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Review

Lipomodelling of the Breast: A review

D. ELFadl [a,*], V. Garimella [a], T.K. Mahapatra [b], P.L. Mcmanus [b], P.J. Drew [a]

[a] Postgraduate Medical Institute, Hull York Medical School, University of Hull, Cottingham Road, Hull HU6 7RX, UK
[b] Breast Unit, Hull And East Yorkshire Hospital NHS Trust, Castle Hill Hospital, Cottingham, HU16 5JQ, UK

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ABSTRACT

Background: Autologous fat transplantation has been used to correct cosmetic deformities in almost all areas of the body. In recent years, there has been a resurgence of interest in the use of fatty tissue to fill defects resulting from breast conserving surgery (BCS) and asymmetries after reconstructive breast surgery.
Methods: A Medline database search was performed, and the published evidence was reviewed.
Results & conclusion: We describe and discuss the technique and indications, advantages, disadvantages and future direction of fat transfer to the breast.
Search methodology: A Medline database search was used to retrieve relevant literature. Key search words used were: breast fat transfer, fat auto-transplantation, adipose tissue injection and lipomodelling. As a number of original articles are in French these were translated and used in addition to the English publications.

Introduction

The first report of fat transplantation was in 1893 when Neuber transferred fat from the arm to correct a facial deformity.[1] The procedure has been applied to almost every region in the body including limbs, breasts, buttocks and genitalia. Its popularity springs from the simplicity of the basic concept, technical ease, autologous nature and the possibility of altering the outcome by repeating the intervention.

Czerny first described fat transplantation to the breast in 1895.[2] He used a large lipoma to reconstruct a defect resulting from excision of a benign lesion. Lexer transferred fat to the face, and later to the breast.[2] Bruning was the first to use a syringe to inject fat in 1911.[1] Following the introduction of liposuction by Fischer in the mid 1970s, and the report by Illouz of more than 3000 cases of liposuction, the concept of using the suctioned fat to correct defects elsewhere began to emerge.[3] Illouz started injecting fat to correct contour deformities resulting from liposuction. He also introduced the idea that individual adipose cells survived by osmosis before the development of neovascularisation, as opposed to adipocytes within compact surgically excised adipose tissue. He compared this to a cell culture environment.[4] A short revival in breast fat transplantation was initiated by Mel Bircoll in the early eighties, but was terminated after concerns over post-operative calcifications, and the risk of obscuring developing malignant lesions.[5]

Fournier introduced the term “liposculpture” as his own version of the technique. He claimed to be the first to use a needle for aspiration in 1985, and to obtain good results in facial and breast transplants.[6] However, the recent re-emerging popularity of breast fat transplantation is based on recent reports and work by a number of surgeons including Coleman and Delay, who have introduced the term “lipomodelling”, and used the technique alone, or in combination with other reconstructive procedures.

Technique

The steps in the process of lipomodelling are: identification of donor sites, harvesting, preparation, and injection of the fat. The overall aim is to minimize adipocyte damage and promote survival. Lipomodelling can be a lengthy operation, which constitutes a major limiting factor. Coleman reported an average of 2 h for the first 100 ml injected, and 45 min for any additional 100 ml.[7] Others, employing the same technique, reported an average procedure time of 115 min (range 60–165 min) for an average injection volume of 144 ml in each breast.[8]

General anaesthetic is usually used; however local anaesthesia can be used in smaller procedures.[9] The lower abdomen, back, trochanteric region, thighs and medial aspect of the knee are all possible donor sites. The first is preferable as it provides a single

* Corresponding author. Research Laboratories, Second Floor, Daisy Building, Castle Hill Hospital, Hull, HU16 5JQ, UK. Tel.: +44 7786958450; fax: +44 1482461874.
E-mail address: dalfadl@yahoo.co.uk (D. ELFadl).

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operative field.[9] The thigh region contains less septae and has a relatively low blood supply, and is therefore less susceptible to postoperative collections.[10] The choice of donor sites has not been shown to affect the survival of the adipocytes.[11]

Harvesting is a major contributory factor to the success of lipomodelling. Open excision of fat has now been replaced by liposuction and syringe lipoaspiration. Studies comparing the latter two techniques have found no significant difference in the population of viable adipocytes obtained.[12, 13] In either technique, the use of low negative pressure is recommended.[10, 14] Although both techniques can disrupt the lobular architecture of adipose tissue, suction aspiration has in addition, been shown to cause cellular alteration and dehydration, secondary to cellular fluid evaporation.[15] Animal studies have reported 90% destruction of liposuctioned adipocytes, compared with 5% in the aspirated fat.[16]

Pulling the plunger of a 10 ml syringe can generate an average pressure equal to 40% that generated by liposuction. It can however, reach 100% on maximal withdrawal.[13]

The wet harvesting technique involves injection of a dilute mixture of local anaesthetic and adrenaline into the donor site before liposuction, to decrease postoperative bleeding and provide anaesthesia.[5, 17, 18] Normal saline,[5] or Ringer's solution,[18] can be used for infiltration. Adding hyaluronidase was claimed to facilitate harvesting by "softening" the fat.[3] Hörl used a similar mixture, and observed that the use of hyaluronidase resulted in a 50% increase in adipocyte viability.[17] Advocates of the dry technique have suggested that large amounts of infiltrate could affect cellular adhesion properties.[10]

Fournier published his 15-year experience with facial and trunk (including breasts) fat transfer and suggested a number of different concepts to improve fat survival.[6] He described aspiration with a syringe containing 2 ml of fluid to decrease adipocyte damage by lowering the impact against the syringe walls. He also prepared the donor sites days preceding surgery to induce an inflammatory reaction, and increase graft survival.

Culture media rich in growth hormones have been used to support the cells preceding neovascularisation, through providing nutrition and creating intercellular spaces.[18,19]

Centrifugation of the harvested fat separates the adipocytes from diluting fluid, local anaesthetic, blood and other cellular debris.[20] This decreases the risk of eliciting an inflammatory response at the recipient site. An inverse relationship has been observed between the amount of blood in the lipoaspirate and the number of viable adipocytes.[12] Centrifugation is performed at a speed of 3000–3500 rpm for 3–4 min.[7–9] Speed as low as 1000 rpm has been previously used.[19] No significant differences were detected in adipocyte survival with or without centrifugation.[11] Different durations of centrifugation (2–8 min), had no effect on the number of viable cells in the lipoaspirate.[20]

Centrifugation yields three layers (Fig. 1) with ruptured adipocytes, triglycerides and chylomicrons forming the top layer, purified fat in the middle, and a mixture of fluid, blood and cellular debris at the bottom.[7,8,13]

Washing the lipoaspirate with different solutions such as Ringer's,[18] normal saline,[10,21] or 5% dextrose,[6] has been used to achieve the same effect.

Some prefer avoiding all preparation techniques.[13,22] Smith et al. have used a specific metabolic cell viability assay to demonstrate better survival rates with unprepared samples as compared to washed or centrifuged samples.[13]

Fat is injected in small amounts as the needle is gradually withdrawn. Small pulses ensure that a maximum number of adipocytes are in close proximity to the recipient tissue and therefore to an established source of blood supply.[7] Creating layers of grafted tissue aids initial survival and vascularisation.[9,23] The

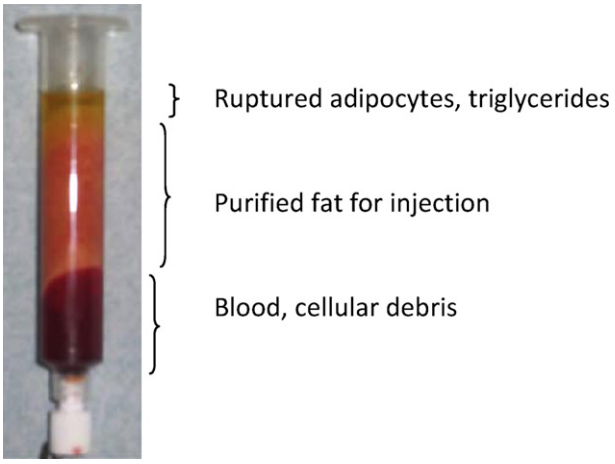

Fig. 1. Products of centrifugation. Centrifugation of the lipoaspirate yields three layers, with the purified fat forming the central layer.

multilayered and multidirectional arrangement of the fat strands is represented in Fig. 2. Fat can be injected into more than one space, thus creating more than one effect. Subcutaneous infiltration improves the contour, while intra-parenchymal injection can enhance the projection of the breast.[7]

Coleman and Delay have described in detail their technique of fat injection.[7,9] Small skin incisions are made with a scalpel or a trocar and blunt cannulae 1–2 mm in diameter are used to inject the fat, avoiding vascular damage and intravascular injections.[6,8–10,14] A pistol device, which delivers constant pulses of 0.5–1 ml of fat, had been previously used.[10] The maximum recommended pulse varied from 0.2 ml,[7] 0.25 ml,[6] 1 ml[5,17] to 5 ml.[21] Injecting large volumes of fat could cause contour irregularities[8] and jeopardize the vascularity of the graft[9]; injections of more than 1.5 ml can result in fat necrosis.[24] It is important to recognize tissue tension, and plan a repeat session instead.

The volume of injected fat varies depending on the size and surface area of the defect. In a study of 17 patients with different deformities, between 70 and 460 ml of fat were injected.[7] Missana used an average of 144 ml per breast following latissimus dorsi (LD) reconstructions and transverse rectus abdominis (TRAM) flaps, and an average of 75 ml in breasts following breast conserving surgery.[8]

Volume loss after lipomodelling

A degree of fat resorption occurs in almost all cases of lipomodelling, constitutes a major disadvantage, and may necessitate repeating the procedure.

Experimental studies have found that up to 90% of transplanted adipose tissue could be lost,[13,16,25] while clinically reported figures range between 40 and 60%.[9,10,17] Most of the volume loss occurs within the first 4–6 months following surgery.[7,9]

Histological examination of the fat graft within the first few weeks has revealed macrophages, lymphocytes, fibroblasts and giant cells,[16] in addition to lipid cysts and necrotic tissue. Suctioned fat has shown more of these changes than aspirated or excised fat.[16,25] Months later, more fibrous tissue and less viable fat cells were evident. Improvements in shape and contour can be preserved through fibrous tissue, even in the absence of viable adipocytes.[26] On the other hand, biopsies obtained up to 3 years after facial transfer have revealed viable adipocytes in a well defined vascular lobular structure, and no evidence of fibrosis.[10,15]

Cellular disruption secondary to mechanical stresses, lipid induced membrane damage, development of an inflammatory