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Laser-assisted liposuction for gynecomastia: statistical and ultrasound follow-up of the effects observed in skin retraction

Liposucción láser-asistida en ginecomastia: seguimiento ecográfico y estadístico de los efectos observados de retracción cutánea

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Abstract

We evaluated the efficacy of laser-assisted liposuction for gynecomastia by means of ultrasonography and statistical studies, taking into consideration the skin retraction, the recovery time of patients and the satisfaction index in relation with the surgery outcome.

We present a prospective study undertaken on 28 patients suffering from gynecomastia who were treated by means of liposuction assisted by 1470 nm Diode laser lipolysis. Surgery was carried out under sedation and tumescent anesthesia. Laser was programmed at 15 W, of 8 to 12 kJ total cumulative energy per breast. Neither skin resection nor drainages were employed. Doctors and patients evaluated results objectively and subjectively using the same Visual Analogue Scale. For scoring results, pictures taken before and 6 months after the procedure were used. Measurements of the chest and areola diameter of before and after the surgery were taken for comparative statistical analysis. Ultrasonography follow-up of the treated areas was performed for comparison purposes before and 6 months after the treatment. Student's T test was used as a contrastive test.

No complications such as ischemia or skin burns were observed. The decrease in the chest perimeter and areolas diameter was statistically significant. Objective and subjective evaluations produced results higher than 90%. The ultrasonography also demonstrated a statically significant decrease in subcutaneous fatty tissue ($p<0.05$) in the comparison of images of before and 6 months after treatment. On average, patients could resume their activities within 3 days.

Laser-assisted liposuction is an efficacious and reproducible procedure. Ultrasonography controls and the statistical study demonstrated good results and limited the surgical trauma, all of which provides patients with a high level of satisfaction.

Key words Liposuction, Lipolysis, Gynecomastia, Diode laser, Ultrasonography.

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We evaluated the efficacy of laser-assisted liposuction in gynecomastia by means of ultrasonography and statistical studies, taking into consideration the skin retraction, the recovery time of patients and the satisfaction index with the surgery outcome.

Prospective study whereby 28 patients suffering from gynecomastia were treated with liposuction assisted by 1470 nm Diode laser lipolysis. Surgery was carried out under sedation and tumescent anesthesia. The laser was programmed at 15 W, of 8 to 12 kJ total cumulative energy per breast. Neither skin resection nor drainages were used. Doctors and patients evaluated the results objectively and subjectively using the same Visual Analogue Scale. For scoring results, pictures taken before and 6 months afterwards were used. Measurements of the chest and areola diameter before and after the surgery were taken for comparative statistical analysis. Ultrasonography follow-up was done to determine the width of the eliminated subcutaneous fat layer. Student's T test was used as a contrast test to examine the obtained results.

No complications such as ischemia or skin burns were observed. The decrease in chest and areolas diameter was statistically significant. Objective and subjective evaluations produced results higher than 90%. The ultrasonography demonstrated a statistically significant decrease in subcutaneous fatty tissue ($p<0.05$) in the comparison of images of before and 6 months after the treatment.

Laser-assisted liposuction is an efficacious and reproducible procedure. The ultrasonography controls and the statistical study demonstrated good results and limited the surgical trauma, which implies a high level of satisfaction of the patients with the surgery outcome.

Key words Liposuction, Lypolisis, Gynecomastia, Diode laser, Ultrasonography.

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Introduction

Laser-assisted liposuction for the treatment of gynecomastia is a technique that has consolidated itself in the medical-surgical practice for several years now (1). Gynecomastia is initially caused by the proliferation of glandular tissue that is substituted by fibrous tissues over the course of time, which makes conventional liposuction procedures complicated. Laser-assisted lipolysis prior to suction-assisted fat removal has advantages over conventional procedures because it poses a lower surgical trauma (2). This advantage, along with the skin retraction produced by the thermal effect of the laser, allows to avoid skin excess resection, which translates into a faster and more satisfactory surgical recovery for the patient (2). Among the advantages mentioned above, the skin retraction that is closely related to the thermal energy applied into the tissue by the laser is one of the most important, since it makes it unnecessary to remove any skin excess, thus preventing the unaesthetic scars and risks associated to them, such as the formation of keloids. On the other hand, in many of the proposed surgical techniques, whether or not they are laser-assisted, skin resection plays an important role for obtaining a good aesthetic result, maintaining the adequate proportions of the breast and the areola-nipple complex with respect to the rest of the pectoral region.

In this prospective study, we intend to verify whether or not the laser-assisted lipolysis provides a significant symmetry between both breasts and achieves the decrease in diameter of the areola-nipple complex without the need to remove part of the skin. In order to target the results of the removal of the subcutaneous layer of fatty tissue, we have performed comparative ultrasonography tests and we have measured the perimeter of the thorax and the areolar diameter, for statistical analysis.

Material and Method

We recruited 28 patients for the treatment of gynecomastia with laser-assisted liposuction. The study was performed through October 2011 to January 2013. We assessed the patients before the treatment, after the surgery and 6 months later. The treatment was explained to the patients and they signed the informed consent.

Sample

We considered it essential for the study approach to identify and classify the gynecomastia severity that the patients presented, in order to prevent surgical difficulties from arising and to improve the outcome. In following this principle, we have applied Rohrich's (3) classification, which, unlike Simon's (4), it provides a better correlation of the clinical findings with the current surgical practices based on liposuction. The surgical technique proposed by Rohrich provides for the skin excess resection, even when there is a hypertrophy of the breast of less than 250 g (Table I).

The 28 patients ranged in age from 21 to 65 (38.5 in average) and presented gynecomastia with an evolution of several years, which we describe in Table II. We based the inclusion criteria on the full clinical history, including the hormonal profile of steroids (estradiol and testosterone), the analytical evaluation of the hepatorenal function and the thyroid hormones profile, as well as the clinical examination and the ultrasound on testicles and on both breasts. We also determined the weight and the body mass index (BMI) of each patient. We based the exclusion criteria on a BMI higher than 35, on the presence of masses in the breasts, in which case a biopsy was performed with the purpose of ruling out tumors, or on altered analytical parameters,

Table I. Rohrich's classification with modifications

Gynecomastia grades	Clinical presentation	Treatment options
Grade I: Minor hypertrophy<250 g	IA: Prevalence of adipose breast tissue	Liposuction is the treatment of choice
	IB: Prevalence of fibrous breast tissue	Skin resection may be necessary
Grade II: Moderate hypertrophy, 250-500 g	IIA: Prevalence of adipose breast tissue	Liposuction is the treatment of choice
	IIB: Prevalence of central fibrous breast tissue and peripheral adipose breast tissue	Central skin resection and peripheral liposuction are required
Grade III: Severe hypertrophy >500 g	Severe hypertrophy of the breast on adipose and/or fibrous tissue with grade I ptosis.	Liposuction with fairly extensive skin resection
Grade IV: Severe hypertrophy >500g, with grade II or grade III ptosis	Severe hypertrophy of the breast on adipose and/or fibrous tissue with grade II or grade III ptosis.	Liposuction with fairly extensive skin resection as well as nipple repositioning are required

in which case we referred the patient to the endocrinologist.

The characteristics we found in patients were, among others: obesity in 9, with a BMI higher than 30, while 6 presented overweight with a BMI of 25-30; the remaining patients had a normal BMI. The gynecomastia was characterized by: Rohrich's grade III in 3 patients, while the rest presented grades I and II. Cutaneous flaccidity in 7 patients, and areola asymmetry, linked to size or location of the areola-nipple complex, and of one breast with respect to the other, in 4 patients (Table II).

Marking the surgical area

For marking the liposuction area, we took into consideration the gynecomastia severity and the flaccidity or asymmetry of the breasts. We marked the lower limit of the liposuction up to 3 cm below the inframammary fold, with the aim of producing sufficient skin retraction to avoid the shadow of the breast, which, if present, produces a similar appearance to the female breast. We also marked the incision points to introduce the cannula for anesthetics, the laser fiber cannula and the liposuction cannula.

Anesthesia

All surgical procedures were performed under sedation and tumescent anesthesia administered through a 12 cm long and 5 mm diameter blunt cannula with multiple

Table II. Patients sample and gynecomastia features

N	Age	BMI	Rohrich's Grade	Cutaneous	Areola asymmetry
1	44	21.5	II	Y	No
2	49	22.1	I	No	No
3	28	23.3	I	No	Y
4	31	30.2	II	No	No
5	51	24.5	I	Y	No
6	25	27.8	II	No	No
7	36	23.1	I	No	No
8	31	23.5	II	No	Y
9	42	20.9	II	No	No
10	44	29.4	I	No	Y
11	46	34.4	I	Y	No
12	28	23.7	II	No	No
13	54	29.4	III	Y	No
14	21	22.6	II	No	No
15	38	22.8	II	No	No
16	26	22.2	II	No	No
17	65	26.1	I	Y	No
18	42	32.7	II	Y	No
19	24	25.6	I	No	No
20	38	31.8	III	No	No
21	29	32.9	II	No	No
22	31	27.5	II	No	No
23	46	24.2	I	No	No
24	51	21.9	II	Y	No
25	45	22.3	II	No	No
26	28	24.7	III	Y	No
27	39	34.1	I	No	No
28	46	32.4	II	No	No

perforations; we employed modified Klein formula based on lidocaine 0.1% with epinephrine 1:1.000.000 (5). The injected quantity per breast ranged from 350 to 500 ml. The anesthetist performed the sedation using Midazolam.

Laser system

The laser employed was a 1470 nm Diode operated at cumulative energy. The Diode technology has a great efficacy because it requires a small power supply to put the laser light emitting mechanism into operation. The Diode laser (Alma Lasers®, Cesarea, Israel) is emitted in continuous pulsations. The regulation of the pulses is adjustable to allow the operator to maneuver the cannula according to his/her expertise and for ease of use of the laser system. One of the particular advantages of the Diode laser used in this study is the laser fiber employed. It emits light radially and thanks to this characteristic, it allows for an even accumulation of thermal energy and a safe increase of heat on each area of treatment. The repeated laser passes achieve a progressive, safe and effective accumulation of heat, avoiding the risk of burns.

In this study, the laser irradiation was applied with cumulative energy, adjusting the speed of the movement of the cannula forward and backward without a pause, to avoid causing injuries in the skin. The laser cumulative energy generates a remarkable increase of heat into the tissue, which produces the rupture of adipocytes, the coagulation of collagen fibers and the closing of small vessels (6).

Surgical technique

The procedure started 15 minutes after the administration of the tumescent anesthesia, making two 2 mm incisions by 11 blade scalpel to introduce the 9 cm long and 1 mm diameter cannula that is used to tunnel the treated area, if the breasts are soft or not significantly fibrotic. If the breasts are hard or fibrotic, we employ the Toledo cannula to break the fibrous septa. Once the tunneling maneuvers are finished, we passed a 600 microns diameter fiber optic connected at its distal end to the 1470 nm Diode laser through the same cannula. The other unoccupied end of the fiber was placed poking 3 mm out of the cannula.

The irradiation was variable in terms of breast dimension, with a total accumulated energy ranging from 8 to 12 kJ per breast. Only in the case of breasts of a larger dimension or higher flaccidity we increased the laser irradiation by 2 to 4 kJ. We moved the cannula with the laser fiber inserted through it, first at the deep subcutaneous tissue and then passing through a more superficial plane. We ensured that the movement of the cannula was faster at this level, in order that the contact of the fiber tip with the skin was gentle, so that no burns were produced. Although these maneuvers imply a potential risk, it is important to apply sufficient laser energy on the subdermal plane to produce an efficient skin retraction. It was especially important to ensure the speed, precision and care in the maneuvers for moving the cannula under the areola-nipple complex in order to avoid injuries in the vascular pedicle. In order to avoid the possibility of thermal damage on the skin, we employed a device to cool the skin. We aimed a continuous -20 ºC cold air jet with a 600 liters/minute flow (Zimmer Cryo5¤ , Neu-Ulm, Germany) at the point where the cannula tip was placed, which is visible by the laser guide beam through the skin. We also employed an infrared thermometer with laser guide beam (CEM DT-880 b¤ , Shenzhen Evervest Machinery Industry Co. Ltd., China) that detects the outer temperature of the skin in real time, to avoid exceeding 42 ºC. If this happens, the cannula is quickly moved to another sector, in order to avoid burns.

Once the laser lipolysis was finished, we went on to the liposuction, employing a 1 mm diameter cannula connected to a suction device of 1 bar negative pressure (Lipo-MR¤, Ordisi SA, Barcelona). While the liposuction is performed, the contralateral hand controls that there are no irregularities in the treated areas. Once the liposuction was finished, we repeated the exploration using the hand soaked in saline solution to facilitate moving across the surface of the liposuctioned area and be able to detect any residual irregularities; if the result was satisfactory, we closed the incisions by using one metal staple per incision. It is not necessary to leave the usual drainages as in similar procedures but we applied elastic compression bandages consisting of previously folded triangular bandages to increase the pressure on the treated area. Finally, an elastic strap was placed on the thorax and was maintained 24 hours for 7 days.

Post-operative protocol

We prescribed all patients with Amoxicillin with Clavulanic Acid (500 mg and 125 mg, respectively), 1 capsule every 8 hours for 8 days; Prednisolone, 30 mg/day single dose in the morning for 4 days and Paracetamol 650 mg every 6 hours for 5 days.

The first check was made the day after the procedure. Afterwards, we maintained the elastic strap on the thorax for 3 weeks longer, removing it only for daily hygiene. After this period, it was maintained for 4 weeks longer only during the night. The staples were removed 7 days after the procedure.

Subjective evaluation

Based on our previously published experience (2, 7), we decided to control the results 6 months after the surgical procedure. At that time, we asked the patients for their subjective evaluation of the

outcome. For that purpose, we provided them with a Visual Analogue Scale (VAS) to judge the decrease in volume of their breasts. They were required to indicate if the protrusion was smaller, if the size of the areola had diminished and if the level of symmetry, the texture and firmness of the skin were different and/or had improved or worsened. We correlated the average assessment of the results with the scores obtained, as follows: Very Good, from 80 to 100; Good, from 60 to 79; Regular, from 40 to 59; Bad, from 20 to 39; Very Bad, from 0 to 19. During the assessment, the patients were accompanied by a physician who had not participated in the surgical procedure. During the examination, the physician limited exclusively to remind the patients about the details that they had to take into consideration to issue the score. To that end, we provided the patients with photos taken before the procedure and 6 months afterwards, asking them to make the examination before a mirror.

Objective evaluation

Two independent examiners experienced in laser-assisted liposuction performed the objective evaluation. They employed the same VAS scale and assessments as the patients. They also took into consideration the photographs taken before the procedure and 6 months later. As part of the evaluation, the anthropometric data were recorded

Table III. Measurements and differences in the chest and areola diameter of each patient

N	Chest diameter (cm)		Difference (cm)	Average diameter of the areolas (cm)		Difference (cm)
	Before	6 months later		Before	6 months later	
1	111	94	-16	3.7	1.9	-1.8
2	123	111	-12	3.9	2.3	-1.6
3	126	110	-15	3.3	1.6	-1.7
4	134	121	-13	4.2	2.8	-1.4
5	124	109	-13	4.1	2.5	-1.6
6	131	118	-13	4.1	2.4	-1.7
7	129	118	-9	4.1	2.2	-1.9
8	97	86	-11	3.2	1.8	-1.4
9	103	91	-12	3.6	2.2	-1.4
10	125	112	-13	4.0	1.9	-2.1
11	133	121	-12	4.4	2.5	-1.9
12	106	92	-14	4.2	2.6	-1.6
13	129	118	-11	3.3	2.4	-0.9
14	114	102	-12	3.6	1.7	-1.9
15	103	92	-11	4.0	1.9	-2.1
16	108	97	-11	3.2	1.6	-1.6
17	110	98	-12	3.9	2.7	-1.2
18	114	104	-10	4.3	2.8	-1.5
19	116	105	-11	3.8	2.1	-1.7
20	121	108	-13	4.5	2.9	-1.6
21	126	112	-14	3.9	2.2	-1.5
22	114	102	-12	3.7	2.5	-1.2
23	106	98	-8	2.8	2.1	-0.7
24	105	94	-11	4.6	2.8	-1.9
25	102	93	-8	3.4	1.8	-1.6
26	117	104	-13	4.9	2.5	-2.4
27	126	114	-12	3.6	1.9	-1.7
28	125	112	-13	4.1	2.5	-1.6

(weight and size) of each patient to determine the BMI, the chest diameter and the diameter of both areolas. These measurements were taken from the patient in standing position and exhalation, in order to compare them with those taken before the surgery (Table III).

Ultrasonography

The ultrasonography was performed before the surgery and during the check, 6 months later. We employed a SonoSite MicroMaxx® ultrasound equipment with a multi-frequency linear probe (SonoSite Inc., U.S.A.) that was placed perpendicularly to the skin and in the center of the areola. Both breasts were assessed separately.

The measurements were taken on the patient in supine position, ensuring that no pressure was applied with the probe on the gel layer, avoiding a biased measurement of the thickness of the subcutaneous tissue. We recorded the figures from each breast for a comparative statistical study (Table IV).

Statistical Analysis

We used SPSS v. 20 for Windows. As a statistical contrast test, we used Student's T distribution for independent samples, taking $p<0.05$ as the significance level.

Table IV. Ultrasonography values of the decrease in thickness of the adipose panicle before and 6 months after the treatment

N	Sub areolar subcutaneous tissue (cm) before the surgery		Sub areolar subcutaneous tissue (cm) 6 months after the surgery		Difference in subareolar subcutaneous tissue (cm) 6 months after surgery	
	Right	Left	Right	Left	Right	Left
1	3.46	3.52	1.29	1.32	2.17	2.20
2	3.23	3.33	1.34	1.36	2.08	1.97
3	3.01	3.81	1.15	1.38	1.86	2.43
4	3.32	3.22	1.56	1.47	1.76	1.75
5	3.15	3.21	1.32	1.37	1.83	1.84
6	3.67	3.58	1.76	1.69	1.91	1.89
7	3.31	3.32	1.39	1.41	1.92	1.91
8	3.31	3.28	1.65	1.57	1.66	1.71
9	3.39	3.43	1.42	1.47	1.97	1.96
10	2.87	3.04	1.21	1.26	1.66	1.78
11	3.62	3.51	1.49	1.38	2.13	2.13
12	3.74	3.89	1.52	1.60	2.22	2.29
13	3.46	3.77	2.03	2.02	1.43	1.44
14	3.40	3.44	1.36	1.37	2.04	2.07
15	3.83	3.76	1.63	1.57	2.20	2.19
16	3.62	3.74	1.38	1.44	2.24	2.30
17	3.48	3.61	1.26	1.33	2.22	2.28
18	4.11	4.23	1.84	1.92	2.27	2.39
19	3.22	3.41	1.28	1.31	1.94	2.1
20	4.78	4.49	2.16	2.05	2.62	2.44
21	3.86	3.92	2.04	2.12	1.82	1.80
22	3.31	3.10	1.88	1.76	1.43	1.34
23	3.28	3.43	1.46	1.53	1.82	1.90
24	4.37	4.24	2.17	2.13	2.20	2.11
25	4.16	4.27	1.97	2.06	2.19	2.21
26	3.01	3.81	2.17	2.07	0.84	1.74
27	3.84	3.92	1.89	1.94	1.95	1.98
28	3.79	3.94	1.48	1.54	2.31	2.40

RESULTS

None of the patients presented complications and no signs of ischemia or skin burns were found. No edema and/or areolar congestion were observed. Nipples sensitivity remained after the procedure. There were no infections or alterations during wound healing.

Side effects, such as ecchymosis and small-sized isolated hematomas that were spontaneously reabsorbed, were mild. Edema to a higher or lesser degree was interpreted as a procedure associated sign due to an inflammatory reaction of the tissues. These reactions were more intense in such patients with a higher level of fibrosis, which required debridement by Toledo cannula. A dose of 650 mg of Paracetamol administered every 6 hours was sufficient for pain control.

In the subjective evaluation, 21 patients evaluated the results as Very Good (80-100%), 5 as Good (60-79%) and 2 as Regular (40-59%). None of the patients issued scores lower than 40%, which is why there were no results scored as Bad or Very Bad. The objective evaluation issued by the examiners was as follows: 23 patients with Very Good results, 4 with Good results and 1 with a Regular result.

By the experience based on the follow-up results of previous samples and after the ultrasound evaluation of this study, we consider that 6 months is the adequate period of time for the edema to be completely reduced and to evaluate the diameter of the areola after the tissue has reached it full tightening and the skin has contracted.

We performed the Student's T test to verify if the difference between the mean values was statistically meaningful in the reduction of the measurements of the chest diameter and the areola diameter, before and 6 months after the treatment. The chest diameter was reduced by 11.93 cm in average and the areola diameter by 1.80 cm. In both cases, the $p<0.05$ value indicated that the differences between the mean values was statistically meaningful.

In the ultrasound evaluation, we took into account as

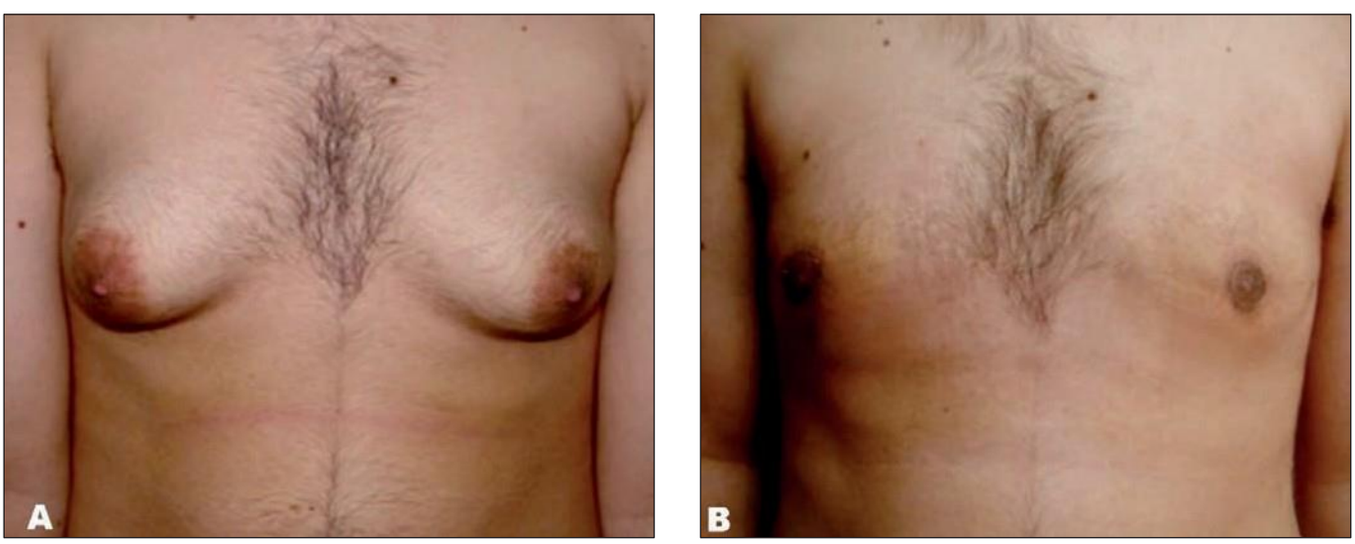

Figure 1. Patient No. 26, 28 years old, IMC 24.7, Rohrich's grade III. A. Before the treatment; B. Six months after laser surgery, we observed a remarkable reduction of the breasts, a decrease in the chest diameter and of the areola diameter, and an evident skin retraction.

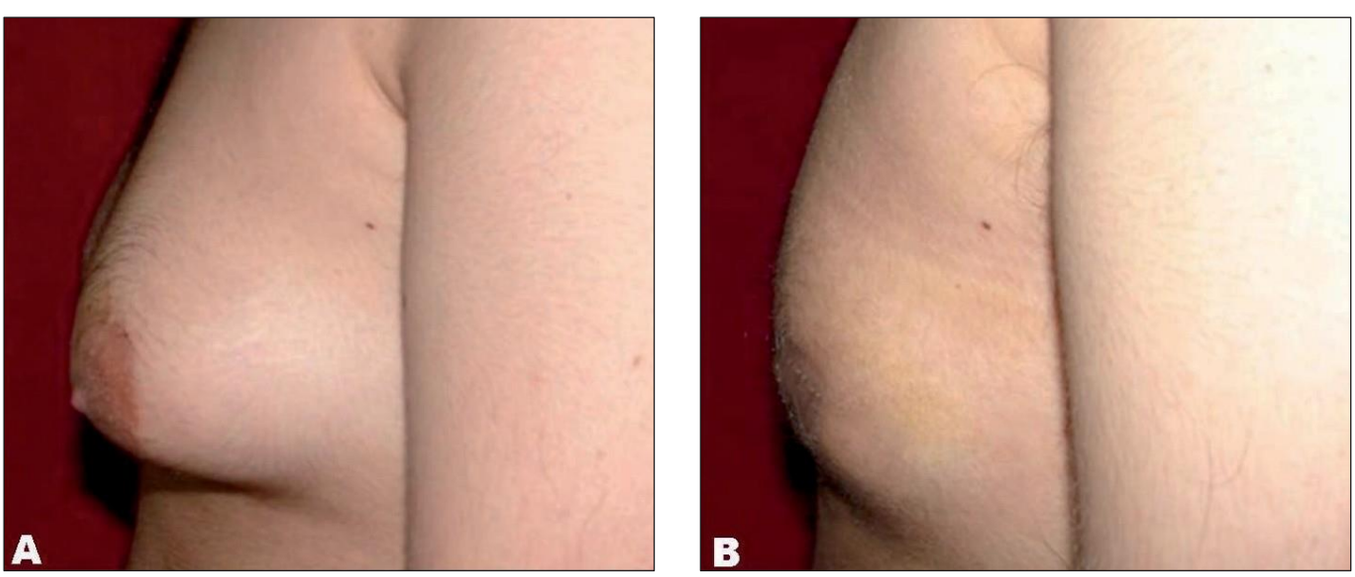

Figure 2.- Patient No. 26, Lateral view. A. Before the treatment; B. Six months later.

criteria for gynecomastia, those described by Sarteschi (8) and Stewart (9), considering the typical cases of gynecomastia, both hypoechogenic images located under the areola and at the center of the nipple, with nodular or triangular morphology, as the diffuse increase of echogenicity (Figure 1-7). The ultrasound measurements taken before and 6 months after surgery were compared by using the Student's T test, with a result of $p<0.05$ for a confidence index of 95%. The measurements of the reduction of the right subareolar adipose tissue, 6 months after the procedure, showed an average decrease of 2.08 cm, while the average decrease in the left subareolar adipose tissue was 2.12 cm. On the other hand, the difference in mean values of 0.034 cm between both breasts was not meaningful. This last information indicated that the subareolar adipose tissue in both breasts decreased proportionally after the surgery.

It is worthwhile highlighting that all patients, including those who obtained a Regular result, achieved a meaningful skin retraction, with a satisfactory flattening and/or disappearance of the inframammary fold. In no case was necessary to perform skin resection. Patients resumed their daily activities within an average period of 3 days. According to our observations, this fast recovery contributed to increase the satisfaction index of patients who had undergone the surgery.

Discussion

Since Apfelberg (1) incorporated laser lipolysis to conventional liposuction, the surgical technique has advanced remarkably because there is an improved knowledge on the anatomy of the breasts and on the different surgical techniques to approach them. Furthermore, technical development of laser systems has succeeded in facilitating the surgical procedures of gynecomastia, particularly because the new wavelengths interact more selectively on fatty tissue (6, 10).

The 1470 nm wavelength of the Diode laser that we use in the patients sampled for this study is one of the longest of the near-infrared spectrum and it achieves a fast and efficient heating up of the subcutaneous tissue because of its high level of absorption through fat and water. The heat produced when the laser energy is absorbed alters the Na+/K+ balance of the cell membrane, allowing for the transport of the extracellular fluid to the interior of the cell (6).

Regardless of the value of the wavelength to produce lipolysis, the dose of energy per unit of treated area is also highly important. The optimal heating of tissue must be attained to achieve the liquefaction of fat, that is, the wavelength of the laser that is used would be considered as secondary in order of interest, giving prevalence to the cumulative energy

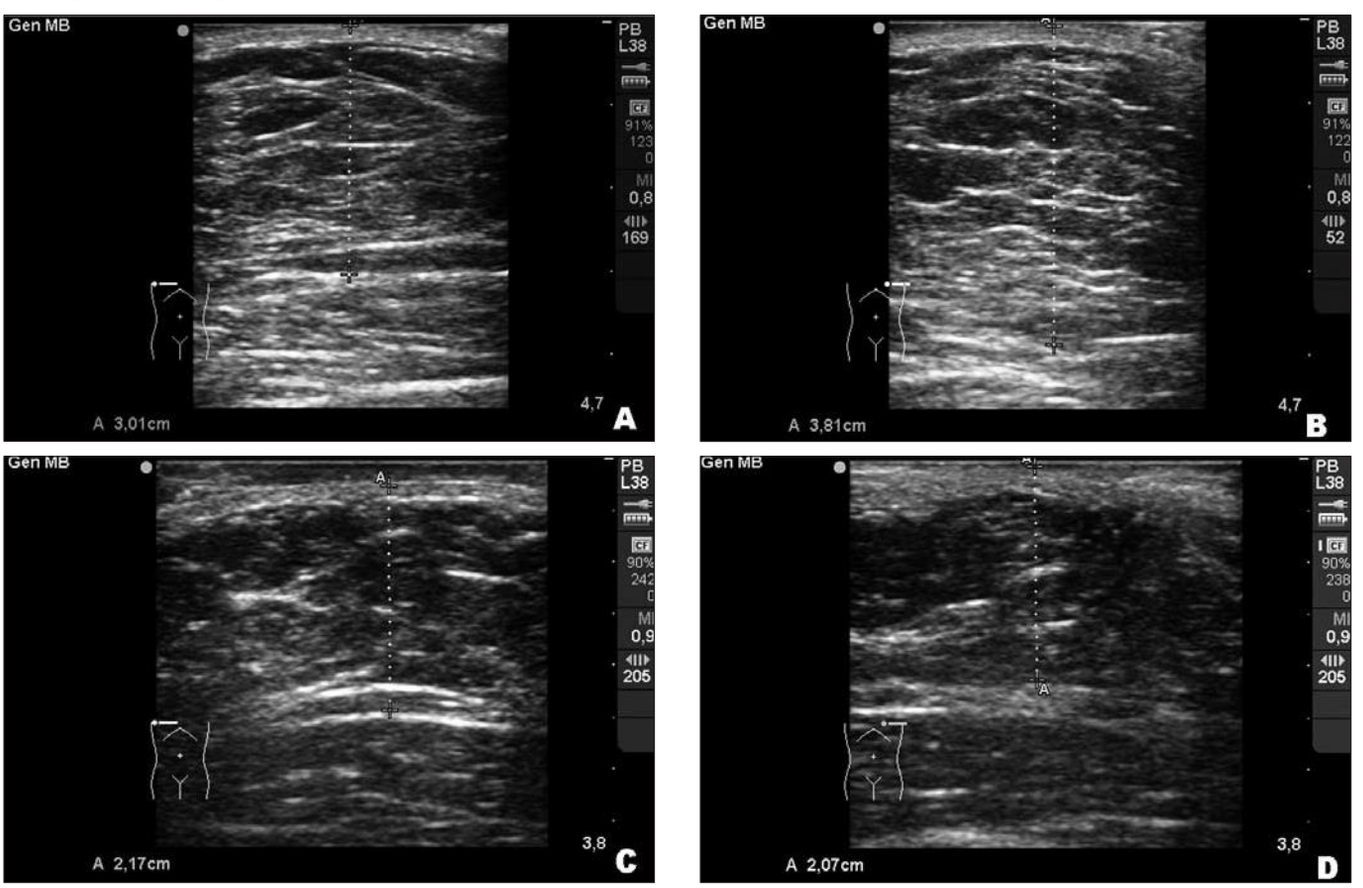

Figure 3. Ultrasonography of the patient of Figure 1. A. Right breast before laser lipolysis; B. Left breast before laser lipolysis; C. Right breast 6 months after the surgery; D. Left breast 6 months after surgery. In both ultrasonography tests we can observe a decrease in adipose tissue and an increase in the thickness of the dermis.

Figure. 4. Patient No. 22, 31 years old, IMC 27.5, Rohrich's grade III. A. Before the treatment; B. Six months after the laser lipolysis. We can observe a remarkable reduction of the breasts.

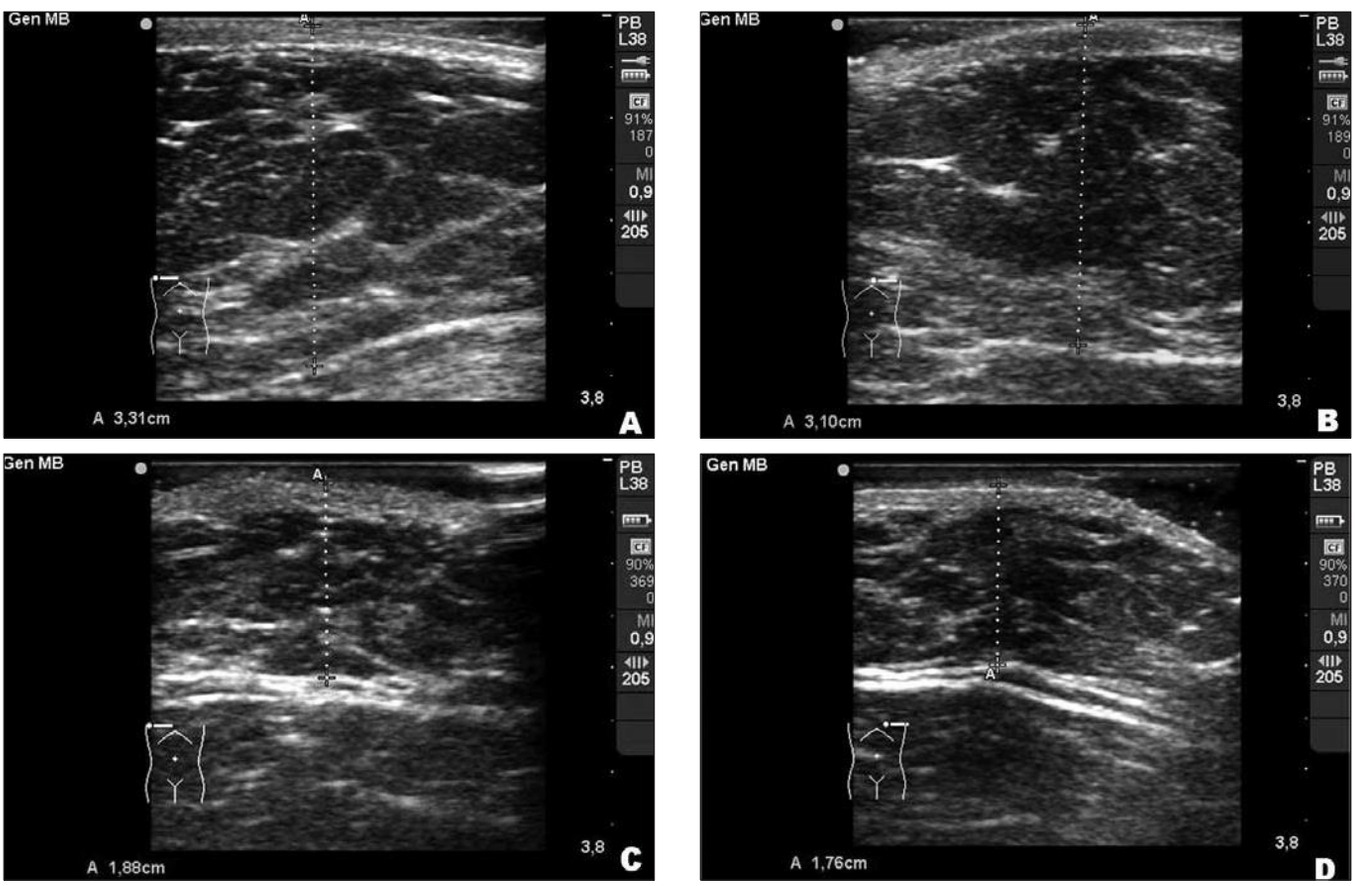

Figure 5. Ultrasonography of the patient of Figure 4. A. Right breast before laser lipolysis; B. Left breast before laser lipolysis; C. Right breast 6 months after the surgery; D. Left breast 6 months after surgery. In the ultrasonography tests of both breasts we can observe a remarkable decrease in the fat and an evident reorientation of the fibrous septa.

for the treatment and the total dose of accumulated energy per treated breast. In the case of the patients sampled in this study, the total accumulated energy that we employed on each breast was of 8 to 12 kJ.

Throughout this study, we intended to emphasize the advantages associated with the contribution of laser-assisted surgery to liposuction, which provides remarkable effects on cutaneous retraction. The use of laser helps to avoid surgical resection and achieves a meaningful reduction of the areola diameter, as well as a reduction of the fatty tissue that is demonstrable in the decrease in chest diameter. In order to evaluate the results on the reduction of fatty tissue, glandular tissue and/or fibrous tissue, the ultrasonography study performed before and 6 months after the surgery allows for observing noticeable changes that are made evident in the reduction of the breast protrusion.

The conventional liposuction or ultrasound-assisted liposuction techniques do not produce thermal deposits in the tissue as is achieved through laser energy. The thermal product originated by laser stimulates the formation of collagen during the surgical injuries healing phase

Figure 6. Patient No. 13, 54 years old, IMC 29.4, Rohrich's grade III. A. Before the laser lipolysis; B. Six months after the laser lipolysis. Good result in the reduction of breast size and perimeter of the chest. There is an evident cutaneous retraction.

, achieving an efficient skin retraction. When the skin is contracted, the action of heat contributes to adequately positioning the areola-nipple complex, generally shifting downwards in the case of gynecomastia. In the conventional procedure for gynecomastia it is necessary, in a remarkable percentage of patients, to perform a fairly extensive skin resection with the purpose of removing skin excess and achieving the correct positioning of the areola-nipple complex (11).

Our study proves that the treatment of gynecomastia with laser-assisted liposuction is a reproducible surgical technique that is consistent with previous studies (2, 7). The accumulation of thermal energy of 8-12 kJ for the treatment of each breast achieves efficient results, as shown by the subjective and objective evaluations that were performed. We observed a decrease in the perimeter of the chest of a mean value of 11.93 cm, while the previous studies produced a value of 12.5 cm (2, 7). The average difference of 0.57 cm between both can be attributed to the fact that in this sampling we excluded from the study those patients with a BMI higher than 35. In our experience, the patients who were more dissatisfied with the results were the patients with a BMI higher than 35. Nevertheless, we observed that there was practically no difference between the average figures of the decrease in the areola diameter achieved in the current group of patients, in comparison with the measures obtained from the samples of previous studies (2, 7).

The 1470 nm wavelength poses a preferential inclination to absorption by the water chromophore in a remarkable proportion of the adipose cell. The fat is also an absorption chromophore of this wavelength. The 1470 nm laser irradiation in continuous node achieves a rapid thermal effect, coagulating the collagen fibers. When this effect is produced at the level of fibrous septa of the fatty tissue and at reticular dermis level, it leads to the tightening of the underlying tissue (12,13). Furthermore, it is necessary to take into consideration the added value on the prevention of skin burns by the particular way in which laser energy is distributed by the radial fiber of the system employed in the lysis of fatty tissue. In its thermal spread, the 1470 nm wavelength originates a dispersion when it interacts with the fatty tissue, which achieves the closing of blood and lymphatic vessels by coagulation. Thanks to this effect, the risk of hematomas and seromas is practically null, which justifies not applying drainages after the surgery.

Blugerman et al. (14) obtained satisfactory results when employing radio frequency-assisted liposuction and they recommend the usage of drainages for their technique. According to these authors, the need of drainages is due to the fact that their procedures require the performance of additional glandular tissue resection. They execute this maneuver by an incision at the nipple, which additionally implies a possible risk of altering the sensitivity of this area of the breast. The total radio frequency energy employed by Blugerman on each breast ranges from 8 to 40 kJ, which indicates a variable range of energy, in comparison with the narrower laser irradiation of merely 8 to 12 kJ used in our study. This narrower laser irradiation parameter allows for an easy reproducibility of the technique and also a better definition in the forecast of the results.

From sampled selection of patients for this study, it would be necessary to consider that the satisfactory results could also be due to the fact that candidates with a BMI higher than 34 were excluded. This detail may constitute a bias. Nevertheless, we can argue that in view of the results, we can confirm the importance of the selection of patients for laser lipolysis surgery.

In Hodgson's review of 13 patients with gynecomastia (15) submitted to laser surgery, 8 presented an evident inframammary fold. This author did not perform skin excess resection in the procedure,

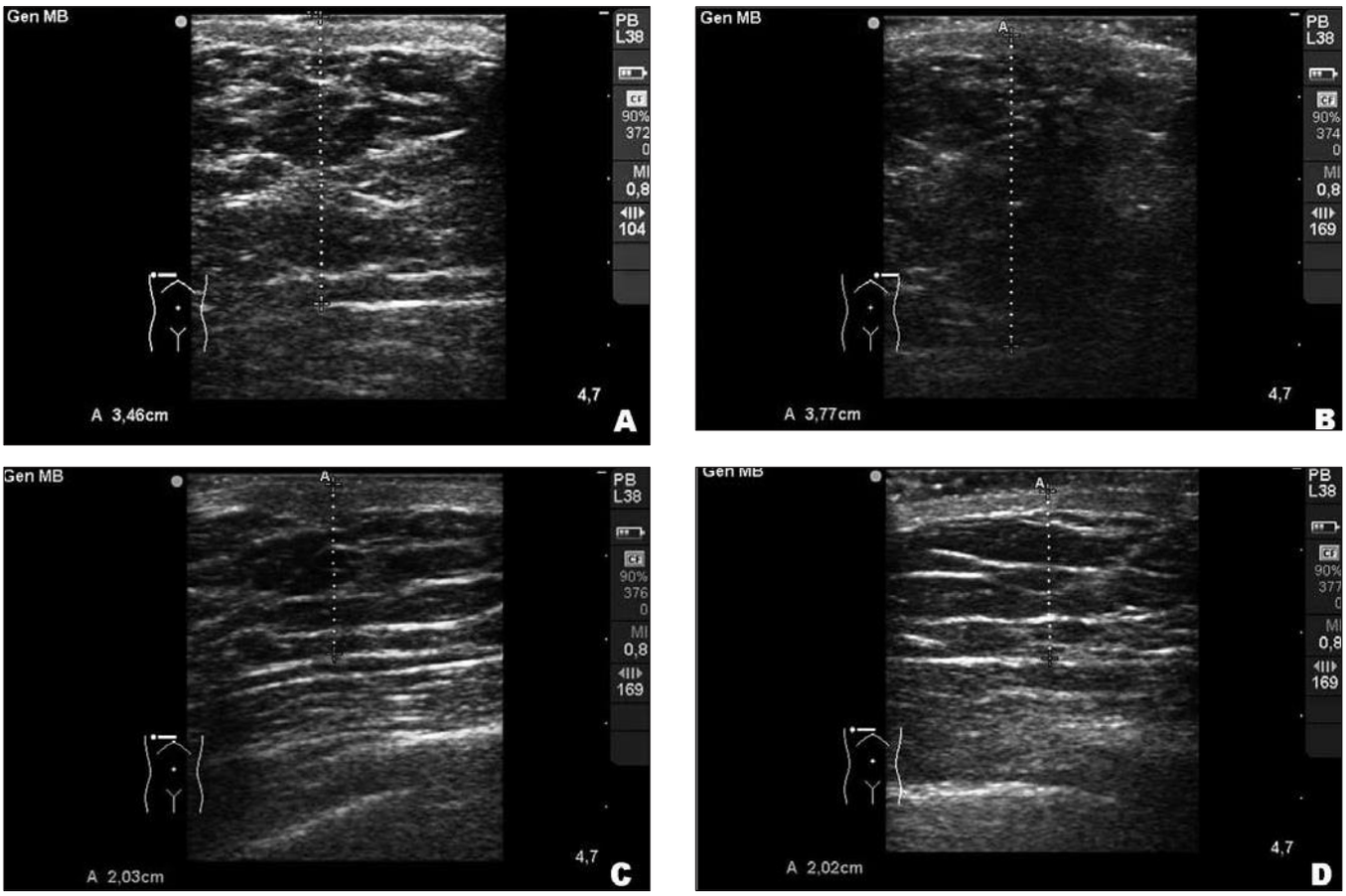

Figure 7. Ultrasonography of the patient of Figure 6. A. Right breast before laser lipolysis; B. Left breast before laser lipolysis; C. Right breast 6 months after the surgery; D. Left breast 6 months after surgery. The ultrasonography performed 6 months after the surgery shows an increase in the thickness of the dermis and a decrease in the subcutaneous fat. We also observed an evident alignment of the fibrous septa in a parallel position with relation to the cutaneous surface.

nor did he extend the limits of the surgery below the inframammary fold. Nevertheless, it is necessary to consider that the average age of the patients in his study was 27 years old, that is to say, there was a difference of 11.5 years with our sampled patients. The satisfactory results obtained by this author, where he does not include a description of the inframammary fold, were due to the skin's elastic quality at a young age, which allows for an effective contraction. His sampling comprises young patients and in the only one aged 57 the inframammary fold persisted. Furthermore, this study only reports on a small sample of patients, which is why the conclusions are hard to extrapolate with the results of studies that involve larger samples and/or age ranges that are wider too.

Benito-Ruiz's study (16), which employs Prado's technique (17), excludes Rohrich's grade I gynecomastia, indicating the axillary approach, which, as the author recognizes, is not risk-free. We included 7 patients with grade I gynecomastia in our study, whom we treated with the same laser-assisted lipolysis technique, obtaining satisfactory results. We agree that liposuction alone does not eliminate fibroglandular tissue, which is why in such cases, as well as laser-assisted liposuction, we employ the Toledo cannula. In Benito Ruiz's work (16) we observed that no comparative measurements were taken of the chest diameter and of the areola diameter before and after the surgery. These data would have been undoubtedly interesting with the purpose of comparing the results of both techniques. Also, the author does not indicate the time required by patients to resume their usual activities, a parameter that is nowadays an important factor to assess the efficacy in recommending one or other surgical technique. Benito-Ruiz's comment about the hematomas decreasing as his surgical technique is refined, is also applicable to laser lipolysis, since it requires a training period. In all certainty, the expertise in the surgical techniques contributes to the success of the results obtained through such techniques. In the case of laser-assisted liposuction in the surgical treatment of gynecomastia, it can only be performed with minimum complications with an expertise in the surgical technique of liposuction and adequate skills in the detailed laser-tissue interaction.

Conclusion

This study confirms that laser-assisted liposuction for gynecomastia is an efficient technique thanks to the

thermal energy focused on the tissue during the process of liquefaction of the subcutaneous fatty tissue. This effect facilitates the suction of fat and the remodeling of the breast. The laser procedure allows for a meaningful skin retraction where the formation of new collagen fibers is directly involved. The procedure is safely performed thanks to the particular radial fiber irradiation that is used by the laser system employed in this study. The result translates into a remarkable aesthetic improvement, since it allows to avoid the performance of a cutaneous resection. Laser lipolysis achieves an evident tightening of the skin and contributes to the correct positioning of the areola-nipple complex. The ultrasonography allows for the reduction of adipose tissue and the alignment of fibrous septa positioned between the subcutaneous tissue. Blood vessels *in situ* coagulation prevents bleeding and the formation of hematomas, avoiding the usage of drainages in the post operative. The mentioned advantages achieve a faster post-surgery recovery that results in a higher level of satisfaction for the patients.

Statement

The authors declare that they have no commercial interest in the products or devices referred to in this study and they thank statistician Mr. Juan Carlos Medina for his collaboration in the data analysis.

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Commentary to article "Laser assisted liposuction for gynecomastia: statistical and ultrasound follow-up of the effects observed in skin retraction"

Dr. Jesús Benito Ruíz.
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Firstly, I wish to congratulate Dr. Telles and his team on their constant display of expertise in laser applications. They have a long trajectory in this technique, which has undoubtedly made them a national and internal benchmark.

The authors expound their experience in the treatment of gynecomastia with a 1470 nm laser diode at cumulative energy over a sample of 28 patients, who are evaluated at subjective (satisfaction) level and at objective level (thickness of the subcutaneous tissue and areola diameter). I extend my congratulations in this sense, because in our specialty it is undoubtedly necessary to take measurements to be able to demonstrate the efficacy and safety of the techniques we use. The difficulty in measuring is especially relevant regarding cutaneous retraction.

Nevertheless, after having read your work, I have a few questions. Table II, which shows data on the patients under study, includes the field "cutaneous flaccidity". How has this been evaluated? I am surprised to see that you have patients with grade III with no flaccidity and on the other hand, patients with grade I with flaccidity. It would be appreciated that you could comment on how this measurement was taken and if you have observed any meaningful difference regarding the result obtained in terms of this pre-operative flaccidity.

Also, the authors explain the physical effects of laser on fatty tissue and on the skin, which likewise illustrates the decrease in thickness of the observed subcutaneous tissue and the skin retraction achieved. However, the effect in the glands is still unclear to me. In my experience, what we can remove by liposuction is the adipose tissue (therefore, an ideal method for pseudogynecomastias and for the fatty component of mixed gynecomastia). In this case, (like ultrasound-assisted liposuction) laser would provide the advantage of a higher cutaneous retraction. When we have a fibroadipose or hyalinized tissue in a long-term gynecomastia, we need to use more aggressive cannulas (such as the Toledo cannula). However, if there is a gland (which is typical in pubertal gynecomastia type I and in those caused by anabolics) we need either to perform open surgery or to use the *shaver* technique. The authors report to have obtained good results with laser-assisted liposuction and Toledo cannula, however, what proportion of the results is due to laser and what proportion is due to the Toledo cannula? I think that the best results in liposuction associated techniques (conventional, ultrasound, laser) are undoubtedly achieved in patients with gynecomastia type II or higher.

In any case, this work confirms that we find ourselves before a new paradigm in the treatment of gynecomastia regarding what the authors call the unaesthetic scars related to the skin removal. Evidently, these are not easy techniques but they are reproducible by applying caution, knowledge of anatomy and of the devices and the technology involved.

Response to Dr. Benito's commentary

Dr. Mario A. Trelles

We thank Dr. Benito Ruiz for his commentary on our study. Having read his commentary in depth, we can appreciate his dedication to the examination of our study in finding the details that very justly motivate his questions. Please see our replies below:

1.- When you refer to Table II, you have observed that cutaneous flaccidity is present in patients with Rohrich's grade II gynecomastia and that there is no flaccidity in the case of some patients who presented grade III. In the latter group, the characteristic, particularly fibrotic increase in the glandular breast tissue results in the skin tightening, making it appear firm and, upon manual examination, not presenting flaccidity. In the case of patients with gynecomastia grade I who presented flaccidity, the skin is frequently lax. This feature prevails as an easily distinguishable characteristic in the mentioned gynecomastia Rohrich's grade I. Please also note that the patient treated for gynecomastia grade III, as indicated in the mentioned Table, is not over the age of 40. We highlighted this detail because, according to our experience, patients who are relatively young do not present cutaneous flaccidity, which supports the fact that even if they suffer from gynecomastia Grade III, the skin is firm.

Regarding the degree of cutaneous flaccidity, we can mention that in previous works we published in the past on cutaneous aging (1-3), we employed computer software, silicon boards, questionnaires and specialized devices, such as a cutometer, which help in the analysis of skin flaccidity. With these methods of analysis, which include digital surface photography, it is possible to monitor the epidermis-dermis features at the levels of shape, cell junction, lipid layer and particularly the skin tension lines, all of which constitute indicators of the level of flaccidity of the tissue. The resulting data are extrapolated with specialized computer software in graphs that help comparatively and objectively determine if the treatments succeed in changing the condition of the skin. None of these methods of analysis were used in our study but we did perform an accurate visual evaluation, along with a thorough manual palpation examinations, pinching the skin on the breast and detailed examination of the characteristics of the superficial tissue with magnifying lenses.

2.- Being one of the purposes of this study, the cutaneous retraction effect was checked 6 months after the treatment and, as we have noticed, it showed meaningful results that determine the efficacy of laser in this sense. We tried to highlight that

the residual thermal deposit that is developed during the laser lipolysis shows advantages over and remarkably exceeds the cutaneous retraction action of ultrasound-assisted liposuction (4). Furthermore, some authors do not obtain the mentioned effect when they employ liposuction with this technique (5).

In the treatment of long-term gynecomastia, in order to remove the fibroadipose tissue, according to our experience, it is sufficient with employing the Toledo cannula, since we did not have the need to employ the *shaving* technique. As is known, the technique of "shaving" the gland often produces a post-operative with a wider variety of symptoms, causing hematomas, edemas and a more prolonged recovery time, as opposed to when laser assisted with Toledo cannula is employed. Nevertheless, Dr. Benito Ruiz's question regarding the level of importance of laser over the usage of this cannula in the removal of the mammary gland is interesting, since as is correctly pointed out in his commentary, it is the liposuction combination technique that allows for the removal of the residual fibrotic tissue with no mayor difficulties, as per our observations. We may venture to say that the fibrotic gland treated with laser thermal energy responds in a similar way as the fibrotic and hyalinized tissue that in softening, it is also subject to liquefaction (6), which would succeed in facilitating its removal by liposuction.

As a conclusion, we are pleased, gratified and praised as well as we agree with Dr. Benito Ruiz's commentary, where he says that newly published techniques focused on the treatment by surgical procedure require a professional expertise based on knowledge and caution.

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