

ORIGINAL  
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ABSTRACT  
ÖZET

# ADIPOSE TISSUE MEASUREMENT IN GYNECOMASTIA WITH COMPUTERIZED TOMOGRAPHY

## JİNEKOMASTİDE BİLGİSAYARLI TOMOGRAFİ İLE YAĞ DOKUSU ÖLÇÜMÜ

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**Objective:** The purpose of this study is to evaluate the ratio of gynecomastic adipose tissue (GAT) to total gynecomastic tissue (TGT) with computerized tomography (CT) and determine its benefits for selection of surgical technique in gynecomastia.

**Material and Methods:** Prospectively; 20 young patients with gynecomastia who were treated between 2006 and 2009 years were included in the study. Patients' mean age was 22 years (19-28). Nine patients were treated with subcutaneous mastectomy (13 breasts) and 7 patients (13 breasts) were treated with suction assisted lipectomy (SAL). Four patients (7 breasts) were operated with subcutaneous mastectomy and SAL. An experienced radiologist used standard software to determine the ratio of gynecomastic adipose tissue (GAT) to total gynecomastic tissue (TGT) in all patients.

**Results:** The mean GAT/TGT ratio was 0.7 (0.6-0.9) in patients treated with SAL and 0.2 (0.1-0.3) treated with subcutaneous mastectomy. The mean GAT/TGT ratio in patients treated with SAL combined with subcutaneous mastectomy was 0.4 (0.3-0.5). The difference between all surgical protocols was statistically significant ( $p < 0.05$ ).

**Conclusions:** We suggest that CT analysis is a useful tool for selection of gynecomastia surgery protocol. If the patient's GAT/TGT ratio is larger than 0.6; SAL should be preferred as the method for gynecomastia treatment.

**Key words:** Computerized Tomography, Gynecomastia, Lipectomy, X Ray

**Amaç:** Bu çalışmada; bilgisayarlı tomografi ile ölçülen jinekomaistik yağ dokusu ve toplam jinekomaistik doku oranının ameliyat yöntemi seçiminde faydalı olup olmadığı araştırıldı.

**Gereç ve Yöntemler:** Çalışmaya 2006-2009 yılları arasında jinekomaistik nedeniyle tedavi edilen 20 genç hasta dahil edildi. Hastaların yaş ortalaması 22 (19-28 yıl) idi. Hastaların 9'u (13 meme) mastektomi, 7'si (13 meme) yağ emme yöntemi ile tedavi edildi. Dört hasta (7 meme) yağ emme yöntemi ve subkutan mastektomi ile tedavi edildi. Radyoloji uzmanı tarafından jinekomaistik dokudaki yağ oranının toplam jinekomaistik dokuya oranı hesaplandı.

**Bulgular:** Yağ emme yönteminin yeterli olduğu hastalarda jinekomaistik dokudaki yağ oranının toplam jinekomaistik dokuya oranı 0,7 (0,6-0,9), mastektomili hastalarda 0,2 (0,1-0,3), kombine tedavi gerektiren hastalarda 0,4 (0,3-0,5) olarak bulundu. Farklı cerrahi protokoller uygulan hastalardaki hesaplanan oranlar istatistiksel olarak anlamlı düzeyde farklı bulundu ( $p < 0,05$ ).

**Sonuç:** Çalışma sonucunda; jinekomaistik doku içeriğinin tomografi ile ameliyat öncesi değerlendirilmesinin uygulanacak cerrahi yöntemin belirlenmesinde faydalı olacağı görüldü. Jinekomaistik dokudaki yağ oranının toplam jinekomaistik dokuya oranı 0,6'dan fazla olan hastalarda yağ emme yönteminin seçilmesi faydalı olacaktır.

**Anahtar kelimeler:** Bilgisayarlı tomografi, Jinekomaistik, Lipetomi, X ışını

## Introduction

Webster, in 1946, described an operation with a semicircular intra-areolar incision (1), which has become the standard operation for excision of gynecomastia. Subsequently, techniques of elliptical skin excision and transposition of nipple on a pedicle were reported in the literature (2, 3). In the late 1970s, Illouz (4) described suction-assisted lipectomy (SAL) and this technique has gained wide acceptance for many conditions (5, 6). Among these, SAL is a very useful technique in gynecomastia in selected cases. However, if the gynecomastic tissue is fibrotic and dense with less adipose tissue; SAL may not be effective. The aim of the present study was to determine the ratio of gynecomastic adipose tissue (GAT) to total gynecomastic tissue (TGT) in order to select the appropriate surgical technique in gynecomastia.

## Materials and Methods

Prospectively, 20 young patients having gynecomastia (13 bilateral, 7 unilateral breasts) and treated between 2006 and 2009, were included in the study. Patients' mean age was 22 years (19-28 years). The presence of gynecomastia is measured as follows: with a finger at the superior inner quadrant and thumb at the inferior outer quadrant, a pincerlike movement is made to pick up breast tissue from the chest wall. Palpation usually demonstrates a palpable, tender, firm, mobile, disk-like mound of tissues. Nine patients were treated with subcutaneous mastectomy (13 breasts) and 7 patients (13 breasts) with suction assisted lipectomy (SAL). The operation had to be combined

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with subcutaneous mastectomy following SAL due to inadequate aspiration of gynecomastic tissue in 4 patients (7 breasts). An experienced radiologist used standard software (General electric Corp., Milwaukee, WI. Independent console, software MRIC version 4.0.) to determine the ratio of gynecomastic adipose tissue (GAT) to total gynecomastic tissue (TGT) without knowing the surgical technique. The grade of gynecomastia was assessed from the patients' preoperative photographs and case notes. According to the Simon classification (7) the degree of gynecomastia was IIb in 17 breasts and, IIa in 16 breasts. Patients who had any endocrinological problem were not included in this study. Photographs were obtained during follow-up visits.

### Statistical Analysis

The Kolmogorov-Smirnov Goodness of Fit test was used to control whether the distribution of parameters was normal or not. Homogeneity of variance of the groups was tested with Levene's test. For all groups the parameters had normal distribution. Thus, groups were compared with the one-way ANOVA (with Tukey HSD) test. All p values less than 0.05 were considered statistically significant.

### Ct Technique for Calculation of Adipose Component in Gynecomastic Tissue

The total gynecomastic tissue (TGT) and gynecomastic adipose-tissue (GAT) volumes were determined by computed tomography (CT) by a multiscan technique. The data were used to assess the adipose component distribution at different levels of gynecomastic tissue.

CT images were centered at the level of the nipple and extended above and below, which encompasses all gynecomastic tissue. We choose to define adipose tissue, as done previously by Weits et al. (8) (e.g. -150 to -50 HU, because the density of adipose tissue can vary between individuals depending on the kilo voltage and milliamperage). The images were taken from a spiral CT GE Hi-speed Advantage scanner (General Electric Medical Systems, Milwaukee, Wisconsin, USA) using an image slice thickness of 7 mm, and was performed in the supine position and using the low dose technique (90 kV, 80 mA, section thickness of 7 mm, scanning time of 2 seconds, field of view of 400 mm). The method permitted site specific calculations of total gynecomastic tissue volume (TGT) and gynecomastic adipose tissue volume (GAT) in each computed tomography scan. GAT and TGT were delineated. The outline of the region of interest (gynecomastic tissue and gynecomastic adipose tissue, gynecomastic glandular tissue) was traced in each image section. Computer-aided medical image analysis software was used for cross-sectional area measurement being a semiautomatic program on all cross-sectional scans obtained in the gynecomastic tissue. The GAT and TGT volumes were calculated separately as:

$$V = (t+h) \sum_{i=1}^N A_i$$

where V is volume,  $A_i$  is each scan's cross-sectional area, h is the between-slice interval, t is the thickness of each slice, and N is the number of total slices. The volumetric measurements were calculated by using all slices to encompass gynecomastic tissue. After acquisition of volumetric conclusion, the total GAT volume was divided into the total TGT volume.

### Operative Technique

Gynecomastic breasts were marked in the upright sitting position, preoperatively. All surgery was performed under general anesthesia. Webster's semicircular intra-areolar incision (1) was used for surgical excision of gynecomastic tissue. If SAL was used, the breast tissue was infiltrated, with a single stab incision in the medial inframammary crease, with a solution of Ringer's lactate, 1 liter of which contained 30 ml of 1% lidocaine and 1 ml of 1:1000 adrenaline, using a super wet/tumescent technique. After infiltration, a suction cannula was inserted through the medial inframammary crease. A 4 mm Mercedes cannula was used for the initial suction by the palm down and pinch techniques. The final contouring was performed with a 3 mm Mercedes cannula. During suction, contour changes were constantly assessed by direct observation. A close watch was also kept on the color and volume of the aspirate. Once satisfactory contour was obtained, the surrounding fat was aspirated to avoid a significant saucer deformity and, the inframammary fold was disrupted. Intra operatively, the patient received one dose of intravenous broad-spectrum antibiotic, which was continued orally for 5 days in all patients. Following the procedure, a pressure dressing was applied on the chest. The patient was instructed to wear a pressure garment day and night for 6 weeks if liposuction was used. SAL was combined with subcutaneous mastectomy in four patients, in whom the gynecomastic tissue was not removed appropriately.

### Results

There was no hematoma, seroma, or infection following SAL. The mean infiltration volume per breast in SAL was 310 ml (range: 210-410 ml) and mean aspiration volume per breast was 340 ml (range: 230-450 ml; Table 1). The mean suction time for each breast was 17 min. (15-21 min). The mean GAT/TGT ratio was 0.7 (0.6-0.9) (Table 1) in patients who were treated with SAL (Figure 1 for a case example of the SAL case).

In two patients, transient seroma was seen after subcutaneous mastectomy. The mean GAT/TGT ratio was 0.2 (0.1-0.3) in patients treated with subcutaneous mastectomy (Table 2) (Figure 2 for a case example of the subcutaneous mastectomy)

In 4 patients; gynecomastia was treated by SAL combined with subcutaneous mastectomy. These patients' mean GAT/TGT ratio was 0.4 (0.3-0.5) (Table 3) (Figure 3 for a case example of the SAL combined with subcutaneous mastectomy)

Patients' mean follow-up time was 1 year (range: 12-26 months). None of the patients required secondary operation in the follow-up period. Acceptable cosmetic outcomes were gained in all patients. The difference between all surgical protocols were statistically significant ( $p < 0.05$ ; Figure 4 and Table 4).

### Discussion

Gynecomastia is a common condition, with a prevalence in young patients as high as 38% (9). It may be caused by estrogen-testosterone ratio imbalance (10). Treatment of any underlying cause is important, but may fail to stop the breast enlargement, especially if it has been present for a long time (11). Gynecomastia may be

**Table 1. Results of gynecomastia treatment with suction-assisted lipectomy**

Case	Age	Gynecomastic breast	Degree of gynecomastia*	GAT/TGT ratio		Infiltration volume		Aspiration volume		Suction time	
				R	L	R	L	R	L	R	L
1	19	BG	IIb	0.6	0.8	330	290	360	320	16	15
2	21	BG	IIb	0.7	0.8	310	340	330	370	16	16
3	23	BG	IIa	0.6	0.7	240	210	270	230	17	16
4	22	BG	IIb	0.7	0.6	290	330	330	360	16	17
5	19	BG	IIa	0.7	0.9	410	380	450	410	21	20
6	24	BG	IIb	0.6	0.7	300	290	330	320	17	17
7	21	UG	IIb	0.7		310		340		17	
Mean	21.8			0.65	0.75	312.8	306.6	344.2	335.0	17.1	16.8
SD	1.8			0.05	1.0	51.2	58.1	54.1	61.5	1.7	1.7

\*According to Simon classification. GAT: Gynecomastic adipose tissue; TGT: Total gynecomastic tissue; BG: Bilateral gynecomastia; UG: Unilateral gynecomastia; R: Right; L: Left

**Table 2. Demographic data of patients treated with subcutaneous mastectomy**

Case	Age	Gynecomastic breast	Degree of gynecomastia*	GAT/TGT ratio	
				R	L
1	20	UG	IIa		0.1
2	23	UG	IIa		0.2
3	19	BG	IIb	0.2	0.2
4	21	UG	IIa		0.2
5	23	BG	IIa	0.2	0.2
6	28	BG	IIa	0.2	0.1
7	19	UG	IIb		0.3
8	23	BG	IIb	0.2	0.3
9	24	UG	IIa		0.2
Mean	22.2±2.8			0.20±0.0	0.20±0.05
	±SD				

\*According to simon classification GAT: Gynecomastic adipose tissue; TGT: Total gynecomastic tissue; BG: Bilateral gynecomastia; UG: Unilateral gynecomastia; R: Right; L: Left

**Table 3. Demographic data of patients treated by suction-assisted lipectomy combined with subcutaneous mastectomy**

Case	Age	Gynecomastic breast	Degree of gynecomastia*	GAT/TGT	
				R	L
1	22	BG	IIa	0.3	0.5
2	27	UG	IIb		0.4
3	21	BG	IIb	0.5	0.4
4	21	BG	IIb	0.3	0.4
Mean	22.7±2.8			0.37±0.11	0.43±0.05
	±SD				

\*According to simon classification GAT: Gynecomastic adipose tissue; TGT: Total gynecomastic tissue; BG: Bilateral gynecomastia; UG: Unilateral gynecomastia; R: Right; L: Left

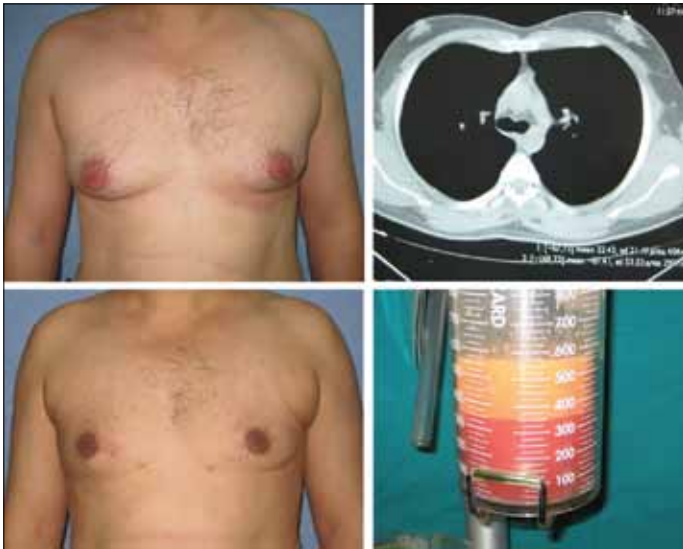
effectively treated with SAL; if the gynecomastic tissues component can be assessed well. To the best of our knowledge, none of the radiologic technique has been described for analyses of the gynecomastic tissues component. Recently, CT measurement of visceral adipose tissue has been developed as a tool to assess visceral obesity more precisely than previously used anthropometric parameters (12, 13). We thought that the CT technique may also be applicable for gynecomastic tissue component analyses. CT evaluation was studied to determine whether it is beneficial for selection of surgical protocol.

There are many surgical techniques currently available in the literature for gynecomastia treatment. The semicircular intra-areolar incision was described by Webster in 1946 (1) and has become the standard surgical operation for excision of gynecomastia up to now. In the following years, numerous approaches for resecting the excess skin were described. Skin has been removed as an ellipse, and the nipple transposed on a pedicle (2, 3) or repositioned as a full-thickness graft (14). Redundant skin has also been excised concentrically around the nipple to avoid extra-areolar scarring; keeping it on a superior (15, 16) or central (17) pedicle. The surgeon is faced with a wide range of excisional procedures, but no single technique is suitable for all forms of gynecomastia. We prefer to use the intra-areolar semilunar incision for surgical gynecomastia treatment.

Illouz, in the late 1970s (4), described the suction assisted lipectomy technique (SAL). This method has gained wide acceptance and popularity, having many advantages (5, 6). In the late 1980s, Zocchi developed ultrasound-assisted liposuction, a technique that allows selective destruction of adipose tissue (18). In this technique, electrical energy is transmitted from the power console to a hand piece containing a piezoelectric crystal which is transformed into mechanical vibrations, by a metal probe, to the tissue (18). Fodor and Watson performed a prospective study comparing conventional and ultrasound-assisted lipoplasty, and found no difference in patient satisfaction, postoperative ecchymosis, swelling, complication rate or skin contracture (19). SAL technique was used in this study.

**Table 4. Comparison of GAT/TGT (Gynecomastic adipose tissue/Total gynecomastic tissue) ratios according to treatment methods**

Method of treatment	Right breast			Left breast		
	Mean±SD	F value	p value	Mean±SD	F value	p value
SAL	0.65±0.05			0.75±0.10		
Mastectomy	0.20±0.00	71.351	<0.05	0.20±0.05	85.001	<0.05
Combined	0.37±0.11			0.43±0.05		

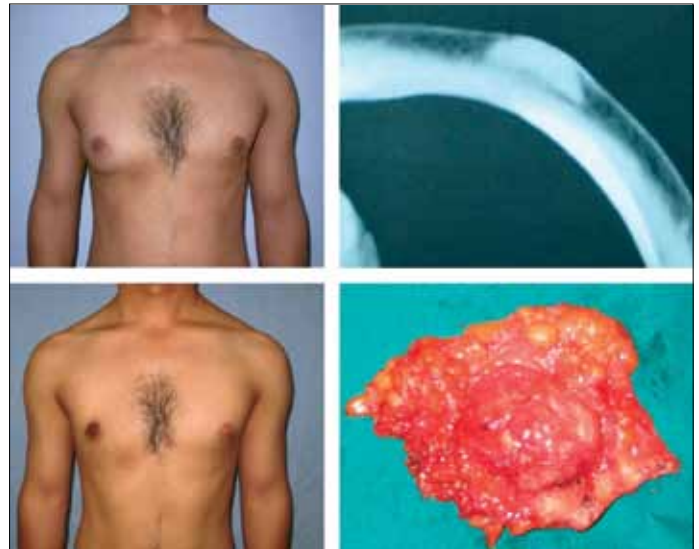


**Figure 1. Preoperative view of a 23-year-old patient treated with suction-assisted lipectomy for bilateral gynecomastia (above, left), CT image of gynecomastic tissue (above, right), Postoperative late view (below; left), view of aspirated material (below, right)**

Liposuction is not regarded adequate alone for gynecomastia treatment for many authors. For this reason; conventional liposuction combined with open excision was described by Teimourian and Perlman in 1983 (20). This combination has gained wide acceptance, because of the frequent difficulty of removing breast parenchyma by suction alone (21-24). However, mastectomy with/without liposuction selection criteria was not clear until now. Preoperative CT evaluation may be useful for unnecessary surgical combination.

Simon et al. (7) classified gynecomastia according to the size of the breast and the amount of redundant skin. They defined four categories: Grade-I: Small enlargement with no skin redundancy, Grade-IIa: Moderate enlargement with no skin redundancy, Grade-IIb: Moderate enlargement with skin redundancy and Grade-III: Marked enlargement with marked skin redundancy. The majority of our patients can be classified as IIa and IIb. We considered that marked enlargement with marked skin redundancy (Grade-III) is not suitable for liposuction. Open techniques or combination methods are more usable for marked enlargement with marked skin redundancy and this type of patient was not included in our study.

We demonstrate that computed tomography can noninvasively quantify the adipose and glandular component distribution at gynecomastic tissue sites. Low-dose CT is highly suitable for limitation of the radiation exposure associated with CT. The estimated radiation dose was reduced by approximately 75% with a 90 -kVp protocol.

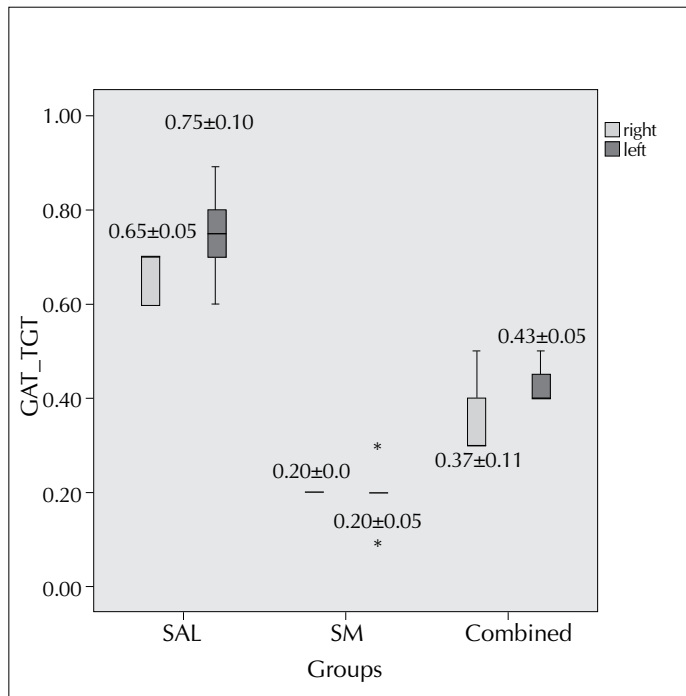


**Figure 2. Preoperative view of a 19-year-old patient treated with subcutaneous mastectomy (left; above), CT image of gynecomastic tissue (above, right); postoperative late view (below; left), pathologic specimen (below, right) are seen**



**Figure 3. Preoperative view of a 22-year-old patient with gynecomastia who was treated by suction-assisted lipectomy combined with subcutaneous mastectomy (above; left and below; left); CT image of gynecomastic tissue (above, right); postoperative view (below; left second figure) pathologic specimen and SAL aspirated material (below, right third and fourth figure) are seen**

According to the results we obtained from this study; (1) if the gynecomastic breast has a GAT/TGT ratio greater than 0.6, SAL should be preferred, (2) if the GAT/TGT ratio is between 0.3-0.5 then mastectomy may be combined with SAL and finally, (3) if the GAT/TGT ratio is under 0.3 then mastectomy may be used alone.



**Figure 4. Comparison of GAT/TGT ratios of treatment methods.** SAL: Suction-assisted lipectomy, SM: Subcutaneous mastectomy, Combined: Suction-assisted lipectomy combined with subcutaneous mastectomy

In conclusion; CT evaluation of gynecomastic tissue by using CT is a very effective method for choosing the optimal surgical procedure. In this way, both surgeon and patient satisfaction may be enhanced with a more acceptable cosmetic result.

#### Conflict of interest

No conflict of interest was declared by the authors.

**Authors' contributions:** Conceived and designed the experiments: YÇ, MAB. Performed the experiments: YÇ, MAB; GA, AKY. Analyzed the data: YÇ, MAB; GA. Wrote the paper: YÇ, MAB, SÖ. All authors read and approved the final manuscript.

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