A Comparison of Conventional with Ultrasonic Liposuction in Gynaecomastia Surgery

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Abstract

A wide range of surgical techniques have been described for gynaecomastia treatment including various forms of liposuction, open excision, skin reduction and combinations. Over the last two decades, conventional liposuction, also known as suction-assisted lipectomy, and ultrasound-assisted liposuction (UAL) have been demonstrated to be effective treatment options. In particular, there has been growing interest in UAL. Although high complications rates were reported in some early studies, subsequent reports have suggested that UAL is a more effective treatment modality versus traditional liposuction. This chapter compares the roles of conventional liposuction and ultrasonic liposuction in gynaecomastia surgery. We outline the salient features and principles of each technique with subsequent review of the literature regarding safety and postoperative outcomes.

50.1 Introduction

Gynaecomastia is defined as the benign enlargement of male breasts. It has a reported prevalence of 30–70 % depending on the age group [1–3] and can be associated with significant

Disclosures The authors have no financial or other relationship with any of the manufacturers of the products mentioned in this article.

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M.A. Shiffman, A. Di Giuseppe (eds.), *Liposuction: Principles and Practice*,
DOI 10.1007/978-3-662-48903-1_50

psychological morbidity. Gynaecomastia is commonly graded using the histological and clinical classification systems proposed by Graser and Simon, respectively [4–6]. To guide our treatment modality, we classify gynaecomastia into two clinical groups [7]: small to moderate size with minimal skin excess and moderate to large size with moderate to marked skin excess.

When surgery is indicated (Table 50.1), the aim is to restore the normal male chest contour with minimal scarring whilst maintaining the viability of the nipple-areola complex. A variety of surgical techniques have been described for gynaecomastia treatment including various forms of liposuction, open glandular excision, skin reduction and combinations. In our practice, surgical treatment always starts with liposuction (Table 50.2) as it is minimally invasive and frequently successful as a single modality [8–11]. In addition it decreases bleeding and improves contouring of the tissues if conversion to open excision is required [7]. In patients with obvious skin excess or very large breasts, skin reduction techniques should also be planned usually at the same time as the open excision of the breast tissue or sometimes months later. Gynaecomastia patients are a difficult group of patients to satisfy [12], and scarring is an issue, hence the popularity of minimally invasive techniques such as liposuction. Liposuction has now become established as the prime modality in the surgical treatment of gynaecomastia.

Table 50.1 Indications for gynaecomastia surgery

Persistent enlargement after puberty (>2 years) and exclusion of medical causes
Inadequate response to medical treatment
Severe breast enlargement
Significant asymmetry or unilateral condition
Severe psychosocial effects or morbidity
Post-massive weight loss
Patient request
Specific clinical conditions
Drug induced – prostate cancer treatment
Drug induced – anabolic steroid use or cannabis use (as unlikely to respond to medical therapy or resolve spontaneously)

Table 50.2 Rationale for liposuction as a routine preliminary procedure in gynaecomastia surgery

Minimally invasive
Frequently successful as a sole treatment modality
Facilitates open excision by pretunnelling
Decreases the bleeding of open excision via a combination of the infiltration and blunt trauma to the vessels resulting in vasospasm
Improved aesthetic results by feathering the peripheries and allowing fine adjustment

Liposuction for gynaecomastia surgery is used in various forms including conventional, power assisted, ultrasound assisted, laser assisted and vibration amplification of sound energy at resonance (VASER) assisted [11, 13–16]. The most common types used are conventional and ultrasound-assisted liposuctions. These modalities are used either alone or in combination with a variety of excision methods such as open excision via circumareolar, periareolar, transareolar or circumthelial incisions [17–29]. An increasing number of minimally invasive techniques have also been described including endoscopically assisted [30, 31], pull-through techniques [32–35], arthroscopic shavers [32, 36, 37] and mammotome excision techniques [38, 39].

Conventional liposuction, also referred to as 'traditional liposuction' or 'suction-assisted lipectomy' (SAL) was introduced by Yves Illouz in the 1970s with a series of over 3,000 cases [40] of body contouring at different sites. It enabled the contouring of diffusely enlarged breasts with minimal scarring. Ultrasound-assisted liposuction (UAL) was developed by Zocchi [13] in the 1980s based on selective destruction of adipose tissue whilst protecting other tissues from damage. By emulsifying breast fat, it is particularly effective for areas with high density of fibroconnective tissue such as the breasts. When available, it has become our preferred modality of treatment because of its putative advantages of better skin contraction, minimal bruising, less surgeon fatigue and safer large treatment volumes [16]. Our practice entails the use of both

conventional and ultrasonic liposuction and these two modalities are hence compared here.

50.2 Surgical Technique

50.2.1 Anaesthesia and Infiltration

All surgery is performed under general anaesthesia as day cases. Patients are marked preoperatively in the upright sitting position highlighting the inframammary fold, breast boundaries, planned stab incision sites and concentric topography-type marks centred on the most prominent portion of the breast (Fig. 50.1). The breast tissue is infiltrated through a stab incision in the lateral inframammary crease using a super-wet (near-tumescent) technique. The wetting solution consists of Ringer's lactate containing 1 mL of 1 in 1,000 solution of adrenaline (1 mg) and 30 mL of 1 % lignocaine (300 mg) per liter. All patients receive an intravenous dose of a broad-spectrum antibiotic such as co-amoxiclav at induction of anaesthesia. A dose of dexamethasone (6.6 mg) is also routinely administered.

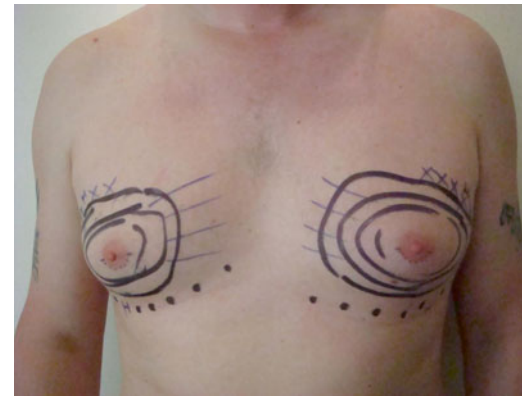

Fig. 50.1 Preoperative marking of gynaecomastia patient in upright position. Concentric topography-type marks are centred on the most prominent portion of the breast. The *dots* highlight the inframammary fold. The *parallel lines* indicate the areas of tapering of the liposuction in the areas adjacent to the breast tissue, whilst the *crosses mark* the areas not to be 'violated' during the liposuction procedure

50.2.2 Conventional Liposuction or Suction-Assisted Lipectomy (SAL)

After infiltration, a suction cannula is inserted through the same access incision used for infiltration. The laterally placed incision allows better access for liposuction to the whole breast over axillary and transareolar incisions preferred by others. A 4.6 mm or 5.2 mm, Mercedes cannula is used for the initial suction employing the palm-down and pinch techniques. The final contouring is performed with a 3.7 mm Mercedes cannula. During suction, contour changes are constantly assessed by direct observation, whilst the thickness of the breast is evaluated intermittently with the contralateral hand. A close watch is also kept on the colour (blood staining) and volume of the aspirate. Once a satisfactory contour is obtained, the surrounding fat is feathered to avoid a noticeable saucer deformity, and any well-defined inframammary fold as determined preoperatively is deliberately disrupted in order to avoid the female contour of the breast. This also enables the liposuction to extend well beyond the confines of the breast in order to facilitate postoperative redraping of the skin as popularised by Rosenberg [41–43].

Special liposuction cannulas specifically designed for the treatment of gynaecomastia have been successfully used for the treatment of more difficult or firmer breasts [42, 44–46]. Cross-suctioning for larger breasts, ptotic breasts, excess skin or well-defined inframammary folds makes SAL more effective. Such extensive cross-suctioning enables more consistent contraction of the skin and allows it to redrape with less waviness and irregularity. The inframammary crease can be obliterated by sharp dissection [47] or by suction cannulas [43]. In our practice we do not employ special sharp cannulas due to the potential risk of intra- and postoperative bleeding.

Conventional liposuction can be used in the traditional manner as in our practice, employ power assistance alone [48] or in combination with open glandular excision [49]. Traditional

liposuction is effective for soft to moderately firm breasts especially those with a diffuse distribution. It is particularly unsuccessful in patients with firm discrete subareolar lumps.

50.2.3 Ultrasound-Assisted Liposuction (UAL)

Ultrasound-assisted liposuction has been widely used in the treatment of gynaecomastia since its introduction by Zocchi [13]. It employs either solid or hollow cannulas. It targets the fat without causing unnecessary damage to the surrounding tissues. Its advantages are well documented [6, 16, 50–52]. In our practice we used the Contour Genesis machine (Mentor Medical Systems, Santa Barbara, California) from 1999 to 2008 (Fig. 50.2). The amplitude is set at 85 %, except in cases of exceptionally fibrous breasts, when it is increased to 95 %. After infiltration with the wetting solution (400 mL/min rate), a hollow UAL cannula (golf-tee shape) is inserted through the same stab incisions as those used for conventional liposuction. In addition to the better mechanical leverage of the liposuction, the laterally placed incisions avoid trauma and thermal burns to the nipple-areola complex [6, 7, 16]. Routine safety measures to avoid thermal injuries are taken [6, 7, 16] including continuous saline irrigation through the sheath system (40 mL/h), use of a probe sheath, wet towels around the entry site and avoidance of 'end hits'. The cannula is continuously moved in fan-like long strokes, starting deep and working superficially. The strokes should go beyond the marked boundaries of the breast enlargement, and as with SAL, a special effort is made to disrupt the inframammary fold where this is well formed. The well-described UAL endpoints [53] are determined by loss of tissue resistance, aspirate volume, blood-tinged appearance of the aspirate and planned treatment time. Final fat evacuation and contouring is performed using conventional liposuction (3.7 mm Mercedes cannula) with the suction set at the machine's maximum of 10 mL/min.

From 2009 the authors switched to the Lysonix 3000 UAL machine (Mentor Medical Systems, Santa Barbara, California) (Fig. 50.3). Essentially this differs from the original Contour Genesis machine in that it can be set on continuous or pulsed modes. It is also less cumbersome and less labour intensive. Its efficient heat dissipation on the pulsed mode avoids the need for continuous

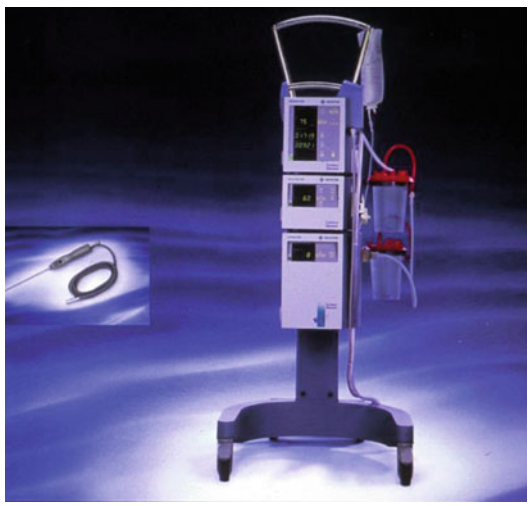

Fig. 50.2 Contour Genesis ultrasonic liposuction machine (Mentor Medical Systems, Santa Barbara, California)

Fig. 50.3 Lysonix 3000 ultrasonic liposuction machine (Mentor Medical Systems, Santa Barbara, California)

Table 50.3 Disadvantages of ultrasonic liposuction

Limited availability and expensive equipment
Increased operating time
Labour intensive for the nurses
Specific risks of:
Thermal injury
Skin necrosis
Demyelination of peripheral nerves
Cavitation and potential DNA changes
Meticulous precautions are needed including:
Skin guard
UAL probe sheath
Continuous fluid irrigation
Wet towel around the skin
Continuous technique
Avoidance of end hits

cooling fluid irrigation during the emulsification period and minimises the risk of thermal injuries. Like the Contour Genesis machine, it also employs a hollow cannula to enable simultaneous aspiration during the emulsification time. Likewise it also needs conventional liposuction for complete evacuation and final contouring. UAL is technically demanding and a number of precautions have to be undertaken to prevent morbidity (Table 50.3) [54–59].

Various studies have shown that UAL is an effective and safe technique when performed by experienced surgeons [6, 11, 16, 50]. There have, however, been concerns expressed about the cavitational effects of UAL. These arise from the generation, expansion and rapid collapse of bubbles in the sound field. In vitro studies suggest that these effects may result in sufficient energy to potentially cause DNA damage and active free radicals with carcinogenic potential [60–63]. However, the results of in vitro studies can be difficult to extrapolate to the clinical situation to make realistic estimates about the carcinogenic risks of UAL in vivo [64], and these negative bioeffects are probably not serious safety concerns with UAL [65]. Di Giuseppe [66], for instance, found no alternations in the morphology of the breast parenchyma on mammographic studies up to 5 years post breast reduction using UAL. Furthermore, Herr et al. [67] found no evidence of excessive formation of lipid oxidation products in response to free radicals during in vivo UAL.

50.2.4 Open Excision ± Skin Reduction

Following liposuction, if there is any residual breast tissue or a satisfactory contour has not been achieved, open glandular excision is performed. Despite meticulous palm-down and pinch techniques, residual nodules are a frequent complication of conventional liposuction [7, 37] requiring intraoperative conversion to open excision, in contrast to UAL [11]. Furthermore, liposuction is sometimes not effective in very glandular tissue, in small discrete breast buds and in body builders as the latter have large amounts of glandular tissue with little fat [68, 69].

Conceptually the conversion of a minimally invasive procedure such as liposuction to open excision of the residual gynaecomastia tissue can be considered or viewed as a failure of the liposuction. This is despite the fact that in some patients, following preoperative clinical assessment, open excision is planned to follow the liposuction. In our practice, surgical treatment of gynaecomastia always starts with liposuction, so any intraoperative conversion to open excision is technically a 'failure' of the liposuction. Open excision is a definitive endpoint which can thus be used to objectively compare different liposuction techniques.

The breast tissue is excised via a semicircular incision along the inferior margin of the nipple-areola complex (Webster's technique). To excise the excess tissue, Bostwick scissors are used to dissect inferiorly to the lower border of the breast before proceeding in a deep plane above the pectoralis major muscle to the superior border of the breast. A 1 cm disc of breast tissue is left under the areola to prevent a depression of the nipple-areola complex [7].

Skin reduction at the time of open excision or as a second stage, a minimum of 4–6 months later, should also be considered for patients requiring totally flat breasts or presenting with true ptosis or skin excess (Table 50.4).

Table 50.4 Indications for skin reduction in gynaecomastia

Severe breast enlargement
Significant breast ptosis
Massive weight loss
Marked skin excess or laxity

Fig. 50.4 An example of a typical gynaecomastia garment

50.2.5 Postoperative Care

Drains are not routinely used similar to the experience of others [70] except for large resections or when skin reduction is performed such as in post-massive weight loss patients. Following the procedure, a pressure dressing consisting of fluffed-up gauze or Reston foam (3M Healthcare System, Borken, Germany) is applied and held in place with Microfoam or Mefix tape. Patients are instructed to wear a gynaecomastia pressure garment (Fig. 50.4) day and night for 4–6 weeks.

50.3 Revisional Surgery

Gynaecomastia patients are by and large a surgically challenging group of patients not least because of their expectations of surgery. In patients who have undergone surgical treatment, it is sometimes necessary to perform revision surgery several months after the initial operation for a variety of reasons. These include inadequate correction, patient dissatisfaction [12], presence of painful residual lumps, asymmetries and 'recurrence' (often related to weight gain). Overcorrection is rare. Similar to other surgical conditions, the need for revision surgery is an objective indicator of the effectiveness of a particular treatment.

50.4 Discussion

Over the last two decades, there has been growing interest in ultrasound-assisted liposuction (UAL) for the surgical treatment of gynaecomastia [6, 16, 50, 71]. Although high complications rates were reported in some early studies [54–59], subsequent reports have suggested that postoperatively, UAL results in less ecchymosis and swelling, smoother breast contours and better postoperative skin contraction [7, 16, 50–52]. However, these supposed advantages are largely subjective, so the authors recently objectively compared conventional liposuction with UAL in the treatment of gynaecomastia using two definitive endpoints, namely, intraoperative conversion to open excision and postoperative revisional surgery rates [11].

The study was a chart review of all gynaecomastia patients treated with UAL or conventional liposuction between September 1999 and January 2012 by a single operator (CMM). All the case records were available for review. UAL was only available in the private sector and was used for all such patients with no other selection or exclusion criteria. Following surgery, patients were reviewed in the outpatient clinic between October 1999 and September 2012. To avoid selection bias and minimise subjectivity, each episode of intraoperative conversion to open excision was included regardless of whether it had been planned preoperatively or not.

A total of 219 patients (384 breasts) with a mean age of 29 years (range 12–74) presented to the senior author for surgical treatment. Their characteristics are summarised in Tables 50.5 and 50.6.

Table 50.5 Gynaecomastia size of patients in the two treatment groups

Size	Number breasts (% total)	
	Ultrasound-assisted liposuction	Conventional liposuction
Small	20 (22 %)	50 (17 %)
Moderate	32 (35 %)	131 (45 %)
Large	36 (40 %)	89 (30 %)
Not documented	3 (3 %)	23 (8 %)

Table 50.6 Breast consistency of gynaecomastia patients in the two treatment groups

Consistency	Number breasts (% total)	
	Ultrasound-assisted liposuction	Conventional liposuction
Soft	10 (11 %)	54 (18 %)
Moderate	35 (38 %)	114 (39 %)
Firm	31 (34 %)	75 (26 %)
Not documented	15 (16 %)	50 (17 %)

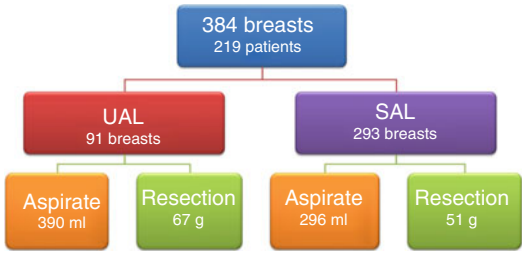

Fig. 50.5 Mean fat aspirate volumes and gland resection weights in patients treated with conventional or ultrasound-assisted liposuction

Conventional liposuction was utilised in 76 % of breasts (172 patients, 293 breasts) (Fig. 50.5). The mean age of patients in this group was 28 years (range 12–69). The average amount of fat aspirated was 296 mls. Patients who had intraoperative conversion to open excision had an average gland resection weight of 51 g. Almost a quarter of all breasts in the series were treated with UAL (24 % of breasts; 47 patients, 91 breasts) (Fig. 50.5). The mean age of the UAL patients was comparable to the SAL group at 28 years (range 14–74). The average amount of fat aspirated was 390 mL, whilst the mean resection weight in those undergoing intraoperative conversion to open excision was 67 g.

Over the 13-year study period, there was no significant bias in the temporal distribution of the number of intraoperative conversion to open excision and postoperative revision cases for the two treatment groups (Figs. 50.6 and 50.7). There was also no difference in outcomes between the two different UAL machines used (Fig. 50.6). Using Student's *t* test, there was no significant difference in age distribution between the two treatment groups ($p > 0.05$). The Pearson's chi-square test similarly revealed no significant difference in the size and consistency of gynaecomastia treated between the two groups ($p > 0.05$). The smoking rates were comparable in the two groups ($p > 0.05$).

Compared to conventional liposuction, UAL had significantly lower rates of intraoperative

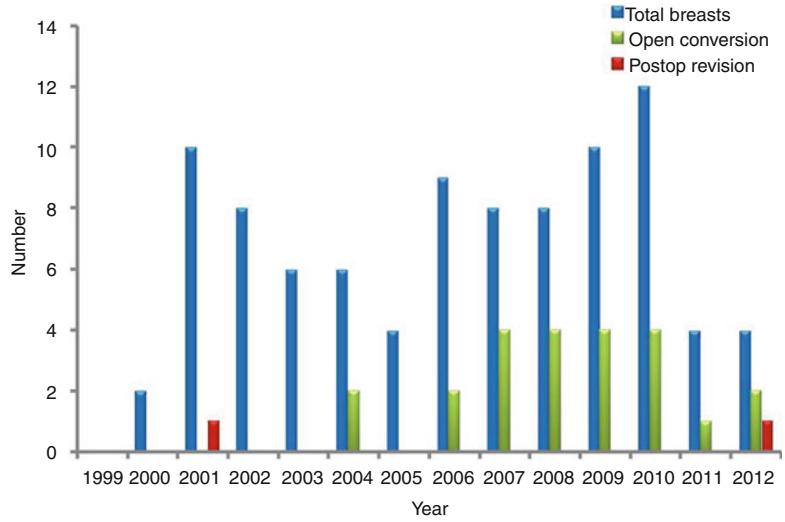

Fig. 50.6 Number of ultrasonic liposuction cases performed per year including associated intraoperative conversions to open excision and postoperative revisions

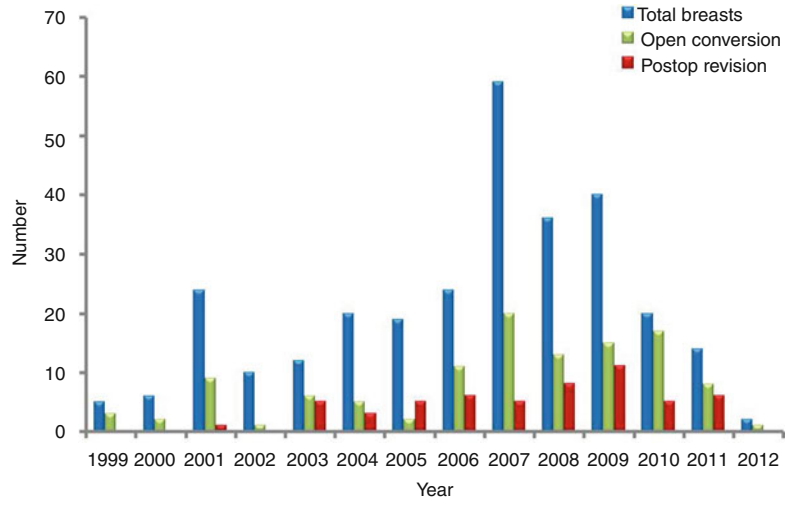

Fig. 50.7 Number of conventional liposuction cases performed per year including associated intraoperative conversions to open excision and postoperative revisions

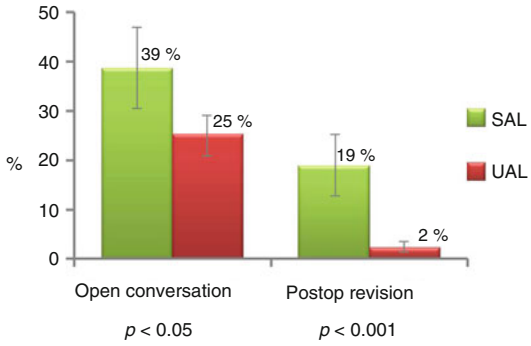

Fig. 50.8 Intraoperative conversion to open excision and postoperative revision rates (± standard deviation) for the ultrasound-assisted liposuction (UAL) and suction-assisted lipectomy (SAL) treatment groups. Using Fisher's exact test, there was a significant difference in these definitive outcome measures between the two treatment groups

conversion to open excision (25 % (23/91 breasts) versus 39 % (113/293 breasts); $p<0.05$) and postoperative revision (2 % (2/91 breasts) versus 19 % (55/293 breasts); $p<0.001$) using Fisher's exact test (Fig. 50.8). Therefore patients treated with UAL were therefore 8.5 times less likely to undergo subsequent revision surgery and 1.5 times less likely to have intraoperative conversion to open excision. Interestingly, the volume of fat aspirated was also significantly higher with UAL as assessed by Student's *t* test ($p<0.05$). Revisional surgery was performed for residual or persistent breast tissue or asymmetry. The haematoma rate for each technique was 1 %. As this was a retrospective study, it was not possible to assign a grade of gynaecomastia to all the patients; thus a subgroup comparison based on gynaecomastia grade was not performed. Both UAL and conventional liposuction techniques were used since 1999 with no obvious temporal trend, thus eliminating the potential surgeon experience bias on the two definitive outcome measures. Representative cases of the results of gynaecomastia treated by conventional liposuction (Fig. 50.9) and UAL (Fig. 50.10) are illustrated.

The study was the first to document an objective comparison of conventional and ultrasonic liposuction in gynaecomastia treatment [11]. A prospective study of 100 patients comparing conventional and UAL at different sites found no difference in postoperative ecchymosis, swelling, complication rate or skin contraction [51]. However, these comparative parameters were largely subjective. Despite the retrospective nature of the study herein reported, it utilised unambiguous and definitive endpoints, namely, intraoperative conversion to open excision and postoperative revisional surgery rates. The latter has a negative effect on patient experience and incurs additional financial costs for the patient and the institution. It is our contention that the present comparison is valid as this single surgeon study eliminates inter-operator variability. Although the senior author was not blinded to the treatment modality used, the only selection bias was the patient's ability to pay for the ultrasonic liposuction. Conventional liposuction was freely available on the National Health Service (NHS).

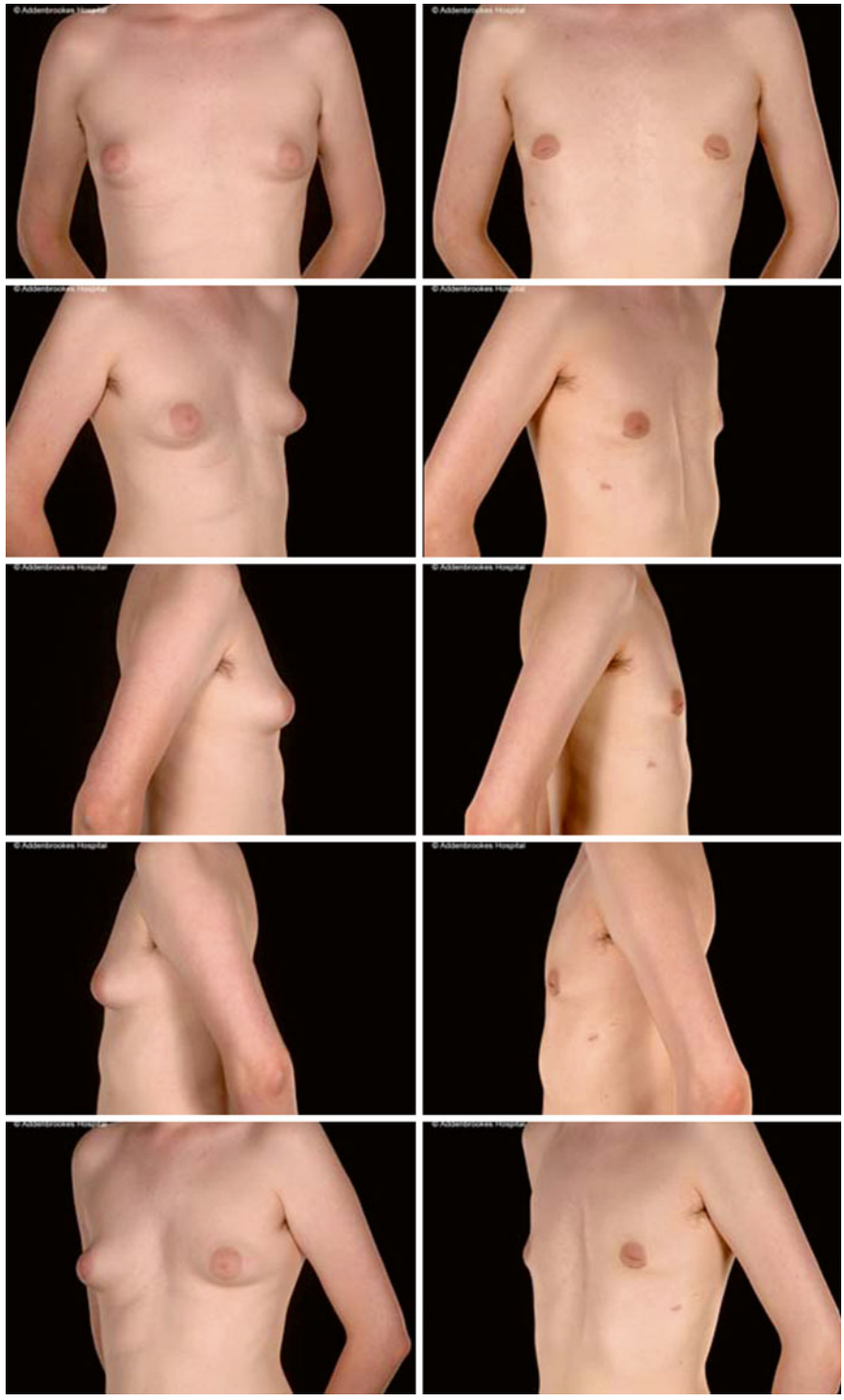

Fig. 50.9 A 20-year-old patient with gynaecomastia of large size and moderate consistency treated by conventional liposuction and open excision. (*Left*) Preoperative. (*Right*) Five months postoperative. Note the destruction of the inframammary fold and loss of the gynaecoid shape of the breasts on the oblique view. On the lateral view, note the restoration of a male chest contour with minimal scarring. The ballooned out areolas have been deflated by the liposuction whilst avoiding tethering of the nipple papillae

Fig. 50.10 A 51-year-old patient with gynaecomastia of moderate size and consistency treated by ultrasound-assisted liposuction only. (*Left*) Preoperative. (*Right*) Five months postoperative in addition to his completed arm tattoo. Skin contraction was satisfactory despite his age and less than ideal skin quality. Wide liposuction enabled adequate redraping of the skin and the smooth disruption of the inframammary folds

The ability to pay and thus receive ultrasonic liposuction is to all intents and purposes not related to gynaecomastia grade or consistency. Furthermore, all private patients received fixed price surgery packages, which included free revisions during the first postoperative year. Hence cost did not discourage UAL patients who were not entirely happy with their cosmetic outcomes from seeking or undergoing revisional surgery. Although it was not a positive encouragement for them to pursue this, at worst our results may have overestimated the revisional surgery rate in UAL patients. On the other hand, there may have been differences in socioeconomic status and lifestyle factors between the two treatment groups that could have affected the outcomes. There were, however, no significant differences in the ages, gynaecomastia grades, breast sizes and smoking rates between the treatment groups.

Despite the limitations of the present retrospective cohort study, it clearly demonstrates that the intraoperative conversion to open excision and revisional surgery rates was significantly higher using conventional liposuction compared to UAL. This is despite the fact that our study underestimates the revisional surgery rate in the SAL group in that a number of patients had more than one revision. More specifically, in this group, 31 patients (55 breasts) required 61 revisional surgeries, but this was crudely assessed as one revision per patient. None of the reoperated patients in the UAL group required more than one postoperative revision. The clinical significance of our study lies in its implications for patient counselling. Based on these two parameters, it can be confirmed that UAL is a better treatment modality for gynaecomastia. Conventional liposuction patients should be informed that they are almost twice as likely to need intraoperative conversion to open excision as those undergoing ultrasonic liposuction and 8.5 times more likely to need postoperative revision.

Conclusions

When surgery is indicated for gynaecomastia, the aim is to consistently achieve a natural-looking male chest with minimal scarring whilst maintaining the viability of the nipple-areola complex. In our practice, surgical treatment always starts with liposuction as it is minimally invasive and frequently successful as a single modality. UAL is a more effective treatment modality for gynaecomastia than conventional liposuction as determined by the objective parameters of intraoperative conversion to open surgery and subsequent need for revision. Whenever available, UAL may be a more efficacious liposuction method for treating gynaecomastia.

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