

Original Research Article

Effect of energy-based devices on skin retraction in gynaecomastia in comparison to conventional techniques: a prospective observational study

Prince Garg*, Rakesh Koudki, Ravi D. R.

Department of Plastic Surgery, Narayana Health City, Bangalore, Karnataka, India

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*Correspondence:

Dr. Prince Garg,

E-mail: princegargdude@gmail.com

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ABSTRACT

Background: Gynecomastia is a common benign condition in males that often requires surgical correction to achieve satisfactory aesthetic outcomes. Power-assisted liposuction (PAL) is widely used; however, optimal skin retraction remains challenging.

Methods: This prospective cohort study evaluated whether the addition of radiofrequency-assisted liposuction (RFAL) to PAL results in superior skin retraction compared with PAL alone in patients undergoing gynecomastia surgery.

Results: A total of 32 patients were equally divided into PAL alone and RFAL+PAL groups. Baseline demographic characteristics and Simon's grading were comparable between the groups. Both techniques resulted in progressive improvement in nipple–areola complex size and positioning over 6 months; however, the RFAL+PAL group demonstrated significantly greater reduction in NAC horizontal diameter and improved positioning ($p < 0.001$).

Conclusions: The addition of RFAL to PAL significantly enhances skin retraction and aesthetic outcomes in gynecomastia surgery, providing superior NAC reduction, improved alignment and sustained contour refinement compared with PAL alone.

Keywords: Chest contouring, Gynecomastia, Nipple–areola complex, Power-assisted liposuction, Radiofrequency-assisted liposuction, Skin retraction

INTRODUCTION

Gynecomastia is defined as the benign enlargement of male breast tissue resulting from proliferation of glandular components. It is a common clinical condition affecting males across different age groups, with peak incidence seen during neonatal life, puberty and older age. Although gynecomastia is often physiological, persistent enlargement may lead to significant psychological distress, social embarrassment and impaired quality of life.¹ Surgical management remains the mainstay of treatment for moderate to severe gynecomastia, particularly in cases refractory to medical therapy or long-standing fibrotic glandular tissue.

Conventional surgical techniques include liposuction, open excision or a combination of both. While these methods are effective in removing excess glandular and adipose tissue, achieving optimal skin retraction remains a challenge, especially in patients with moderate to severe grades of gynecomastia. Inadequate skin contraction may result in residual skin laxity, contour irregularities or the need for secondary procedures.²

In recent years, energy-based devices like ultrasound-assisted liposuction (UAL), radiofrequency-assisted liposuction (RFAL) and laser-assisted liposuction (LAL) have gained popularity in aesthetic and reconstructive surgery. These devices deliver thermal energy to the

subdermal tissues, promoting collagen denaturation and subsequent neocollagenesis, which enhances skin tightening and retraction. The theoretical advantage of these technologies lies in their ability to provide simultaneous fat emulsification and dermal contraction, potentially improving contour outcomes while minimizing the need for extensive skin excision.³

Despite the increasing use of energy-based devices in body contouring procedures, limited prospective data are available comparing their effectiveness in skin retraction specifically in gynecomastia surgery. Furthermore, objective evaluation of postoperative skin contraction and comparison with conventional techniques remains insufficiently explored in current literature.⁴

Therefore, the present prospective observational study was undertaken to evaluate the effect of energy-based devices on skin retraction in gynecomastia patients and to compare the outcomes with those achieved using conventional surgical techniques. The findings of this study may help in optimizing surgical strategies and improving aesthetic outcomes in patients undergoing gynecomastia correction.⁵

METHODS

This prospective cohort study was done in the Department of Plastic and Reconstructive Surgery, Narayana Hrudayalaya, Bommasandra, Bangalore, over a period of 12 months. Adult patients diagnosed with gynecomastia who met the inclusion criteria were enrolled and divided into two cohorts based on the surgical technique used. Group 1 included patients with Simon's grade IIB and III gynecomastia treated with power-assisted liposuction (PAL) along with gland excision, while Group 2 consisted of patients with the same grades treated using a combination of PAL and radiofrequency (RF)-assisted liposuction. Both groups were followed prospectively to assess and compare skin retraction outcomes.

Patients aged 18 years and above with Simon's grade IIB or III gynecomastia, without endocrine or systemic disorders and not on medications known to cause gynecomastia were included in the study. Patients with psychiatric disorders were excluded. Eligible participants presenting during the study period were recruited using consecutive sampling after obtaining informed written consent.

Baseline data including demographic details, gynecomastia grade, clinical characteristics and preoperative photographs were recorded. Preoperative assessment included detailed history, physical examination, laboratory investigations, radiological evaluation and ultrasonography to confirm the diagnosis. Standardized anatomical measurements like horizontal diameter of the nipple-areolar complex (NAC), distance from the mid-sternal line and deviation from the mid-

clavicular line were recorded under controlled conditions to avoid cold-induced NAC contraction.

Surgical correction aimed at removal of excess glandular and adipose tissue while preserving chest contour. Tumescence infiltration was performed using a standardized solution, followed by deep and superficial liposuction in a fan-like pattern using a multi-perforated micro-cannula. Glandular excision was carried out through an infra-areolar approach, leaving a thin disc of tissue beneath the NAC to prevent complications. In Group 2, RF energy (BodyTite) was applied intraoperatively to enhance skin retraction. All procedures and data collection were performed by a single surgical team.

Postoperatively, patients were followed up at 1, 3 and 6 months. Skin retraction was assessed quantitatively using anatomical landmarks and served as the primary outcome measure. Secondary outcomes included postoperative complications like seroma, hematoma, infection, skin necrosis and hypertrophic scarring, which were classified according to Bengtson's standard criteria.

Sample size was calculated based on a previous study by Pfeiler et al considering a significance level of 0.05, power of 80%, equal group allocation and an odds ratio of 11.733. The calculated minimum sample size was 16 patients per group, resulting in a total of 32 participants.

Data were entered into Microsoft Excel and analyzed using SPSS version 20. Categorical variables were analyzed using the Chi-square test, while continuous variables were compared using independent t-test or Mann-Whitney U test as appropriate. A p value of less than 0.05 was considered statistically significant. Ethical approval was obtained from the Institutional Ethics Committee prior to study initiation and confidentiality of patient data was strictly maintained throughout the study.

RESULTS

The age distribution and mean age of patients were comparable between the PAL alone and PAL+RF groups. Most patients were below 25 years of age, with a fairly even distribution across other age categories. Simon's grading showed a similar proportion of Grade IIB and Grade III gynecomastia in both groups. No statistically significant differences were seen in baseline characteristics, showing adequate group comparability.

Both right and left NAC horizontal diameters showed a consistent reduction from the preoperative period to 6 months postoperatively. The reduction was evident as early as 1 month and continued progressively at subsequent follow-ups. Mean NAC diameter decreased by approximately 0.7 cm on the right side and 0.6 cm on the left side by 6 months. This trend reflects effective postoperative skin retraction and contour improvement. The distance of the NAC from the mid-sternal line

decreased progressively on both sides over the 6-month follow-up period. The most marked reduction was seen within the first 3 months following surgery. Improvements were sustained at 6 months, showing stable medialization of the NAC. These findings suggest enhanced chest symmetry and aesthetic positioning after surgery.

RAF+PAL showed significantly greater reductions in NAC horizontal diameter and distance from the mid-sternal line compared to PAL alone at all follow-up intervals. The magnitude of change increased progressively from 1 to 6 months postoperatively. All intergroup comparisons showed statistically significant

differences, favoring the combined procedure. This shows superior skin contraction and contour correction with the addition of radiofrequency assistance.

Significant positive correlations were seen between NAC horizontal diameter, distance from the mid-sternal line and deviation from the mid-clavicular line at 6 months postoperatively. The strongest correlation was noted between NAC diameter and deviation from the mid-clavicular line. These findings show that reduction in NAC size is closely associated with improved NAC positioning. Overall, the correlations reflect coordinated morphological improvement following gynecomastia surgery.

Table 1: Baseline demographic and clinical characteristics of patients according to procedure group (n=32).

Variables	PAL alone (n=16)	RAF+PAL (n=16)	Total (n=32)	Test value	P value
Age group (in years)					
≤20	5 (31.3%)	2 (12.5%)	7 (21.9%)	$\chi^2=1.829$	0.609
21–25	4 (25.0%)	6 (37.5%)	10 (31.3%)		
26–30	3 (18.8%)	4 (25.0%)	7 (21.9%)		
≥31	4 (25.0%)	4 (25.0%)	8 (25.0%)		
Mean age (in years)	24.75±5.56	26.25±4.31		t=−0.853	0.400
Simon's grade					
Grade IIB	9 (56.3%)	6 (37.5%)	15 (46.9%)	$\chi^2=1.129$	0.288
Grade III	7 (43.7%)	10 (62.5%)	17 (53.1%)		

Table 2: Change in horizontal diameter of nipple–areola complex over time (cm).

Sides	Time point	Mean±SD	Min–Max
Right	Preoperative	3.88±0.68	2.8–5.1
	1 month	3.44±0.60	2.5–4.5
	3 months	3.18±0.54	2.3–4.2
	6 months	3.15±0.54	2.2–4.3
Left	Preoperative	3.60±0.61	3.0–4.9
	1 month	3.20±0.54	2.6–4.3
	3 months	2.95±0.49	2.3–3.9
	6 months	2.93±0.48	2.2–4.0

Table 3: Change in nipple–areola complex position relative to mid-sternal line over time (cm).

Sides	Time point	Mean±SD	Min–Max
Right	Preoperative	11.36±0.47	10.5–12.2
	1 month	10.11±0.37	9.4–10.9
	3 months	9.40±0.53	8.5–10.6
	6 months	9.33±0.77	8.2–10.8
Left	Preoperative	11.26±0.45	10.5–12.0
	1 month	10.02±0.40	9.2–10.8
	3 months	9.34±0.63	8.1–10.5
	6 months	9.44±1.10	7.9–13.5

Table 4: Comparison of mean differences in NAC measurements between procedures at follow-up.

Outcomes	Time	PAL alone (Mean±SD)	RAF+PAL (Mean±SD)	t-value	P value
Horizontal diameter–right	1 month	0.37±0.07	0.51±0.07	−5.62	<0.001
	3 months	0.48±0.08	0.92±0.13	−11.55	<0.001

Continued.

Outcomes	Time	PAL alone (Mean±SD)	RAF+PAL (Mean±SD)	t-value	P value
Horizontal diameter – left	6 months	0.40±0.06	1.06±0.17	−14.39	<0.001
	1 month	0.33±0.06	0.47±0.08	−5.52	<0.001
	3 months	0.44±0.07	0.85±0.15	−9.96	<0.001
	6 months	0.37±0.09	0.96±0.19	−11.39	<0.001
Distance from mid-sternal line	6 months (Right)	1.14±0.06	2.91±0.14	−47.21	<0.001
	6 months (Left)	1.16±0.05	2.49±1.47	−3.61	0.001

Table 5: Correlation between NAC parameters at 6 months (right side).

Variables	Horizontal diameter	Distance from mid-sternal line	Deviation from mid-clavicular line
Horizontal diameter	1	0.439*	0.788**
Distance from mid-sternal line	0.439*	1	0.589**
Deviation from mid-clavicular line	0.788**	0.589**	1

*p<0.05, **p<0.01

DISCUSSION

Gynecomastia is a benign enlargement of male breast tissue that can lead to considerable physical discomfort and psychological distress. Surgical management remains the definitive treatment; however, achieving optimal aesthetic outcomes particularly adequate skin retraction continues to be a challenge. This prospective cohort study evaluated whether the addition of RFAL to PAL results in superior skin retraction compared to PAL alone in gynecomastia correction surgery.

The results clearly showed that combining RFAL with PAL significantly enhanced skin retraction across all evaluated parameters. Patients in the RFAL+PAL group showed a greater reduction in the horizontal diameter of the NAC, improved medialization toward the mid-sternal line and reduced deviation from the mid-clavicular line at all postoperative time points over the 6-month follow-up period. These findings confirm that RFAL provides a sustained and measurable benefit in improving chest contour and NAC positioning.

Baseline demographic characteristics, including age distribution and Simon's grading, were comparable between the two groups, ensuring that seen differences in outcomes could be attributed to the surgical technique rather than confounding variables. Similar age ranges have been reported in previous studies, including Hodgson et al and Keskin et al supporting the generalizability of our findings.^{6,7} Additionally, the absence of significant differences in Simon's grade distribution is similar to observations by Bailey et al who highlighted the applicability of advanced techniques across varying grades of gynecomastia.⁸ The enhanced reduction in NAC diameter seen with RFAL+PAL is consistent with earlier reports by Blugerman et al who

attributed improved contour outcomes to RF-induced collagen contraction and remodelling.⁹ Comparable benefits of energy-based modalities have also been showed with ultrasound-assisted liposuction, as reported by Wong et al and Malata et al reinforcing the role of adjunctive energy-based technologies in optimizing aesthetic outcomes.¹⁰

Furthermore, the significantly greater medialization of the NAC toward the mid-sternal line in the RFAL+PAL group suggests improved chest symmetry and masculinity, a finding that complements the contour-focused observations of Boni et al and Bailey et al.^{8,11} Similarly, the greater reduction in deviation from the mid-clavicular line with RFAL shows superior alignment with anatomical landmarks, contributing to a more balanced and harmonious chest appearance.

Correlation analysis further showed significant associations between NAC size reduction and improvements in positioning, particularly the strong relationship between horizontal NAC diameter and deviation from the mid-clavicular line. These findings highlight the interdependence of NAC dimensions in achieving optimal aesthetic outcomes, supporting the emphasis on proportionality noted by Pfeiler et al.¹²

In conclusion, the incorporation of RFAL into PAL significantly enhances skin retraction, NAC repositioning and overall chest contour in gynecomastia surgery. These improvements are sustained over time and are similar to existing literature supporting the use of energy-based technologies. RFAL+PAL should therefore be considered a superior technique for patients in whom optimal skin retraction and aesthetic refinement are desired, although larger studies with longer follow-up are warranted to confirm long-term benefits.

Limitations

This study was limited by its relatively small sample size, single-centre design, using specific RFAL device, non-randomized observational methodology and follow-up duration of only 6 months, which may limit the generalizability and long-term interpretation of the findings.

CONCLUSION

This prospective comparative study shows that both PAL alone and RAF+PAL are effective techniques for the surgical management of gynecomastia, resulting in progressive improvement in NAC size and positioning over time. However, the addition of radiofrequency assistance to power-assisted liposuction provides significantly superior outcomes, with greater reduction in NAC diameter, improved medialization toward the mid-sternal line and better overall symmetry at all follow-up intervals. The strong correlations seen between NAC size reduction and positional improvement further highlight the role of enhanced skin contraction in achieving optimal aesthetic results. Therefore, RAF + PAL appears to be a more effective approach than PAL alone, particularly in patients where improved skin retraction and contouring are desired.

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