UK Guidelines for Lipomodelling of the Breast on behalf of Plastic, Reconstructive and Aesthetic Surgery and Association of Breast Surgery Expert Advisory Group

BAAPS

British Association of Aesthetic Plastic Surgeons

Summary

Lipomodelling has become increasingly popular for reconstructive, aesthetic and therapeutic indications. The guidelines summarise available evidence for indications, training, technique, audit and outcomes in lipomodelling and also highlight areas for further research.

Keywords

Lipomodelling, fat grafting, fat transfer, lipofilling, indications, techniques, complications, outcomes, guidelines, breast reconstruction, aesthetic breast surgery

Background

The injection of autologous fat into the breast has become popular over the last 20 years and its role has expanded to cover almost all aspects of reconstructive and aesthetic breast surgery. Following the description by Illouz in 1986 [1] of using fat grafts to fill depressions, Bircoll [2] described cosmetic breast augmentation utilising autologous fat and liposuction techniques in 1987. After publications by Coleman [3] demonstrating the efficacy of structural fat grafting to the face, the procedure for lipomodelling to the breast was popularised by Delay [4] and others. Other terms used to describe the procedure are autologous fat transfer, fat grafting and lipomodelling.

AIMS

These guidelines aim to update the 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 published in 2012 [5] and provide guidance on current indications, training and techniques, outcomes and areas for future research.

INDICATIONS

Indications for lipomodelling to the breast are wide and varied and it is not possible to draw up an exhaustive list. Predominantly, indications can be divided into

those for breast reconstruction, aesthetic breast surgery and therapeutic purposes.

Post-mastectomy Reconstruction

1. Primary reconstruction

   In conjunction with other methods of reconstruction

   Lipomodelling can be planned as part of a primary breast reconstruction and can be used in combination with free or pedicled flaps or with implants and tissue expanders [6] [7]. The addition of injected fat can improve volume and contours and expands the role of total autologous reconstruction.

   Recent advances in implant reconstruction show lipomodelling being used in pre-pectoral reconstruction [7] [8] as well as with serial tissue expansion in the subpectoral plane.

   Concern over the number of procedures required to achieve satisfactory outcomes has led to increasing use of lipomodelling at the time of the primary reconstructive surgery. Some surgeons recommend lipomodelling of the mastectomy skin flaps and the pectoralis major muscle at the time of either implant or flap procedure and also into the latissimus dorsi flap itself, allowing greater volume transfer at the first operation and reducing the need for subsequent procedures [9] [10]

2. Total breast reconstruction

   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 satisfactory projection [11]. It is best suited to small-breasted women with suitable donor sites in whom other types of reconstruction may not be possible or desired. Techniques of pre-expansion have been described [12] [13] using various devices prior to fat transfer, to improve graft uptake but have not been widely adopted.

   Adding fat to the tissues following a “Goldilocks mastectomy” [14] has been reported to improve outcomes in high-risk patients not suitable for more complex surgery.

3. Irradiated chest wall.

   Lipomodelling has been shown to improve the quality of irradiated tissues [15] and can be utilised before or during reconstruction to enable implant-based reconstruction and reduce the risks of associated complications [16 17].

Secondary reconstruction

Lipomodelling is indicated for the improvement of volume and contours following reconstruction [18] and the replacement of implant volume beneath flaps following implant removal due to complications [19].

Partial breast reconstruction

Lipomodelling has been shown to be oncologically safe for the correction of breast conservation defects [20] though good results can be difficult to achieve following radiotherapy especially in the context of persistent fat necrosis. Immediate lipomodelling at the time of cancer surgery shows promising results and may reduce the incidence of postoperative deformity [21 22]. There is no evidence regarding optimal timing of delayed lipomodelling after breast conserving surgery, however some surgeons prefer to delay at least 6 months after radiotherapy or until the first annual surveillance mammogram.

Breast asymmetry and developmental anomalies

Lipomodelling is indicated for the correction of hypoplastic breast syndrome and Poland's syndrome and may obviate the need for implants or flap transfer [23].

Aesthetic breast surgery

Lipomodelling alone can be used for cosmetic volume enhancement [24] or it can be used following primary augmentation in either the immediate [25] or delayed setting in order to make implants less visible [26].

It can also be used in conjunction with mastopexy (immediate or delayed) to avoid using implants [27] and following capsulectomy and removal of implants to improve the cosmetic result [28].

Lipomodelling is used with caution to correct donor site deformities after autologous flap harvest. After gluteal flap harvest, infiltration of fat should be subcutaneous to avoid injection into the gluteal muscle or deep veins, as there is a higher risk of fat embolism and death (www.surgery.org/sites/default/files/Gluteal-Fat-Grafting-02-06-18_0.pdf).

Therapeutic Indications

Lipomodelling can be useful in the management of capsular contracture, for enhancement of soft tissue coverage and amelioration of discomfort, either as sole treatment or in combination with capsulectomy and/or change of implants [29 30].

Fat grafting has been shown in small studies to be effective in reducing pain in post-mastectomy pain syndrome [31 32] and for some patients may be an alternative to medication and its associated side effects.

Both clinical and in vitro studies [15 33] have shown that fat transfer can be an effective therapy for radiotherapy tissue changes such as radiodermatitis, improving the quality of irradiated tissues and promoting wound healing. However, caution should be exercised in the presence of established radionecrosis, when a multidisciplinary approach is recommended.

PATIENT SELECTION

Patients must have suitable donor sites and be fit for surgery, potentially for multiple procedures.

Radiotherapy reduces fat graft survival but although there is limited evidence on the impact of other patient factors it appears that increasing age, body mass index, diabetes and tamoxifen may also affect outcomes [34 35]. Nicotine consumption reduces graft survival and adversely affects the efficacy of fat transfer [36].

TRAINING AND TECHNIQUE

Introduction

Fat transfer is often the technique of choice to correct volume or contour defects in reconstructive and cosmetic surgery. Considerable expertise is required to achieve op-

timal results in lipomodelling. Where clinicians and hospitals are introducing lipomodelling in their institution, they should follow local established clinical governance processes for implementing new procedures.

These guidelines aim to describe the standard technique for the procedure, and recommendations for training.

Training in Lipomodelling

Formal training should be undertaken under the mentorship of a breast or plastic surgeon with experience in lipomodelling and should include the following components:

- Background theory and knowledge including indications and complications

- Practical skills

- Arrangements for supervision, assistance and mentoring during local implementation

- Evidence of completion of training to an acceptable standard before starting to perform lipomodelling

- Processes in place for consent, audit of efficacy, safety and long-term data collection using the core dataset [37].

Technique

Lipomodelling involves the transfer of fat from one area of the body to another. Success is dependent on techniques used for harvesting, processing and grafting of the fat.

Harvesting

Donor site aesthetics should be considered to minimise morbidity and deformity and potentially improve and enhance the donor areas. Consideration also needs to be given to preserving potential future autologous flap donor sites. It is essential that the surgeon is trained to assess, plan and deliver an aesthetically pleasing outcome (http://www.bapras.org.uk/docs/default-source/default-document-library/bapras-baaps-liposuction-guidelines.pdf?sfvrsn=2). Fat donor sites should be accessible and consideration may be given to the likelihood of including adipose derived stem cells (ADSC), which are reported to be higher in the inner knee and lower abdomen [38-41].

ADSC have been shown to improve fat graft retention and efficiency by enabling graft vascularisation and adipose tissue regeneration [42 43]. In clinical practice abdominal, gluteal and lumbar area harvest sites are the most frequently used because of their ease of access and tissue availability.

Infiltration of the donor area is not compulsory but facilitates analgesia and reduces bruising [18 43 44]. The potential impact of local anaesthetics (LA) on adipose cells is a matter of debate. In experimental work, lidocaine and epinephrine did not alter the uptake of fat grafts [45 46]. However, cell culture experiments suggest a cytotoxic effect of LA on adipose cells and ADSC although the use of epinephrine was not deleterious [47 48]. If lipomodelling is performed under general anaesthetic, a tumescent solution containing diluted epinephrine can be used. Local anaesthetic can be infiltrated after fat harvest for post-operative analgesia. For procedures undertaken under local anaesthetic, simple techniques such as centrifugation and washing can be used to reduce the deleterious effect of LA. The use of hyaluronidase in the fluid infiltration is not recommended due to potential adipocyte disruption, although there is limited evidence.

Stab incisions are made with an 11 blade for access. Infiltration can be undertaken first. A 2-4 mm blunt-tipped fat harvest cannula, preferably with a number of small holes near the tip is selected. Smaller fat particle size corresponds to better adipocyte survival, however smaller cannula openings correspond to slower and more difficult fat graft harvesting with potential more cellular damage [49]. Fat is harvested by passing the cannula back and forth through the fat in a fan pattern, avoiding over harvest in any particular location. A number of access incisions allow a more uniform harvest. Care should be taken to avoid superficial fat harvest to reduce the chance of skin irregularity or necrosis. Gentle suction can be applied by hand with a 10 ml Luer-lock syringe or with a low vacuum to avoid damage to the fat cells. Low-pressure suction (<250 mmHg) appears to increase adipocyte viability (49). Various devices are available to assist fat harvest, however none has been proven to be superior and surgeons and teams should have specific training in the preferred harvest technique and evaluate safety and outcomes [50].

Processing

After aspiration of the fatty tissue, it is important that nonviable components of the aspirate such as oil, blood, and tumescence solution are removed and, at the same time, the quality, integrity, and viability of the adipocytes and the inherent mesenchymal stem cells in the aspirate are maintained. Processing techniques include sedimentation, filtration, washing, and centrifugation. There is no consensus as to the optimal method of fat graft preparation [39]. Histological comparison of autologous fat processing methods suggests that sedimentation appears to yield a higher proportion of viable adipocytes than washing or centrifugation. On the other hand, washing harvested fat eliminates inflammatory mediators, reduces immune response at the recipient site, and enhances overall graft survival [51].

The most evidence available is for centrifugation of the lipoaspirate at 3000rpm for 1 - 3 minutes to separate the fluid (decanted) and oil (absorbed) leaving fat cells [52]. However, some recommend shorter duration and lower speeds. Higher centrifugation speeds are associated with adipocyte damage [53]. Several companies have developed systems for collecting and processing lipoaspirate but data concerning efficacy and efficiency for each method is limited. The available evidence does not support any one processing technique above another [39]. Surgeons and their teams should have specific training in the preferred technique and evaluate safety and outcomes.

Cryopreservation of fat has been the subject of several publications but is not in routine practice [54].

Fat injection

Lipomodelling requires the grafted fat to be revascularised by the surrounding tissues. This is dependent on very small aliquots of undamaged fat cells being placed into a healthy recipient bed. In order to achieve these aims, small amounts of fat are injected with blunt tipped small calibre infiltration cannulae (17-18G, maximum diameter 1.5mm), using a Luer-lock syringe. The cannula is pushed gently through the tissues that require grafting via a small stab incision and the fat is injected slowly as the cannula is withdrawn. It is recommended that about 1cc of fat be injected with each pass to achieve optimal deposition. A fresh tunnel is then created for the next pass. Tunnels are all separate from one another and are at different depths and angles to create a lattice of fat deposits. Multiple infiltration sites around the recipient area can facilitate uniform

enhancement of the area. Care should be taken to avoid depositing larger volumes of fat in a single site, as the fat cells will fail to revascularise. This could cause oil cysts, microcalcification or fat necrosis, which may require subsequent imaging and biopsy.

Care should also be taken to avoid damage to adjacent structures, in particular breast implants or the pleura by injecting tangentially where possible. It is advisable to undertake injections prior to implant insertion or exchange during a combined procedure.

The recipient area capacity limits the amount of fat that can be injected in a single session, therefore patients may require repeat procedures to achieve optimal results. The final volume achieved tends to remain stable in the longterm, provided the patient maintains a constant weight and avoids smoking. Some surgeons recommend exceeding volume requirements to compensate for anticipated resorption [22] but only if the recipient area capacity is sufficient.

Preconditioning of recipient sites

Preconditioning of the tissues has been reported; experimental evidence suggests microneedling 1 week prior to fat grafting can increase fat take [55 56]. Similarly, enhancing fat grafts with adipose stromal cells, p38 inhibitors and platelet rich plasma is recommended by some to increase fat graft survival but none of these techniques are in common use [57]. Some authors recommend preoperative tissue expansion with external suction devices to expand tissues prior to fat grafting [58].

COMPLICATIONS

Complications in lipomodelling tend to be minor and well-tolerated and major complications are rare. Overall, 7% of patients develop a complication. Among these, 86% are reported as minor and do not need any therapeutic intervention (4, 60-64).

Donor site

Complications include postoperative bruising and swelling, which can be reduced by using infiltration with adrenaline solution (1:100,000). Postoperative compression garments may help. Contour irregularity and skin necrosis can be

avoided by good technique as described above.
Major complications can occur in liposuction including infection, sepsis, visceral perforation and death [59]. It is important to undergo training and ensure competence before performing liposuction.

Recipient site

Fat necrosis is the most common complication; occurring in 3-15% of patients. It can lead to increased graft loss, oil cyst formation and calcifications (62, 63). Once fat necrosis is established and has not resolved spontaneously, it may require formal aspiration or surgical excision.
Other complications are usually mild and self limiting. Bruising is common, but haematoma and infection are rare. Perioperative antibiotics can be used according to local guidelines, particularly in the presence of breast implants. Postoperative infection increases the risk of graft loss. Medium term complications can include hypertrophic scarring, contour irregularities, skin necrosis, over or under-correction.

The most serious complications, which are very rare, include damage to underlying structures, intravascular injection with fat embolism and death [59].

Fat resorption of 30 -50% is not a complication and is expected after each procedure. Patients should be made aware that multiple procedures may be required.

ROLE OF IMAGING AFTER BREAST LIPOMODELLING

Breast cancer patients should continue clinical and mammographic follow-up by the MDT according to local protocols. In patients without a previous history of breast cancer, routine follow-up imaging is not advised, other than screening mammography through NHS Breast Screening Programme.

Patients who have undergone lipomodelling may present with symptomatic or screen-detected abnormalities in the breast [60-65]. They should undergo investiga-

tion according to national guidelines [66]. A meta-analysis reported radiological abnormalities in 14.5% patients [67].

Patients who have undergone lipomodelling are at increased risk of fat necrosis and subsequently more likely to have calcifications visible on mammography. Mammographic signs of fat necrosis may not be visible for at least twelve to eighteen months. These calcifications have a typical appearance and are usually easily recognisable. However, patients need to be made aware this may lead to an increase need for biopsy [63 64], leading to additional radiological exposure and potential psychological anxiety.

ONCOLOGICAL SAFETY CONSIDERATIONS

There is no evidence that lipomodelling adversely affects breast cancer detection, surveillance or recurrence rates [67-72]. There is no evidence to suggest that fat injection into the breast parenchyma is unsafe. Long-term data is awaited for newer techniques such as immediate lipomodelling at the time of cancer resection [21].

OUTCOMES AND AUDIT

A core outcome dataset [37] (Table 1) has been developed for use in local and regional audit and research. Any unit undertaking lipomodelling should audit these core outcomes to ensure safety and efficacy.

Patient reported outcomes

Pre and post operative photographs in additional to 3D imaging can be used to demonstrate outcomes and volume improvement objectively, which may be used as part of the patient record, for patient education to manage expectations and for medicolegal purposes. The majority of outcome studies indicate that patients were either satisfied or very satisfied after lipomodelling procedures [67].

Research

Topics for future research include strategies to improve graft survival [73], feasibility of fat banking [54], the role of fat grafting in enhancing implant and autologous reconstruction, oncological safety of immediate lipomodelling after breast conserving surgery and in BRCA mutation carriers,. There is need for QoL (quality of life) studies after lipomodelling, as current evidence is limited [74].

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