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Gynecomastia treatment using radiofrequency-assisted liposuction (RFAL)

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Abstract
Background Male gynecomastia is a commonly occurring aesthetic concern. Traditional liposuction, laser and ultrasound-assisted liposuction have many limitations, and excisional gynecomastia procedures can leave undesirable scars in the treatment of the enlarged male breast.
Methods In this study, the authors report the use of radiofrequency-assisted liposuction (RFAL) in the treatment of male gynecomastia. A total of 59 males had their gynecomastia treated by RFAL technology, 47/59 by closed RFAL alone, and an additional 12 patients with RFAL combined with our personal technique of trans-mammillary glandular reduction. The RFAL device afforded strong RF current and thermal energy for glandular and adipose coagulation and liquefaction, together with strong soft tissue contraction forces.
Results All patients were followed for more than 12 months, and all reported good to excellent breast contour results. There was one seroma and over 90 % of patients report being very happy with their contour, and no secondary surgical procedures were necessary. The authors report RFAL as new and potentially powerful option in the treatment of male gynecomastia, having the advantages of strong coagulation, liquefaction and aspiration of glandular tissue, simultaneous coagulation and aspiration with constant thermal monitoring, and very strong soft tissue contraction, eliminating the need for skin resection in the majority of cases. In minority of cases where there may be remnant glandular structures following RFAL, a simple, minimally intrusive trans-mammillary glandular extraction technique can be deployed that leaves minimal scarring.
Conclusions The mixed technique presented in this study appears to be safe and effective. The RFAL mixed technique has proven to be superior to ultrasonic and power-assisted liposuction due to the skin contraction, having no limitation dependent on the quality of the patient's skin.
Level of Evidence: Level IV, therapeutic study.

Keywords Gynecomastia · Radiofrequency-assisted liposuction · Minimal scarring · Skin contraction

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Introduction

Gynecomastia was initially the term used to describe male breast enlargement resulting from an imbalance of hormonal activity; however, recently, this term has been more broadly applied to any prominence of breast tissue caused by any factor including obesity, hypertrophy of the breast tissue, hormonal imbalances, or multifactorial etiologies [1]. Increasing incidences of obesity in the western world and other cultures, in combination with the growing demand in the male population for cosmetic procedures, make gynecomastia treatment one of the more popular male elective surgeries. The aesthetic nature of this procedure places a very high premium and importance on treatment outcomes that combine volume reduction of adipose and glandular tissue and skin tightening with minimal scarring.

Minor gynecomastia procedures with uncompromised skin can be resolved surgically through a small incision or using liposuction of adipose and glandular tissue [2–4]. Historically, patients with decreased breast skin tone, ptotic breasts, or large volume reduction required the excision of excessive skin, resulting in a significantly visible scar and a limited patient desire for this elective procedure. A characteristic surgical feature of male breast tissue is the high concentration of fibrotic tissue that impedes and limits the

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use of traditional suction lipoplasty alone for gynecomastia treatment. The liposuction gynecomastia treatment method was later improved by using sharper cannulas [5]. Eventually, the most popular methods became ultrasound-assisted liposuction and power-assisted liposuction, which operate non-thermally by destroying treated tissue mechanically and allowing tissue aspiration with less physical effort [6, 7].

Recently, new methods combining liposuction with thermal energies have been developed that have been evaluated for gynecomastia, stimulating skin tightening through thermal collagen contraction. Laser-assisted liposuction (LAL) employs laser energy, delivered through a small cannula that aids in the coagulative thermal destruction of the adipose and, to a lesser extent, glandular tissue and stimulates collagen contraction [8, 9].

This current study presents the use of radiofrequency-assisted liposuction (RFAL) for the treatment of gynecomastia, to evaluate its glandular tissue coagulation efficiency, male breast soft tissue contraction effects, side effects, and aesthetic outcomes.

Materials and methods

The authors treated 59 male patients using the BodyTite™ device (Invasix, Israel), which employs RFAL technology. Radiofrequency (RF) energy travels from an internal electrode to an external electrode and gently tightens dermal tissue. The internal electrode is also a blunt-nose suction cannula and simultaneously aspirates the coagulated tissue. RFAL procedure results in coagulation of adipose, vascular and fibrous tissue, as well as heating the entire soft tissue matrix (the vertical adipose fibrous septae) for tissue contraction. RF power used in the procedure varied from 25 W for superficial layer tissue and up to 75 W for deeper tissue treatment. Typical RF power used for gynecomastia procedure is lower than for other body areas because of the thinner tissue depth and higher curvature of the male breast (Fig. 1). Data were statistically analyzed using Epi Info® 3.5.3 and Stata® 10.0 software.

Subjects were males ranged from 18 to 62 years of age with a median of 41 years old [interquartile range (IQR), 30–48] and were subjected to clinical screening, which included various laboratory tests and mammography to rule out any pathological causes of gynecomastia. Preoperative surgical markings were made on their breasts to determine the proportion and the relative limits of glandular and adipose tissue while patients were standing. The procedure can be used for the removal of excess tissue, but also in preserving muscle edges of anatomical form, which can provide more sculpted contour to the patient's chest. For this reason, we prefer to undergo treatment from a top access, by

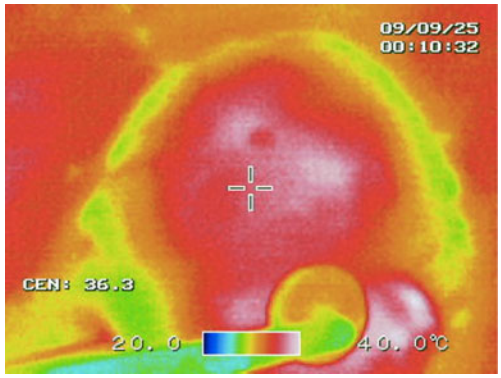

Fig. 1 Thermographic picture of gynecomastia treatment using RFAL™

entering through an incision in the anterior axillary crease, near the insertion of the pectoralis major to the humerus. The design of the treatment area is usually triangular, with the longest side projection located on the outer inferior edge of the pectoralis major (Fig. 2). Prior to surgery, the patients were placed in a supine position and connected to pressure monitors, oxygen saturation, and cardiac monitoring. In order to reduce discomfort during the procedure, the anesthesiologist administered IV medication.

The marked area was then infiltrated with warm tumescent solution composed of:

- Normal saline solution 1,000 ml
- Lidocaine 1,200 mg
- Sodium bicarbonate 1 M 30 ml
- Adrenaline 1:1,000 1 ml

Infiltration was performed through a multi-perforated micro-cannula connected to a peristaltic pump. The tumescent infiltration was placed from the anterior axillary line towards the bottom of the breast, and the infiltration was applied to full depth of the gynecomastia soft tissue, from the pre-pectoral space to the surface. In general, super-wet to tumescent levels of infiltration were deployed not only for pain control and additional hemostasis to the RFAL coagulative effect but also because RF energy requires a hydrous-salinated environment for optimal energy propagation.

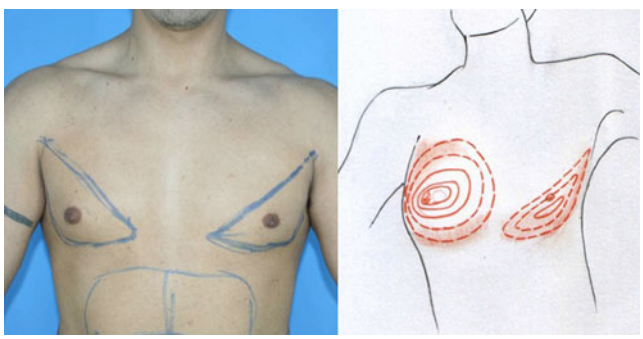

Fig. 2 Triangular design for gynecomastia treatment

After the bilateral tumescent infiltration, RF lipolysis of the fat and glandular tissue was initiated. Synchronous thermal coagulation and aspiration of the coagulated breast and adipose tissue occurred simultaneously using the RFAL cannula, which consists of an RF emitting Mercedes style tip that is Teflon insulated in the shaft with a conductive blunt nose. The Teflon coating obviates the need for port protectors (Fig. 3).

There were two cohorts in this study: the closed RFAL cohort consisting of 47/59 patients and the open RFAL cohort of 12/59 patients. In both the closed and open RFAL gynecomastia cohorts, the end point of thermal RF treatment was determined by one of four factors:

- Reduction of tissue mechanical resistance in the glandular tissues
- Epidermal skin temperature reaching 38–40 °C
- Deposition of 15–25 kJ per breast
- Skin thermal responses, such as skin erythema

During the RFAL stage, with synchronous RF application and suction, approximately 60–70 % of the glandular tissue was removed while achieving our thermal endpoint. This was followed by small SAL cannula aspiration for contour refinement through the remaining fat and glandular tissue.

In 12 of the 59 patients, at the completion of the RFAL and SAL, there was persistent glandular tissue in the subareolar region; thus, further resection was carried out directly using a minimal access glandular reduction technique, trans-mammillary glandular resection (TMGR; Fig. 4). Using a microsurgery scalpel 65 mounted on a specially designed handle, a cross-like incision was made on the nipple. The whitish and pearly glandular tissue, which was easily identified through the incision, was taken up with a Gillies hook or a Halsted forceps. Four well-irrigated triangular flaps are thus obtained, and were averted by the tension force on the glandular tissue to prevent damage during glandular dissection. Exercising traction on the hook, the glandular dissection process started in the plane that joins it to the subcutaneous tissue. The glandular tissue was subdivided into small portions to be removed through

Fig. 3 Synchronous thermal coagulation and aspiration done using the RFAL™ Teflon-coated cannula

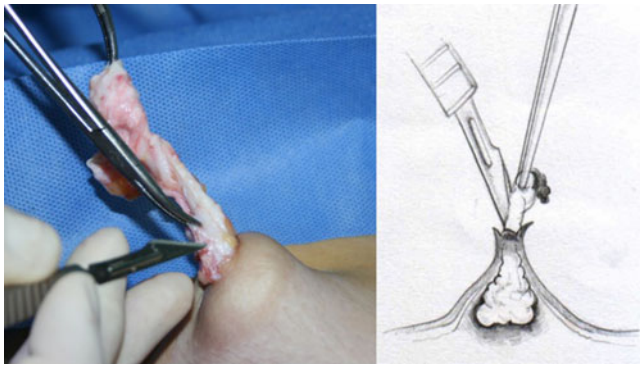

Fig. 4 Trans-mammillary glandular resection

Table 1 Demographics of 59 patients with gynecomastia treated with RFAL

Characteristic	Value
Type of treatment	
Closed RFAL (alone)	47
Open RFAL (TMGR)	12
Total no. of patients	59
Simon classification (%)	
Grade I	25.40
Grade II	44.10
Grade III	30.50
Tumescent anesthesia infiltrated (cc)	
Minimum	500
Maximum	230
Median	1,100
Total energy deposed per breast (kJ)	
Minimum	8
Maximum	40
Median	28
Total supranatant tissue aspirated (cc)	
Minimum	250
Maximum	1,400
Median	625
Fluid collection management in closed RFAL	
No drainage	35
Drainage	12
Complications (%)	
Edema	44.1
Hematoma	25.4
Seroma	3.4
None	1.7
Patient satisfaction scores	
Minimum	5
Maximum	10
Median	8.13

Fig. 5 Removed residual mammary tissue through cross-shaped nipple incision leaving inconspicuous scar

the small incision. All maneuvers were performed in a very delicate fashion, to prevent damage to the areolar skin and to make sure that no devitalized tissue remained inside the newly formed cavity. It is most important to keep sufficient tissue both in the sub-areolar and the pre-pectoral plane to avoid over-resection and retraction, with the possible depressed contour and adherence of the skin to deeper planes. Due to the tumescent anesthesia and the coagulative RF effect, in most cases the only hemostatic maneuver necessary was elastic compression in the immediate postoperative period. The incision was sutured joining the four triangular flaps in the middle; a flat dressing was applied, followed by the elastic compression, and the patient was instructed to relax for 24 h.

Results

Infiltrated volume ranged from 500 to 2,300 cc with a median of 1,100 cc (IQR, 750–1,600). Total deposed energy to a patient ranged from 8 up to 40 kJ per breast with a median of 28 kJ (IQR, 20–32). The amount of energy was delivered for patients depending on the classification of their

Fig. 6 Before and after pictures of a patient treated of gynecomastia with RFAL™

Fig. 7 Before and after pictures of a patient treated of gynecomastia with RFAL™

gynecomastia [10]. About 70 % of volume was aspirated during the RF thermal treatment, and final contouring was conducted without RF energy, ensuring a symmetrical smooth shape. The amount of supranatant tissue (fat and glandular tissue) aspirated ranged from 250 to 1,400 cc with a median of 625 cc (IQR, 450–900; Table 1).

One cohort of 47/59 patients, the closed RFAL subset, had all the gynecomastia tissue, both adipose and glandular, coagulated and aspirated using only RFAL of the breast tissue, followed by aspiration contour completion, using standard suction-assisted liposuction (SAL). Only 12 closed RFAL gynecomastia patients had closed drains inserted, which were removed postoperatively when the drainage in each breast space was less than 20 cc for two consecutive days. The other 35 patients did not need any type of drainage and were monitored with diagnostic ultrasound.

In a second cohort of 12/59 patients, the open RFAL subset, following RFAL coagulation and aspiration reduction, the previously reported TMGR technique was used [9] (Table 1). In the minimal incision glandular reduction, access to the glandular tissue was made through a small cross-shaped incision on the nipple since breastfeeding functionality did not need to be preserved for a male patient. Through this areola incision, large amounts of residual

Fig. 8 Before and after pictures of a patient treated of gynecomastia with RFAL™

mammary tissue could be removed, leaving a very small, aesthetically pleasing scar (Fig. 5).

There were no major complications observed after the surgery (necrosis, skin burns, or depressions and retractions). The following side effects were observed in the open RFAL cohort: one case of seroma developed, two patients had prolonged hematomas, and one patient had prolonged edema. All side effects were resolved within 6 weeks and non-operative management. There were no major side effects or complications in the closed RFAL cohort, notably, no cases of seroma (Table 1).

Patients demonstrated high satisfaction from the treatment results, which was measured using a linear analog scale of 1 to 10, with 10 being most satisfied. The satisfaction scores ranged from 5/10 to 10/10, with a median of 8/10 with an average score of 8.13 (IQR, 7–9; Table 1). In the closed RFAL gynecomastia cohort, all chest and sub-nipple areolar complex contours were judged by patient and physician to be flat, no revision reduction surgeries were required, and there were no postoperative soft tissue laxities or breast ptosis. Breast skin after the surgery appeared tighter at their 3-month follow-up, even in the cases where high volume of tissue was removed, and there was no subglandular excision (Figs. 6, 7, and 8).

Discussion

Gynecomastia being a pathologic enlargement of the male breasts regardless of its origin, either glandular or fat tissue, is an increasing pathology. Throughout time, there have been various treatments given to the patients, with the inconvenience of skin laxity when removing the excessive tissue.

Recently, noninvasive radiofrequency devices have demonstrated skin tightening during thermal cutaneous treatment; however, the impact on high-resistance areas such as the abdomen and thighs was shown to be only mild. The use of a radiofrequency bipolar device that generates enough energy during liposuction to convey elevated though controlled skin and subdermal temperatures in a precise location has proven to generate fat liquefaction, blood vessel coagulation, and skin tightening. Previous RFAL studies have reported soft tissue area contraction of 40–60 %, which may obviate the need for male gynecomastia excisional procedures in only a small proportion of patients [9, 11–14].

The mixed technique presented in this study appears to be safe and effective. It is based on the use of either RFAL alone, to produce RF lipolysis and aspiration of adipose and glandular tissue, together with a strong RF-mediated soft tissue contraction, or RFAL combined with a trans-mammillary resection of the remaining mammary glandular tissue. The RFAL appears to add significant advantages in male gynecomastia due to the efficient RF coagulative effect on both glandular and adipose tissue and the strong RF contraction effects, minimizing the risk of post-aspiration tissue laxity and ptosis, eliminating the need in most cases for large breast scars. The results have been highly satisfactory for both surgeons and patients and the rate of complications acceptably low.

A special design of the areas to be treated, that consists in preserving the fat located above the pectoral muscle, provides a more natural look at this level and simultaneously prevents skin laxity postoperatively with consequent sagging and descent of the nipple areolar complex. We have also noticed a significant improvement in symptomatology in patients presenting mastodynia due to anabolic steroids and where glandular trans-mammillary resection was needed.

The RFAL mixed technique has proven to be superior to ultrasonic and power-assisted liposuction [6, 7]. One of the major drawbacks of these technologies has been the relatively poor skin contraction, limiting their deployment to male gynecomastia patients with relatively good skin tone and minimal to no ptosis.

The advantages of the RFAL mixed technique have also overcome some of the limitations of LAL gynecomastia procedures [8, 9] that are lengthy treatment time, due to a relatively long thermal treatment required to coagulate glandular tissue and then aspirate the coagulum, lack of laser thermal uniformity, and only relatively moderate soft tissue contraction.

The shift towards a gynecomastia solution with less visible scarring and subsequently decreased downtime and a more optimal aesthetic appearance has forced plastic surgeons to look towards new approaches. Currently, it appears that the RFAL mixed technique described in this study gives the most comprehensive solution to a wider range of male gynecomastia patients.

Conflict of interest Dr. Blugerman and Dr. Schavelzon received the device at no charge to conduct some studies. Dr. Mulholland is a paid consultant of Invasix and received the device at no charge to conduct some studies. Dr. Soto and Dr. Siguen have no conflict of interests.

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