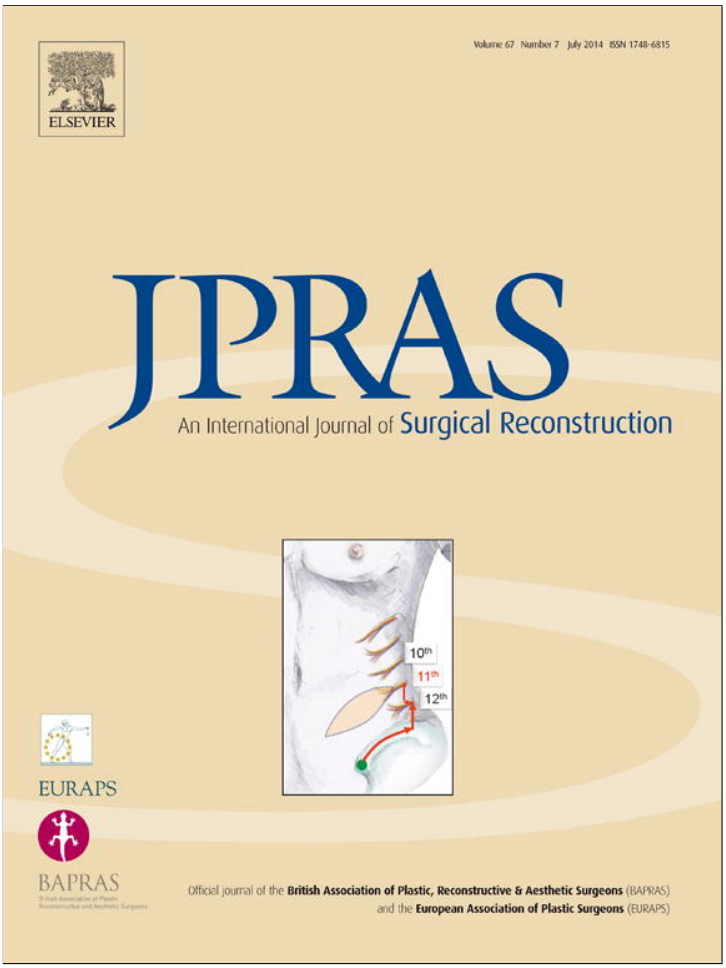

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Conventional versus ultrasound-assisted liposuction in gynaecomastia surgery: A 13-year review☆

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Summary *Background:* Numerous surgical techniques exist for gynaecomastia treatment. Although ultrasound-assisted liposuction (UAL) is thought to be more effective than conventional liposuction, to date there remains no objective and direct comparison of the two modalities. Hence, a comparative study was performed of a single surgeon's experience over 13 years using two definitive parameters, namely intraoperative conversion to open excision and postoperative revisional surgery rates.
Methods: All gynaecomastia patients treated with UAL or conventional liposuction (1999—2012) were retrospectively studied. UAL was only available in the private sector and was used for all such patients with no other selection or exclusion criteria.
Results: A total of 219 patients (384 breasts) with a mean age of 29 years (range 12—74) were evaluated. UAL was utilised in 24% of breasts (47 patients, 91 breasts). Compared with conventional liposuction, UAL had significantly lower rates of intraoperative conversion to open excision (25% vs. 39%; $p < 0.05$) and postoperative revision (2% vs. 19%; $p < 0.001$) using Fisher's exact test. The haematoma rate for each technique was 1%.
Conclusion: UAL is a more effective treatment modality for gynaecomastia than conventional liposuction as determined by intraoperative conversion to open surgery and subsequent need for revision.

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Introduction

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 past two decades, there has been growing interest in ultrasound-assisted liposuction (UAL) for this purpose.[1–4] Although high complication rates were reported in some early studies,[5–10] subsequent reports have suggested that postoperatively, UAL results in less ecchymosis and swelling, smoother breast contours and better postoperative skin contraction.[1,4,11–13] However, all these supposed advantages are subjective, and specifically, there has been no objective and direct comparison to date of conventional or suction-assisted lipectomy (SAL) versus UAL in the treatment of gynaecomastia. It was therefore the objective of this investigation to review a single surgeon's experience over 13 years and retrospectively compare these two treatment modalities using two definitive end points, namely intraoperative conversion to open excision and postoperative revisional surgery rates.

Methods

Study design

This 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.

Operative techniques

All surgery was performed under general anaesthesia using standard techniques as previously published.[4,13] Patients were 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. All patients underwent liposuction, whether conventional or ultrasonic, at the beginning of surgery[13] and therefore the breast tissue was infiltrated through a stab incision in the lateral inframammary crease using a superwet/tumescent technique. The wetting solution consisted of Ringer's lactate containing 1 ml of 1 in 1000 solution of adrenaline (1 mg) and 30 ml of 1% lignocaine (300 mg) per litre. Drains were not routinely used.

Following the procedure, a pressure dressing consisting of fluffed-up gauze or Reston foam (3M Healthcare System, Borken, Germany) was applied and held in place with microfoam or mefix tape. Patients were instructed to wear a pressure garment day and night for 4–6 weeks. The following surgical techniques were used singly or in combination.

Conventional liposuction or SAL

After infiltration, a suction cannula was inserted through the same incision, and occasionally a second incision was made over the anterior axillary fold superiorly. A 4.6-mm or 5.2-mm Mercedes cannula was used for the initial suction by the palm down and pinch techniques. The final contouring was performed with a 3.7-mm Mercedes cannula. During suction, contour changes were constantly assessed by direct observation, while the thickness of the breast was evaluated intermittently with the contralateral hand. A close watch was also kept on the colour and volume of the aspirate. Once a satisfactory contour was obtained, the surrounding fat was feathered to avoid a noticeable saucer deformity, and any well-defined inframammary fold as determined preoperatively was disrupted.

Ultrasound-assisted liposuction

Ultrasonic liposuction was available only in the private sector and was performed with the Contour Genesis machine (Mentor Medical Systems, Santa Barbara, CA, USA) from 1999 to 2008. The amplitude was set at 85%, except in cases of exceptionally fibrous breasts, when it was increased to 95%. After infiltration with the wetting solution (400 ml/min rate), a hollow UAL cannula (golf-tee shape) was inserted through the same stab incisions as that used for conventional liposuction. Routine safety measures to avoid thermal injuries were taken[3,4,13] 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 was continuously moved in fan-like long strokes, starting deep and working superficially. The strokes went beyond the marked boundaries of the breast enlargement, and as with SAL, a special effort was made to disrupt the inframammary fold where this was well formed. The well-described UAL end points were determined by loss of tissue resistance, aspirate volume, appearance of the aspirate and treatment time. Final evacuation and contouring was performed using conventional liposuction (3.7-mm Mercedes cannula) set at the machine's maximum of 10 ml/min.

From 2009 onwards, the Lysonix 3000 UAL was used (Mentor Medical Systems, Santa Barbara, CA, USA). This new equipment can be set on continuous or pulsed modes. It is less cumbersome and less labour intensive. Its efficient heat dissipation avoids the need for continuous 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.

Open excision

Following liposuction, if there was any residual breast tissue or if a satisfactory contour had not been achieved, it was decided to undertake open glandular excision. The breast tissue was excised via a semicircular incision along the inferior margin of the nipple–areolar complex. To excise the excess tissue, Bostwick scissors were used to dissect inferior to the border of the breast before proceeding in a deep plane to the superior border of the breast. A 1-cm disc of breast tissue was left under the areola to prevent a depression of the nipple–areolar complex.

Data analysis

Fisher's exact test was used to compare the frequencies of definitive end points between the two different operative techniques. Pearson's chi-square test was used to compare the size and consistency of gynaecomastia between the two treatment groups. Other data were analysed by the unpaired Student's *t*-test as appropriate. A p value of <0.05 was taken as significant. All statistical calculations were performed using SPSS version 20.

Results

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 1 and 2.

Conventional liposuction was utilised in 76% of breasts (172 patients, 293 breasts). The mean age of patients in this group was 28 years (range 12–69). The average amount of fat aspirated was 296 ml. Patients who had intraoperative conversion to open excision had an average resection weight of 51 g.

UAL was utilised in almost a quarter of all breasts treated (24% of breasts; 47 patients, 91 breasts). The mean age of UAL patients was 28 years (range 14–74). The average amount of fat aspirated was 390 ml. Patients who had intraoperative conversion to open excision had an average resection weight of 67 g.

Table 1 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 2 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)

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. There was also no difference in outcomes between the two different UAL machines used. 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 ($p > 0.05$). There was also no significant difference in the rate of smoking between the two groups ($p > 0.05$).

Compared with conventional liposuction, UAL had significantly lower rates of intraoperative conversion to open excision (25% vs. 39%; $p < 0.05$) and postoperative revision (2% vs. 19%; $p < 0.001$) using Fisher's exact test (Figure 1). 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, comparison

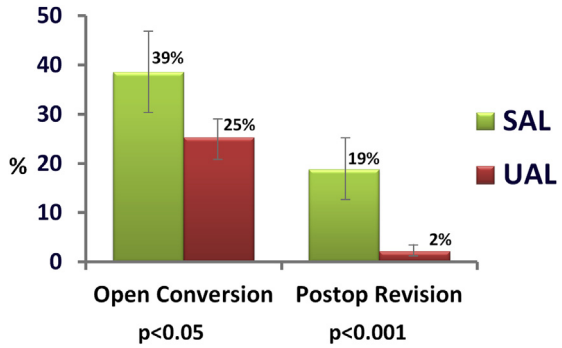

Figure 1 Intraoperative conversion to open excision and postoperative revision rates (±standard deviation) for the ultrasound-assisted liposuction (UAL) and suction-assisted lipectomy (SAL) treatment groups. Using Fisher's exact test, there was a significant difference between the definite outcome measures of the two treatment groups.

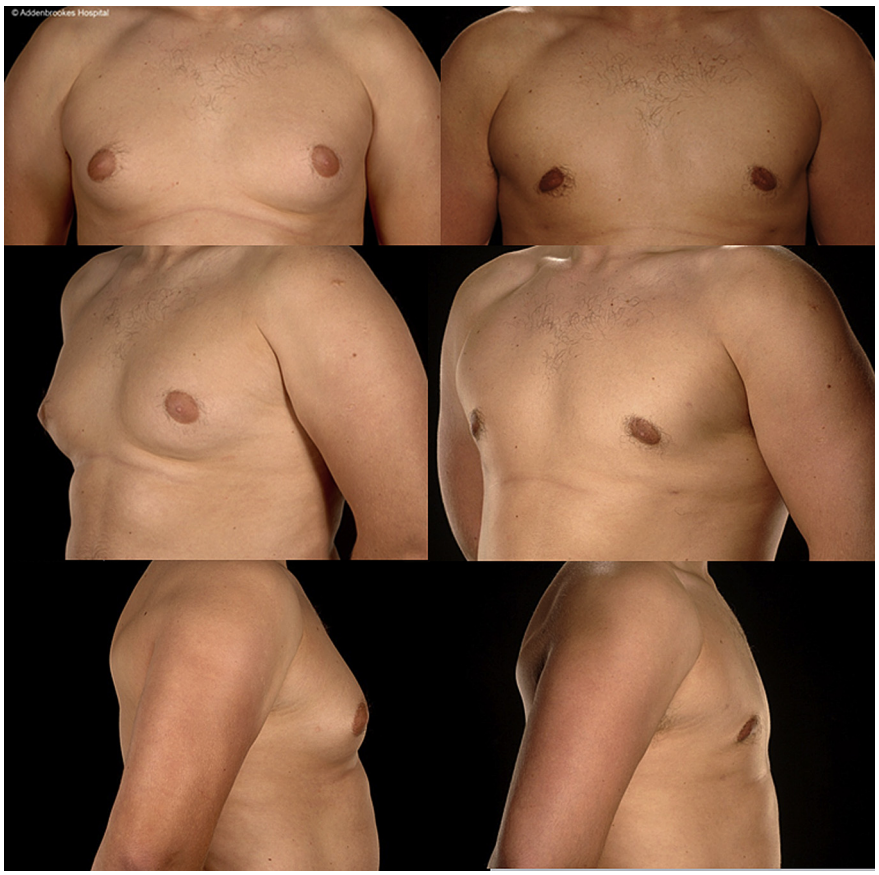

Figure 2 A 25-year-old patient with gynaecomastia of moderate size and consistency treated by conventional liposuction only. (*Left*) Preoperative appearance and (*Right*) postoperative result 6 months later.

between groups based on 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 (Figure 2) and UAL (Figure 3) are illustrated.

Discussion

The present study is the first to document an objective comparison of ultrasound-assisted liposuction (UAL) and conventional liposuction for gynaecomastia treatment. A prospective study of 100 patients comparing conventional liposuction and UAL at different sites found no difference in postoperative ecchymosis, swelling, complication rate or skin contraction.[11] However, these comparative parameters were largely subjective. Despite the retrospective nature of the study herein reported, it utilised unambiguous and definitive end points, 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. We believe our comparison is valid as this single-surgeon study eliminates inter-operator variability. Although the senior author was not blinded to the treatment modality, the only selection bias was the patient's ability to pay. The latter 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. On the other hand, there may have been differences in socio-economic status and lifestyle factors between the two treatment groups that could have affected the outcomes. There was however no significant difference in the smoking rate between the treatment groups.

Despite the limitations of our study, it clearly demonstrates that the intraoperative conversion to open excision and revisional surgery rates were significantly higher using conventional liposuction compared to UAL. This is despite the fact that our study underestimates the revisional surgery rate in the conventional liposuction 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 patients in the UAL group required more than one postoperative revision. The clinical significance of our study lies in its implications for patient counselling.

Various studies have shown that UAL is an effective and safe technique when performed by experienced surgeons.[1,4] There have however been concerns expressed about the cavitational effects of UAL. These arise from the

Figure 3 A 64-year-old patient with gynaecomastia of moderate size and consistency treated by ultrasound-assisted liposuction only. (*Left*) Preoperative appearance and (*Right*) postoperative result 6 months later.

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 produce active free radicals with carcinogenic potential.[14–17] 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[18] and these negative bioeffects are probably not serious safety concerns with UAL.[19] Di Giuseppe found no alternations to the morphology of the breast parenchyma on mammographic studies up to 5 years post breast reduction using UAL.[20] Furthermore, Herr et al. found no evidence of excessive formation of lipid oxidation products in response to free radicals during in vivo UAL.[21]

In conclusion, this retrospective single-surgeon study suggests that 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.

Conflict of interest or funding

None.

References

1. Maxwell GP, Gingrass MK. Ultrasound-assisted lipoplasty: a clinical study of 250 consecutive patients. *Plast Reconstr Surg* 1998;**101**:189–202.
2. Graf R, Auersvald A, Damasio RC, et al. Ultrasound-assisted liposuction: an analysis of 348 cases. *Aesthetic Plast Surg* 2003;**27**:146–53.
3. Rohrich RJ, Ha RY, Kenkel JM, Adams Jr WP. Classification and management of gynaecomastia: defining the role of ultrasound-assisted liposuction. *Plast Reconstr Surg* 2003;**111**:909–23.
4. Hodgson EL, Fruhstorfer BH, Malata CM. Ultrasonic liposuction in the treatment of gynaecomastia. *Plast Reconstr Surg* 2005;**116**:646–53.
5. Baxter RA. Histologic effects of ultrasound-assisted lipoplasty. *Aesthetic Surg J* 1999;**19**:109–14.
6. Perez JA. Treatment of dysesthesias secondary to ultrasonic lipoplasty. *Plast Reconstr Surg* 1999;**103**:1534.
7. Gerson RM. Avoiding end hits in ultrasound-assisted lipoplasty. *Aesthetic Surg J* 1997;**17**:331–3.
8. Grolleau JL, Rouge D, Chavoin JP, Costagliola M. Severe cutaneous necrosis after ultrasound lipolysis: medicolegal aspects and review. *Ann Chir Plast Esthet* 1997;**42**:31–6.
9. Troilius C. Ultrasound-assisted lipoplasty: is it really safe? *Aesthetic Plast Surg* 1999;**23**:307–11.
10. Lack EB. Safety of ultrasonic-assisted liposuction (UAL) using a non-water-cooled ultrasonic cannula: a report of six cases of

disproportionate fat deposits treated with UAL. *Dermatol Surg* 1998;**24**:871—4.
11. Fodor PB, Watson J. Personal experience with ultrasound-assisted lipoplasty: a pilot study comparing ultrasound-assisted lipoplasty with traditional lipoplasty. *Plast Reconstr Surg* 1998;**101**:1103—16.
12. Baker JL. A practical guide to ultrasound-assisted lipoplasty. *Clin Plast Surg* 1999;**26**:363—8.
13. Fruhstorfer B, Malata CM. A systematic approach to the surgical treatment of gynaecomastia. *Br J Plast Surg* 2003;**56**:237—46.
14. Doida Y, Brayman AA, Miller MW. Modest enhancement of ultrasound-induced mutations in V79 cells in vitro. *Ultrasound Med Biol* 1992;**18**:465—9.
15. Fuciarelli AF, Sisk EC, Thomas RM, Miller DL. Induction of base damage in DNA solutions by ultrasonic cavitation. *Free Radic Biol Med* 1995;**18**:231—8.
16. Kondo T, Yoshii G. Effect of intensity of 1.2 MHz ultrasound on change in DNA synthesis of irradiated mouse L cells. *Ultrasound Med Biol* 1985;**11**:113—9.
17. Miller DL, Thomas RM. The role of cavitation in the induction of cellular DNA damage by ultrasound and lithotripter shock waves in vitro. *Ultrasound Med Biol* 1996;**22**:681—7.
18. Topaz M. Long-term possible hazardous effects of ultrasonically assisted lipoplasty. *Plast Reconstr Surg* 1998;**102**:280—3.
19. Young VL, Schorr MW. Report from the conference on ultrasound-assisted liposuction safety and effects. *Clin Plast Surg* 1999;**26**:481—524.
20. Di Giuseppe A. Breast reduction with ultrasonic-assisted lipoplasty. *Plast Reconstr Surg* 2003;**112**:71—81.
21. Herr J, Hofheinz H, Hertl C, Olbrisch RR, Wieland E. Is there evidence for excessive free radical production in vivo during ultrasound-assisted liposuction? *Plast Reconstr Surg* 2003;**111**:425—9.