Autologous fat transfer for breast surgery

ABSTRACT

Cosmetic and reconstructive surgeries always have a primary aim of the best outcome for the patient, with a big emphasis on the aesthetics. Lipomodelling is one such technique, originally described over a century ago but still used to this day, to provide a patient with the highest quality results. This is particularly true for lipomodelling of the breast, whether it be purely cosmetic, or for a post-mastectomy reconstruction for a breast cancer patient. Lipomodelling provides an effective way of restoring and even improving the look and aesthetics of the breast and of helping achieve the patient's expectations. With the added advantage of being autologous, the procedure is safe and effective. This review discusses the latest guidelines and literature on autologous lipomodelling.

Autologous fat transfer, or the transfer of a person's fat from one site to another, has been used for cosmetic surgeries for over a century. This technique is also used in therapeutic surgeries such as repairing CSF defects in neurosurgery (Esposito et al, 2007; ELFadl et al, 2010). First described by Neuber in 1893 for correcting facial defects, autologous fat transfer has come a long way since then, with varied indications for and techniques by which this procedure is now performed.

Breast surgery has used this procedure to improve the outcomes of contour defects through reconstructive surgery. Autologous fat transfer was first used for reconstructive purposes over a century ago by Czerny, 2 years after it was first described in 1895 for the correction of a post-mastectomy defect (Chan et al, 2008). The procedure gained popularity among surgeons over the years owing to its autologous nature negating an immune response, ease of technical steps and the possibility of repeating the procedure in the near future for an improved outcome. The term 'liposculpture' was introduced by Fournier in 1985 and accurately portrays the procedure as one that provides successful reconstructive results (Fournier, 2000). However, the recent popularity of autologous breast fat transplantation is in part the result of the work of Delay and Coleman, who have described it as 'lipomodelling' (Coleman and Saboeiro, 2007; Delay et al, 2013).

Based on advances made over the years and the exponential rise in use of this procedure over the last decade, this article reviews the latest literature and clinical guidelines for best practice as set out by the National Institute for Health and Care Excellence (2012) and the British Association of Plastic, Reconstructive and Aesthetic Surgeons (2012).

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Indications

This technique is primarily used post-breast cancer reconstructive surgery, with the aim of filling in any contour defects or asymmetry in the breast after reconstruction with an implant or flaps, such as transverse rectus abdominis myocutaneous or latissimus dorsi flap. This allows smoother coverage of soft tissue, giving a more natural look and feel, and correcting any folds or ripples in the implant (Spear et al, 2005b; Zocchi and Zuliani, 2008; Delay et al, 2009). This procedure is particularly useful for patients who have undergone a wide local excision and would have otherwise been left with a large 'empty space' in the breast. These patients might not necessarily be suitable candidates for an implant (Coleman and Saboeiro, 2007).

Lipomodelling can be used to improve the skin and soft tissue profile of patients who have undergone radiotherapy. For patients undergoing a mastectomy alone without any reconstruction, lipomodelling would be unsuitable because of the lack of breast tissue available to lipofill. However, it is an acceptable technique in patients who have undergone a mastectomy with further reconstruction procedures such as implants or autogenous flaps (Coleman and Saboeiro, 2007). Other indications for this procedure include patients with congenital or acquired abnormalities, such as pectus excavatum, Poland's syndrome (males or females), tuberous deformities and correction of defects after the treatment of gynaecomastia (Pinsolle et al, 2008; Del Vecchio, 2009). Another common indication is for cosmetic and aesthetic improvements. This could be either breast augmentation using only fat transfer, to improve the appearance post-breast reduction and mastopexy, or to attempt to treat the effects of capsular contracture (Missana et al, 2007; Zocchi and Zuliani, 2008; Khouri and Del Vecchio, 2009).

Technique

As with every surgery, it is essential to carry out a thorough preoperative assessment of the patient to determine fitness for surgery. Any medical conditions that could prevent

administration of a general anaesthetic should be taken into consideration. However, a local anaesthetic with or without sedation can also be used for a smaller procedure with minimal fat grafting (Spear et al, 2005a). It is not recommended that smokers undergo this procedure. Bleeding disorders and blood thinning medications should be reviewed before undergoing this procedure (Delay et al, 2009).

Most importantly, the patient should be assessed to see whether a suitable fat donor site is available or not. This is usually the lower abdomen, buttocks and thighs, and should be properly assessed before agreeing to perform this procedure (Markey and Glogau, 2000). The lower abdomen is preferred, as it can usually provide a single donor area. The thigh is also a good choice as its relatively lesser blood supply, compared to the lower abdomen, can reduce the incidence of postoperative collections (Niechajev and Śevćuk, 1994; Spear et al, 2005a). The site chosen to harvest the fat does not affect the outcome of the adipocytes as much as the technique used to put the fat graft into the recipient site (Rohrich et al, 2004).

The British Association of Plastic, Reconstructive and Aesthetic Surgeons (2012) and National Institute for Health and Care Excellence (2012) recommend that breast cancer patients chosen to undergo this procedure should be discussed in the multidisciplinary team before being accepted. Although there is currently no evidence that lipomodelling leads to increased recurrence of breast cancer, there are limited data on this (Gosset et al, 2008; Fraser et al, 2011). These patients should also be thoroughly investigated, using imaging and clinical examination, for any signs of a recurrent cancer. National Institute for Health and Care Excellence (2012) also recommends that only specialist surgeons trained in this procedure should treat post-cancer patients. It is also recommended that post-radiotherapy patients wait a minimum of 12 months before undergoing lipomodelling (Fraser et al, 2011).

Procedure

The donor site is initially injected with a local anaesthetic and adrenaline solution to reduce bleeding and provide postoperative analgesia. This process is known as 'wet harvesting' (Missana et al, 2007). Hörl et al (1991) showed that adding hyaluronidase to the solution results in a 50% increase in the viability of the adipocytes, but this is not currently recommended in any clinical guidelines. The British Association of Plastic, Reconstructive and Aesthetic Surgeons (2012) recommends the use of blunt-tipped cannulae not exceeding 3 mm for liposuctioning fat from the donor site, and a blunt-tipped cannula ≤1.5 mm for depositing the fat grafts (*Figure 1*). The fat should be centrifuged for 1–3 minutes at 3000 revolutions per minute (*Figure 2*), which separates the fat into three distinct layers. This reduces the risk of inflammation in the breast by ensuring the transfer of only the purified fat (Coleman and Saboeiro, 2007; Missana et al, 2007). The three layers are oil (top), fat cells (middle), and serum, local anaesthetic and blood (bottom layer). The oil from the top layer is absorbed and removed using string patties (*Figure 3*).

Once centrifuged, the fat graft can be transferred to the breast. Particular care is needed in the transfer process. Particles >3 mm should not be transferred as this increases the chance of developing fat necrosis or an oil cyst, which can present as a suspicious lump in future (Coleman,

Figure 1. 15 cm x 3 mm cannula used to harvest fat from the donor site.

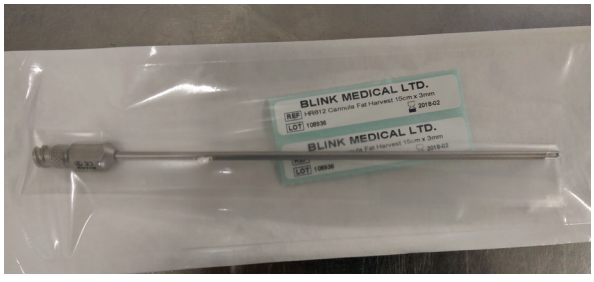

Figure 2. Centrifuge used to separate the harvested fat.

Figure 3. String patties used to absorb oil after fat centrifugation.

> A certain amount of fat transferred to the breast will be lost by resorption. The patient should be informed about this loss of volume and potential change in body contour and aesthetics before the procedure.

2006). This will lead to unnecessary investigations and imaging, as well as causing worries and stress to the patient who may presume it to be cancerous. Fat necrosis will be visualized as calcifications on a mammogram, leading to a needle biopsy to ascertain the diagnosis; a lengthy diagnostic process that can be avoided by following correct surgical techniques (Bonomi et al, 2013).

The fat should also be transferred to the pectoral fascial or subcutaneous plane and not directly into the breast tissue, ensuring a highly vascularized surrounding area for the successful viability of the fat graft (Delay et al, 2009; Sinna et al, 2010). The fat is injected in small amounts as the needle is withdrawn. The process of creating 'layers' of fat also helps in ensuring viability through adequate vascularization (Spear et al, 2005a; Coleman, 2006). The depth of the fat injection determines whether or not the procedure leads to an increase in breast projection or an improvement in the appearance of the external contours. The fat is injected using a blunt cannula, attached to a pistol device, capable of delivering 'pulses' of fat of varying volumes from 0.2 ml to 5 ml (Hörl et al, 1991; Spear et al, 2005b; Coleman and Saboeiro, 2007). Using higher volume pulses of fat is not recommended because of the risk of fat necrosis and contour irregularities. The total volume of fat injected per breast depends entirely on the indication for the procedure. Procedures carried out purely to improve the contours of the breast will use smaller amounts of fat (up to 100 ml) whereas procedures used for breast-conserving purposes could require up to 500 ml (Coleman and Saboeiro, 2007; Missana et al, 2007). The total amount needed will also depend on the donor site availability. The desired outcome may not always be achieved in a single procedure, so multiple procedures may be required. Although there are no guidelines on the 'maximum' number of procedures per patient, the clinician and patient should decide together when an outcome is acceptable (Spear et al, 2005a).

Volume loss

A certain amount of fat transferred to the breast will be lost by resorption. The patient should be informed about this loss of volume and potential change in body contour and aesthetics before the procedure. This volume loss usually occurs within the first 4–6 months postoperatively (Spear et al, 2005a; National Institute for Health and Care Excellence, 2012). Delay (2005) described this loss as the 'twice 30% rule' – 30% of the fat is lost during the liposuction and centrifugation process, and the other 30% is lost within 4 months of surgery following resorption. Hence the authors proposed injecting up to 150% of the volume required to take into account the inevitable losses (Niechajev and Śevćuk, 1994; Spear et al, 2005a).

Graft survival

As with any transfer of tissue, organs or even cells to another site or to another person, the main issue that affects graft outcome and survival involves the immune response to the graft and adequate perfusion to the tissue delivering oxygen and nutrients (Boschert et al, 2002). Adipocytes are no different and have a low tolerance to ischaemia, so having a well-vascularized area to re-vascularize the graft is crucial to their survival. Karacaoglu et al (2005) compared different sites of fat transfer in rabbits and showed that the supramuscular plane had the highest graft survival rates (81.9%), compared to subcutaneous (41.6%) and submuscular (31.7%). Despite the lack of research in humans, this indicates that the site and volume injected in each site should be carefully considered during the procedure.

Complications

Lipomodelling is generally considered as a procedure with a minimal complication and side-effect profile. However, as with every surgery complications can occur that should be investigated and prevented where possible. The two major foci of complications occur at two sites – the fat donor site and the fat recipient site (Sinna et al, 2010). Donor site complications include swelling and bruising. These usually settle with time, and compression of the area is advised. Bruising usually settles within a few weeks, but can be more prominent if the patient takes anticoagulants such as warfarin. Infiltration with adrenaline helps reduce the chances of developing bruising and swelling (Coleman and Saboeiro, 2007). The donor site may become numb but this also resolves within a few weeks. Finally, infection is a common, yet easily avoidable complication at the donor site (Delay et al, 2009; Mu et al, 2009). Ensuring effective sterility of equipment during the procedure, keeping the wound clean and changing the dressings regularly in the postoperative period helps significantly in eliminating this complication.

Recipient sites are prone to further complications. As well as swelling, bruising and infection, the breast may also form fat necrosis or calcifications (Sinna et al, 2010). These may present as lumps in the breast, leading to unnecessary and avoidable investigations and imaging to rule out cancer. The technique of this procedure may cause damage to the surrounding structures, such as the chest wall and the pleura, or even the implant. This could cause a pneumothorax or a punctured implant, which could lead to loss of implant and further reconstructive surgeries for the patient (Chan et al, 2008). The aim of the operation is to improve aesthetics of the breast, and a complication resulting in the over- or under-correction of a deformity would lead to further irregularities in the contour of the breast and a discontent patient (Zheng et al, 2008).

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This may be secondary to fat resorption after a few months, and the patient should be informed before the procedure that he/she may require a second or even third surgery in the future to correct any deformities (Delay et al, 2009; Sinna et al, 2010).

Post-lipomodelling

Lipomodelling was first described over a century ago, but there is still a lack of studies and data which look at the long-term outcomes and implications of this procedure, particularly in the breast. This limitation is something that National Institute for Health and Care Excellence and the plastic and aesthetics societies are well aware of. Clinical guidelines specifically mention that any patient considered for this procedure should be thoroughly informed and consented, and made aware of the fact that he/she is being offered a surgery which still has limited long-term outcome data available. Although there is evidence that lipomodelling has no effect on cancer recurrence in patients, the National Institute for Health and Care Excellence (2012) recommends that every centre carrying out this procedure audits their results and collects data, especially on long-term outcomes, and looks at the effects of lipomodelling and recurrent breast cancer (Malata et al, 2000).

Post-lipomodelling, the British Association of Plastic, Reconstructive and Aesthetic Surgeons (2012) recommends patients not to have a mammogram for at least 6 months, but that patients should otherwise continue to undergo routine surveillance screens at NHS breast screening clinics as they normally would depending on their age and history. This includes both those with and without a history of breast cancer. The screening frequency recommended by local centres should be followed.

Some of the hypotheses proposed with regards to the safety of lipomodelling include the risk of local breast cancer developing secondary to increased growth factors in the breast that promote re-vascularization. Experimental animal studies have shown that adipocytes and the associated progenitor cells have the potential to produce various growth factors that could interact with cancerous cells in a paracrine fashion. This puts further doubt on the potential risk of cancer recurrence in an area that was previously treated for cancer and is now undergoing lipomodelling involving the infiltration of adipocytes (Vona-Davis and Rose, 2007; Zhang et al, 2009; Petit et al, 2011). A review article by Lohsiriwat et al (2011) on the subject of whether autologous fat transfer could either 'silence' or 'fuel' dormant cancerous cells analysing data from experimental studies provides an interesting insight. The authors highlight the 'tumour-stroma interaction', which entails the potential fuelling of dormant cancerous cells in a tumour bed. However, we have yet to see data on humans. The lack of translational research should encourage clinicians to conduct prospective long-term follow up on their patients. Second, with regards to stem cells, an experimental mice study conducted by Zhu et al (2007) involved the injection of adipose tissue, adipose derived stem cells and tumour cells (MCF-7 and MDA-MB-231) and concluded no significant increase in tumour growth at 8 weeks.

The safety and efficacy of lipomodelling on breasts will only be fully understood by long-term data collection of patients from multi-centres carrying out this procedure.

KEY POINTS

- Autologous lipomodelling provides an excellent surgical option for oncoplastic and breast reconstructive surgery.
- It provides a quick and safe method of improving defects in projection or contours of the breast in either post-mastectomy breast cancer patients, or for purely cosmetic purposes.
- It is essential for surgeons to inform patients about volume resorption post-surgery, leading to a cosmetic result which might differ from what the patient notices immediately after surgery.
- Long-term prospective studies are required to strengthen the evidence of the lack of correlation between lipomodelling and breast cancer.

Conclusions

Lipomodelling for the purpose of reconstructive and aesthetic breast surgery is an effective and safe procedure. With advances in technique and instrumentation, surgeons can deliver safe and pleasing results to patients who would benefit from this surgery, especially for the individuals undergoing reconstructive surgery post-mastectomy. Additional long-term data certainly need to be collected and analysed, to reveal any long-term effects with regards to new or recurrent breast cancer and patient satisfaction. **BJHM**

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