any mammograms or ultrasound after the surgery, at any point in the future, please let the person carrying out these tests know what type of surgery you have had, as this may influence the way these tests are carried out and interpreted.

Having breast implants can sometimes mean that not all areas of the breast can be seen on a mammogram; however, there are techniques the radiographer can use when carrying out your mammograms to help improve this.

Further Questions?

Please contact:

References

- Annual Audit British association of aesthetic plastic surgeons, https://baaps.org.uk/about/news/38/super_cuts_daddy_makeovers_and_celeb_confessions_cosmetic_surgery_procedures_soar_in_britain; 2016 Accessed 27 Feb 2018.
- Annual Audit British association of aesthetic plastic surgeons, https://baaps.org.uk/media/press_releases/29/the_bust_boom_busts; 2017 Accessed 27 Feb 2018.
- Breast Cancer Statistics. Cancer research UK. <http://www.cancerresearchuk.org/health-professional/cancer-statistics/statistics-by-cancer-type/breast-cancer/incidence-invasive#ref-1>. (Accessed 27 Feb 2018).
- Male Breast Cancer. Cancer research UK. <http://www.cancerresearchuk.org/about-cancer/breast-cancer/stages-types-grades/types/male-breast-cancer> (Accessed 27 Feb 2018).
- Hassan FE, Pacifico MD. Should we be analysing breast reduction specimens? A systematic analysis of over 1000 consecutive cases. *Aesthetic Plast Surg* 2012;**36**(5):1105-13.
- Review of the Regulation of Cosmetic Interventions. Department of Health, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/192028/Review_of_the_Regulation_of_Cosmetic_Interventions.pdf; 2013 Accessed 27 Feb 2018.
- Professional Standards for Cosmetic Surgery Royal College of Surgeons (Eng), <https://www.rcseng.ac.uk/standards-and-research/standards-and-guidance/service-standards/cosmetic-surgery/professional-standards-for-cosmetic-surgery/>; 2016 Accessed 27 Feb 2018.
- Ambaye AB, Goodwin AJ, MacLennan SE, Naud S, Weaver DL. Recommendations for pathologic evaluation of reduction mammoplasty specimens: a prospective study with systematic tissue sampling. *Arch Pathol Lab Med* 2017;**141**(11):1523-8.
- Douglas-Jones AG, Varma M. Screening at breast reduction. More than a little extra work. *BMJ* 2009;**338**:b2342. doi:10.1136/bmj.b2342.
- Keshtgar M, Hamidian Jahromi A, et al. Tissue screening after breast reduction. *BMJ* 2009;**338**:b630.
- van der Torre PM, Butzelaar RM. Breast cancer and reduction mammoplasty: the role of routine pre-operative mammography. *Eur J Surg Oncol* 1997;**23**(4):341-2.
- Keleher AJ, Langstein HN, Ames FC, et al. Breast cancer in reduction mammoplasty specimens: case reports and guidelines. *Breast J* 2003;**9**(2):120-5.
- Muir TM, Tresham J, Fritschi L, Wylie E. Screening for breast cancer post reduction mammoplasty. *Clin Radiol* 2010;**65**(3):198-205.
- Eklund GW, Busby RC, Miller SH, Job JS. Improved imaging of the augmented breast. *AJR Am J Roentgenol* 1988;**151**(3):469-73.
- Handel N, Silverstein MJ, Gamagami P, Jensen JA, Collins A. Factors affecting mammographic visualization of the breast after augmentation mammoplasty. *JAMA* 1992;**268**(14):1913-17.
- NHS Breast Screening Programme: Screening Women with Implants Public health England, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/624796/Screening_women_with_breast_implants_guidance.pdf; 2017 Accessed 27 Feb 2018.
- Willett AM, Michell MJ, Lee MJR. Best practice diagnostic guidelines for patients presenting with breast symptoms., <http://associationofbreastsurgery.org.uk/media/1416/best-practice-diagnostic-guidelines-for-patients-presenting-with-breast-symptoms.pdf>; 2010 Accessed 27 Feb 2018.
- Lipworth L, Tarone RE, Friis S, et al. Cancer among Scandinavian women with cosmetic breast implants: a pooled long-term follow-up study. *Int J Cancer* 2009;**124**(2):490-3.
- Noels EC, Lapid O, Lindeman JH, Bastiaannet E. Breast implants and the risk of breast cancer: a meta-analysis of cohort studies. *Aesthet Surg J* 2015;**35**(1):55-62.
- Miglioretti DL, Rutter CM, Geller BM, et al. Effect of breast augmentation on the accuracy of mammography and cancer characteristics. *JAMA* 2004;**291**(4):442-50.
- Lavigne E, Holowaty EJ, Pan SY, et al. Breast cancer detection and survival among women with cosmetic breast implants: systematic review and meta-analysis of observational studies. *BMJ* 2013;**346**:f2399.
- Brown L, Ferlo Todd J, Do Lou HM. Breast implant adverse events during mammography: reports to the food and drug administration. *J Womens Health* 2004;**13**(4):371-8.
- de Jong D, Vasmel WL, de Boer JP, et al. Anaplastic large-cell lymphoma in women with breast implants. *JAMA* 2008;**300**(17):2030-5.
- Xu J, Wei S. Breast implant-associated anaplastic large cell lymphoma: review of a distinct clinicopathologic entity. *Arch Pathol Lab Med* 2014;**138**(6):842-6.
- Clemens MW, Medeiros LJ, Butler CE, et al. Complete surgical excision is essential for the management of patients with breast implant-associated anaplastic large-cell lymphoma. *J Clin Oncol* 2016;**34**(2):160-8.
- Adrada BE, Miranda RN, Rauch GM, et al. Breast implant-associated anaplastic large cell lymphoma: sensitivity, specificity, and findings of imaging studies in 44 patients. *Breast Cancer Res Treat* 2014;**147**(1):1-14.

27. Veber M, Tourasse C, Toussoun G, Moutran M, Mojallal A, Delay E. Radiographic findings after breast augmentation by autologous fat transfer. *Plast Reconstr Surg* 2011;127(3):1289-99.
28. Wang YY, Ren GS, Petit JY, Muller C. Oncological risk after autologous lipoaspirate grafting in breast cancer patients: from the bench to the clinic and back. *J Craniofac Surg* 2013;24(3):700-2.
29. Fatah F, Lee M, Martin L, O'Donoghue JM, Sassoon EM, Weiler-Mithoff EM. Lipomodelling guidelines for breast surgery: joint guidelines from the association of breast surgery, the British association of plastic, reconstructive and aesthetic surgeons, and the British association of aesthetic plastic surgeons, <http://www.bapras.org.uk/docs/default-source/commissioning-and-policy/2012-august-lipomodelling-guidelines-for-breast-surgery.pdf?sfvrsn=0>; 2012 Accessed 27 Feb 2018.
30. Martin L, O'Donoghue JM, Horgan K, Thrush S, Johnson R, Gandhi A. Acellular dermal matrix (ADM) assisted breast reconstruction procedures: joint guidelines from the Association of Breast Surgery and the British Association of Plastic, Reconstructive and Aesthetic Surgeons. *Eur J Surg Oncol* 2013;39(5):425-9.
31. Hidalgo DA, Sinno S. Current trends and controversies in breast augmentation. *Plast Reconstr Surg* 2016;137(4):1142-50.
32. Dieterich M, Paepke S, Zwiefel K, et al. Implant-based breast reconstruction using a titanium-coated polypropylene mesh (TiLOOP Bra): a multicenter study of 231 cases. *Plast Reconstr Surg* 2013;132(1):8e-19e.
33. de Bruijn HP, Johannes S. Mastopexy with 3D preshaped mesh for long-term results: development of the internal bra system. *Aesthetic Plast Surg* 2008;32(5):757-65.
34. Goes JC, Bates D. Periareolar mastopexy with FortaPerm. *Aesthet Plast Surg* 2010;34(3):350-8.
35. van Deventer PV, Graewe FR, Würinger E. Improving the longevity and results of mastopexy and breast reduction procedures: reconstructing an internal breast support system with biocompatible mesh to replace the supporting function of the ligamentous suspension. *Aesthet Plast Surg* 2012;36(3):578-89.
36. Tran Cao HS, Tokin C, Konop J, et al. A preliminary report on the clinical experience with AlloDerm in breast reconstruction and its radiologic appearance. *Am Surg* 2010;76:1123-6.
37. Lee CU, Clapp AJ, Jacobson SR. Imaging Features of AlloDerm® Used in Postmastectomy Breast Reconstructions. *J Clin Imaging Sci* 2014;4:19.
38. Camacho C, Pujades MC, Perez-Calatayud J, et al. Impact of the Tiloop Bra® mesh in CT images and dose delivery in breast radiotherapy. *J Appl Clin Med Phys* 2012;13(2):3667.
39. Behranwala KA, Dua RS, Ross GM, Ward A, A'hern R, Gui GP. The influence of radiotherapy on capsule formation and aesthetic outcome after immediate breast reconstruction using bidimensional anatomical expander implants. *J Plast Reconstr Aesthet Surg* 2006;59(10):1043-51.
40. Nelson HD, Pappas M, Cantor A, Griffin J, Daeges M, Humphrey L. Harms of breast cancer screening: systematic review to update the 2009 U.S. preventive services task force recommendation. *Ann Intern Med* 2016;164(4):256-67.
41. Moss SM, Wale C, Smith R, Evans A, Cuckle H, Duffy SW. Effect of mammographic screening from age 40 years on breast cancer mortality in the UK Age trial at 17 years' follow-up: a randomised controlled trial. *Lancet Oncol* 2015;16(9):1123-32.
42. National Institute for Health and Care Excellence Clinical Guideline CG164: Familial breast cancer: classification, care and managing breast cancer and related risks in people with a family history of breast cancer, <https://www.nice.org.uk/guidance/cg164>; 2017 Accessed 27 Feb 2018.
43. 3rd ed. Royal College of Radiologists; 2013 [https://www.rcr.ac.uk/sites/default/files/publication/BFCR\(13\)5_breast.pdf](https://www.rcr.ac.uk/sites/default/files/publication/BFCR(13)5_breast.pdf) Accessed 27 Feb 2018.
44. Boyd NF, Martin LJ, Bronskill M, Yaffe MJ, Duric N, Minkin S. Breast tissue composition and susceptibility to breast cancer. *J Natl Cancer Inst* 2010;102(16):1224-37.
45. McCormack VA, dos Santos Silva I. Breast density and parenchymal patterns as markers of breast cancer risk: a meta-analysis. *Cancer Epidemiol Biomarkers Prev* 2006;15:1159-69.
46. Corsetti V, Houssami N, Ghirardi M, et al. Evidence of the effect of adjunct ultrasound screening in women with mammography-negative dense breasts: interval breast cancers at 1 year follow-up. *Eur J Cancer* 2011;47(7):1021-6.
47. Vinnicombe S. Breast density: why all the fuss? *Clin Radiol* 2018;73(4):334-57.
48. Gilbert FJ. Breast cancer screening in high risk women. *Cancer Imaging* 2008;8(Spec No A):S6-9.
49. Guidelines on organising the surveillance of women at higher risk of developing breast cancer in an NHS Breast Screening Programme, NHS BSP Publication number 73. NHS Breast Screening Programme; 2013 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/439634/nhsbsp73.pdf Accessed 27 Feb 2018.
50. Protocols for the surveillance of women at higher risk of developing breast cancer, NHS BSP Publication number 74, Version 4. NHS Breast Screening Programme; 2013 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/440208/nhsbsp74.pdf Accessed 27 Feb 2018.
51. NHS Breast Screening Programme Consolidated standards. Public health England, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/612739/Breast_screening_consolidated_standards.pdf; 2017 Accessed 27 Feb 2018.
52. ALCL Risk from Breast Implants. British association of plastic aesthetic and reconstructive surgeons. <http://www.bapras.org.uk/professionals/clinical-guidance/alcl-risk-from-breast-implants> (Accessed 27 Feb 2018).