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Relationship between Injected Fat Volume and Gluteal Augmentation Outcomes: A Prospective Case Series

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Abstract

Background: Gluteal fat transfer has witnessed a rapid increase in popularity, with fat transfer becoming an essentially used tool in aesthetic surgery. Many studies detailed the technique of the procedure while few explored the amount of fat needed for optimum results.

The aim of this study is to investigate the volume of fat that needs to be injected into the buttock, in relation to the total surface area injected, and if that would be affected by the presence of preoperative gluteal ptosis.

Methods: This study included 20 female patients seeking glutleoplasty by fat transfer. Patients were assessed preoperatively, and preoperative gluteal projection was recorded. They underwent gluteal augmentation using autologous fat transfer. Postoperatively they were assessed, and postoperative gluteal projection recorded immediately, at 1-month, and 2-months. The volume of fat injected per centimeter was calculated.

Results: The mean volume of injection per unit area within the study was 5.24ml/cm^2 (2.91-7.88ml/cm^2). Mean postoperative gluteal projection (immediately: 19.72cm, at 1-month: 20.90cm, at 2-months: 20.22 cm), was significantly higher than the mean preoperative projection (16.92cm). The area of injection was significantly higher in cases with ptosis (187cm^2), than cases without ptosis (158.67cm^2).

Conclusions: There was significant improvement in postoperative projection immediately, at 1 and 2 months, with the highest projection achieved at 1-month postoperatively. The mean volume of injection per unit area within the study was 5.24ml/cm^2.

Key Words: *Buttock – Augmentation – Fat grafting.*

Ethical Committee: The Ethical Committee of the Faculty of Medicine, Cairo University, approved this study; Approval code CMDRF132701 dated on 24-2-2021.

Disclosure: No disclosure.

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Introduction

Over the last few decades, gluteal augmentation has become increasingly popular around the world **[1]**. Autologous fat grafting has become a research hotspot, due to its practical value, ease of acquisition, and the mutual benefit to both donor and recipient areas **[2,3]**.

Many articles about gluteal fat grafting have been published in the past few years that have primarily focused on the surgical technique **[4]**. Still, the amount of fat to be injected per side to achieve the best aesthetic outcome, as concerns the size and projection of the buttocks, is still of the surgeon's preference and follows no exact rule **[5]**.

Esthetic evaluation has still less attention in publication and is still a very rich medium for research and refinement **[6]**.

The overall shape of the buttock is influenced by 4 different anatomic variables: The bony framework, Gluteus maximus muscle, Subcutaneous fat topography and Skin **[7]**.

Fat topography is the most important component of the frame and the easiest to modify, to achieve the desired gluteal projection and contour **[8]** and hence the importance of the autologous fat grafting **[9]**.

Also, fat grafting, together with lipo-sculpting of the abdomen and lower back, have the value of modifying the waist-to-hip ratio to approach the acclaimed pleasing value of 0.7 **[10,11]**.

The role of the skin can't be ignored when planning surgery to determine whether an upper buttock lift, or an inferior gluteal crease excision is necessary.

Patients could be classified according to the presence or absence of ptosis and the degree of

ptosis, with implications on the overall esthetic appearance, and the glutleoplasty technique planning [7,12,13].

Many studies detailed the technique of the procedure while few explored the amount of fat needed for optimum results, or how is that affected by the surface area of the buttock region.

The aim of this study is to investigate the volume of fat that needs to be injected into the buttock, in relation to the total surface area injected, and if that would be affected by the presence of preoperative gluteal ptosis.

Patients and Methods

This study is a prospective case series, which includes 20 female patients. The study protocol was approved by the ethical and scientific committees in Cairo University Hospital, Faculty of Medicine; Approval code CMDRF132701 dated on 24-2-2021.

The patients visited the outpatient clinic of Plastic Surgery Department in Cairo University Hospital and in Assiut University Hospital, between June 2021 and June 2023.

Patients included in the study were all females seeking buttock contouring, lifting and/or up-sizing. Their age ranged between 18 to 60 years, BMI 20 to 32, with no ptosis or grade I or II ptosis according to Mendieta classification, [7] and finally with sufficient fat to be harvested for injection.

Exclusion criteria included uncontrolled diabetes millets patients, immunocompromised patients, uncontrolled mental disorders, or uncompromised systemic illness rendering the patient unfit for anesthesia or surgery. We also excluded patients with poor skin condition, such as patients on steroids, and patients with buttock ptosis grade III or post massive weight loss, that would require more than fat transfer.

Thorough patient counseling included defining realistic expectations and discussing the limitations and possible complications of fat transfer. Informed consent was then obtained from all patients.

Preoperative photographs were taken for the patients in lateral and posterior views (Fig. 1).

Skin quality was assessed, and pinch test was used to evaluate the tissues of the buttocks. The gluteal projection was measured on both sides, while the patient lied in prone position, as the distance from the greater trochanter to the maximal gluteal projection point (Fig. 2). Two different colors were used to mark the donor areas for fat harvest and the areas for fat injection (Fig. 3).

The area of buttock to be injected by fat was then traced by transparent graph paper, that was used afterwards to deduce the surface area injected in squared centimeters (Fig. 4).

Procedure:

Patients underwent surgery either under general anesthesia or under local anesthesia (tumescent) with sedation. All patients were assessed by the anesthesiologist according to ASA recommendations.

Complete sterile equipment and complete antiseptic precautions were taken throughout surgery. According to the donor areas, patients were positioned for liposuction in supine and prone positions.

For fat aspiration, the donor site was infused with tumescent solution. Per one Liter of Lactated Ringer's solution, 20ml of lidocaine 2% and 1mg of epinephrine were added.

For liposuction, a vacuum suction device, with a 4mm diameter and 32cm candy cane blunt tip liposuction cannula, and sterile fat collecting canisters were used to harvest fat (Fig. 5). Donor sites were mainly flanks, back, abdomen and upper posterior thighs. Fat was harvested utilizing negative pressure below 700mmHg without undue trauma.

In this study there was no specific maneuver in fat harvesting we depended on decanting and washing the fat by saline and antibiotic (gentamycin 40mg on 500ml saline for each 2000ml aspirated fat) then discard the fluid fraction. The fat prepared for grafting was placed in 10mm syringes, ready for injection.

Fat was placed in the subcutaneous plane only, guided by the pre-operative markings, through incisions in the lateral part of the infra-gluteal folds of the buttocks, bilaterally. In many cases, especially with larger amounts of fat to be transferred, the port site that is upper lateral to the gluteal region bilaterally was also employed for fat injection. This port was essentially used for liposuction of the lower back and the flanks that was done in the majority of cases to emphasize the result of the fat injection. A 4mm diameter blunt tip cannula was used for fat placement. Fat was injected in layers, in multiple tunnels in a fan shape, during withdrawal of the cannula. Injection started at the deeper layer of the subcutaneous tissue and built up from there towards the more superficial subcutaneous layer closer to the skin. The end point for injection was when we had reached the required shape and projection, and keeping in mind the safety of the skin with careful monitoring of skin capillary refill, and the absence of irregularities and pumps.

It was ultimate priority to ensure that fat is all injected solely to the subcutaneous layer. The injection cannula was being felt, through the skin, at all times during fat injection. Sometimes the semi-rig-

id injection cannula needed to be made into a slight curve to allow for that.

Incisions were closed with 4/0 non-absorbable prolene sutures.

The buttock projection was again measured (the immediate postoperative record), right after fat placement and incision closure for each buttock, with the patient in prone position (Fig. 6).

Postoperative management:

Patients received broad spectrum antibiotic (Ceftriaxone) and analgesic (Paracetamol) post-operatively just for 2 days postoperative. Pressure garments were used for 4-6 weeks (Fig. 7). Foam under the corset was used for padding of the areas around the buttocks. Patients were educated concerning postural instructions to avoid prolonged excessive pressure on the areas with fat transfer, during the first 2 weeks postoperatively. Patients were followed postoperatively in the outpatient department, at 1-week to ensure there's no infection or other complications, then at 2-weeks for stitch removal and postoperative photos (Fig. 8), then at 1-month and at 2-months to measure the buttock projection.

The volume of fat injected per square centimeter of buttock area was calculated by dividing the total volume of fat injected by the total surface of the injected buttock area, as measured preoperatively.

$$\text{Volume of fat per unit of injected area} = \frac{\text{Total volume injected (ml)}}{\text{Total injected area (cm}^2\text{)}}$$

The difference between the gluteal projection pre and post operatively was calculated.

Statistical methods:

Descriptive statistics was used to present data. Mean and standard deviation were calculated for applicable parameters. ANOVA test and pairwise comparison were used to deduce relations and statistical significance between variables. The level of confidence was kept at 95%, and p-value <0.05 was set as the level of significance.

Results

20 female patients were included in this study. Mean age of cases was 34.10 years (±5.70 years, range: 21-42 years). Mean BMI of cases was 26.35Kg/m^2 (±2.62Kg/m^2, range: 22-31Kg/m^2) (Table 1).

The patients were all Egyptian ladies. Egyptians are mainly described as 'North African' or 'South Mediterranean'. Skin type for all patients were 3 to 4 on the Fitzpatrick scale.

In this study 75% of cases in the study group had no ptosis, while 15% of cases had grade I ptosis, and 10% had grade II ptosis (Table 2).

The volume of injected fat per buttock the total buttock surface area injected and the volume of fat injected per unit are illustrated in Table (3). The volume of injected fat within the study group ranged from 350ml to 1300ml (mean = 882.5ml), per buttock side. The total buttock area injected ranged from 120cm^2 to 210cm^2 (mean = 165.75cm^2), per buttock side. The volume of fat injected per unit area ranged from 2.91 ml/cm^2 to 7.88ml/cm^2 (mean = 5.24ml/cm^2). (Table 3). The correlation between the Volume of fat injected and the buttock area injected is demonstrated on a scatter diagram (Fig. 9).

The mean preoperative gluteal projection was 16.92cm. The mean immediate postoperative gluteal projection was 19.72cm; then at 1-month the mean projection was 20.90cm; and at 2-months it was 20.22cm.

All three recorded mean postoperative gluteal projection recorded figures, immediately, then at 1-month, then at 2-months, were significantly higher than the mean preoperative projection; (p-value <0.05). (Table 4, Fig. 10).

All three recorded mean postoperative gluteal projection recorded immediately then 1 month then at 2 months, were significantly higher than the mean preoperative projection (p-value <0.05).

Also, both mean gluteal projections increase records at 1-month (3.98cm) and 2-months (3.3cm) were significantly higher than the immediate postoperative increase projection (2.85cm); (p-value <0.05). And the mean 1-month postoperative projection increase (3.98cm) was significantly higher than the mean 2-months projection increase (3.3 cm); (p-value <0.05). (Table 5).

The difference between the mean fat injected volume in cases with ptosis (960.0ml), and cases without ptosis (856.7ml) was statistically insignificant; (p-value >0.05). (Table 6).

The difference between the mean fat injected volume in cases with ptosis (960,9ml) was statistically insignificant (p-value >0.05).

The mean buttock surface area injected in cases with ptosis (187.0cm^2) is, however, significantly higher than in cases without ptosis (158.7cm^2); (p-value <0.05). (Table 7).

Among this study group, there was no significant difference in the preoperative mean gluteal projection between cases with ptosis and cases without ptosis (Table 8).

As for the postoperative gluteal projection, recorded immediately, at 1-month and 2-months, it was higher in cases with preoperative ptosis (20.12cm, 21.10cm, 20.60cm respectively), than in cases without preoperative ptosis (19.6cm, 20.83cm, 20.10cm respectively). The difference was, however, not statistically significant; (*p*-value >0.05). (Table 9, Fig. 11).

Apart from the expected side-effects, namely bruising and edema, no complication was encountered among the study patients.

Table (1): Demographic data of the studied patients.

Demographic data	Study group (n=20)
Age (years):	
Mean ± SD	34.10±5.70
Range	21-42
Females:	
N (%)	20 (100%)
BMI (Kg/m^2):	
Mean ± SD	26.35±2.62
Range	22-31

Table (2): The grade of buttock ptosis in the studied patients.

Ptosis	N	%
No ptosis	15	75
Ptosis Grade I	3	15
Ptosis Grade II	2	10
Total	20	100

Table (3): The volume of injected fat per buttock, the total buttock surface area injected and the volume of fat injected per unit in the studied patients.

	Mean	SD	Range
Volume (ml)	882.50	228.86	350-1300
Area (cm^2)	165.75	17.85	120-210
V/A (ml/cm^2)	5.24	1.15	2.91-7.88

Table (4): The mean gluteal projection preoperatively immediate postoperatively at 1 and 2 months postoperative in the studied patients.

Projection (cm)	Mean	SD	Increase from preop.	*p*-value
Preoperative	16.92	1.12	–	
Postoperative (immediate)	19.72	1.36	2.8	<0.0001*
Postoperative (1-month)	20.90	1.316	3.98	1~2,3,4
Postoperative (2-months)	20.22	1.36	3.3	

* *p*-value <0.05 is considered significant.

Table (5): Comparison between increase in mean gluteal projection immediately at 1 month and 2 months postoperative.

Increase in postop. gluteal projection (cm)	Mean	SD	*p*-value
Immediate	2.80	1.07	<0.0001*
1-month	3.97	1.15	1~2,3
2-months	3.30	1.08	2~3

* *p*-value <0.05 is considered significant.

Table (6): The difference between the mean fat injected volume in cases with ptosis and cases without ptosis.

Ptosis	Volume (ml)		*p*-value
	Mean	SD	
Yes	960.0	142.98	0.221
No	856.7	247.65	

Table (7): Comparison between the mean buttock surface area injected in cases with ptosis and without ptosis.

Ptosis	Area (cm^2)		*p*-value
	Mean	SD	
Yes	187.0	13.58	<0.001*
No	158.7	12.79	

* *p*-value <0.05 is considered significant.

Table (8): Preoperative mean gluteal projection in cases with ptosis and without ptosis.

Ptosis	Preop. Projection (cm)		*p*-value
	Mean	SD	
Yes	16.90	1.34	0.937
No	16.93	1.07	

* *p*-value <0.05 is considered significant.

Table (9): Postoperative gluteal projection recorded immediately, at 1 month 2 month in cases with and without ptosis.

Postop. projection	Ptosis				*p*-value
	Yes		No		
	Mean	SD	Mean	SD	
Immediately	20.12	2.32	19.4	1.17	0.321
1-month	21.10	1.67	20.83	1.19	0.586
2-months	20.60	1.54	20.10	1.30	0.321

* *p*-value <0.05 is considered significant.

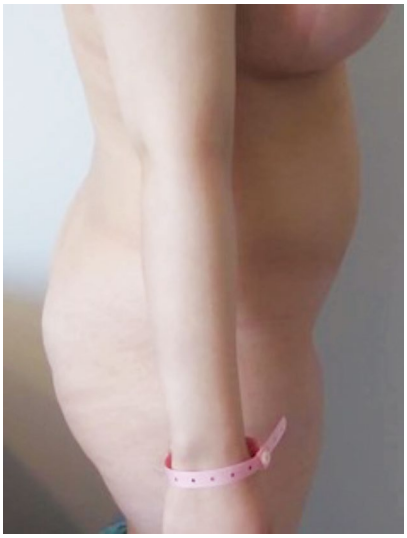

Fig. (1-A): Lateral view preoperative photo.

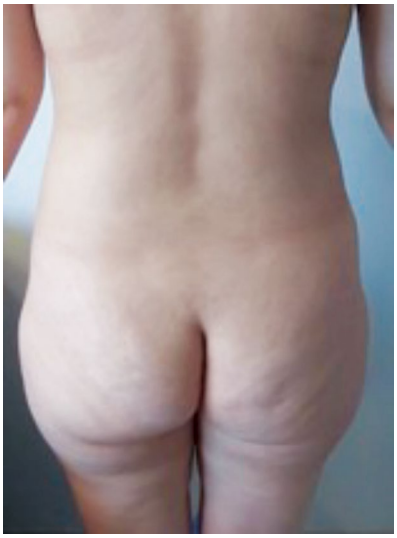

Fig. (1-B): Posterior view preoperative.

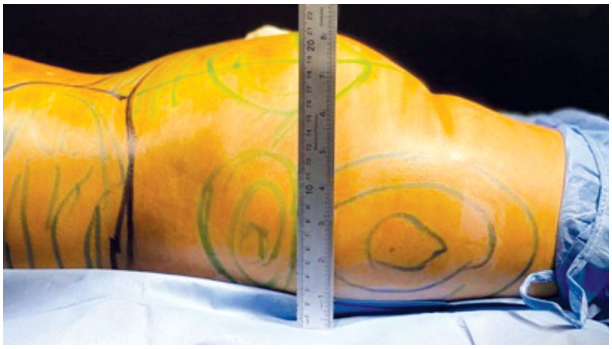

Fig. (2): Preoperative measurement.

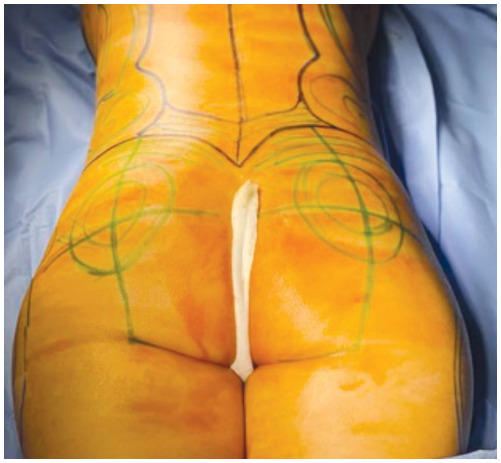

Fig. (3): Marking of the donor sites and areas to be injected.

Fig. (4): Measurement of the area of buttock which will be injected by fat using transparent graph paper.

Fig. (5): Used sterile canisters to collect fat.

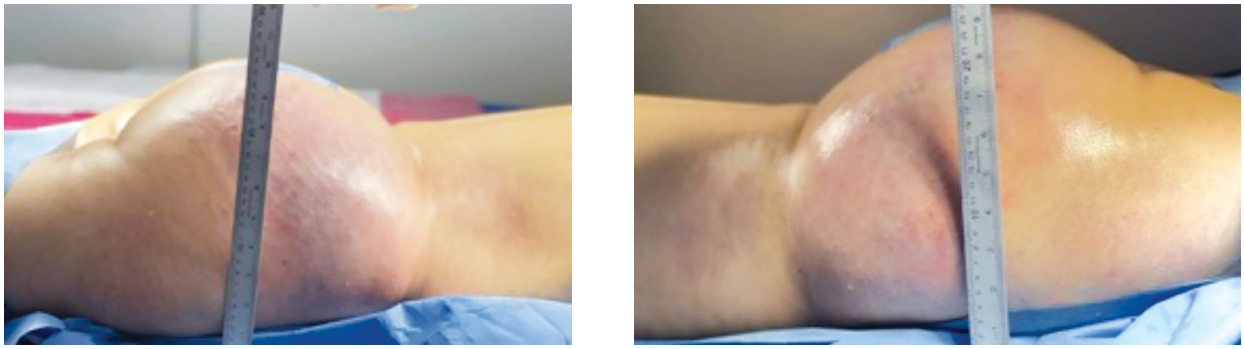

Fig. (6): The buttock projection was immediately measured after fat injection.

Fig. (7): Pressure garment.

Fig. (8): Post-operative lateral & posterior view photographs.

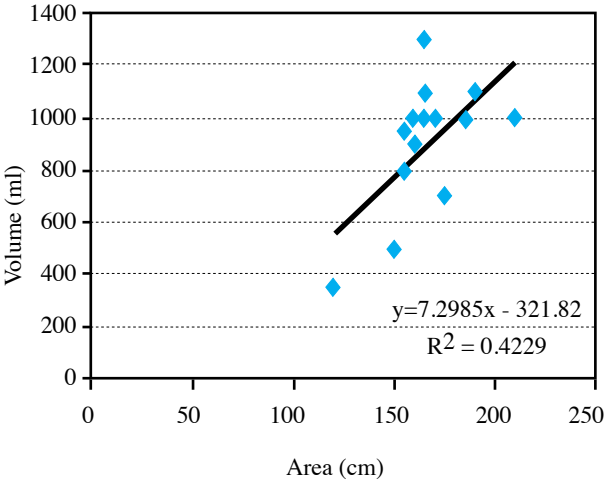

Fig. (9): Volume of fat injected vs. buttock area injected, in the study group.

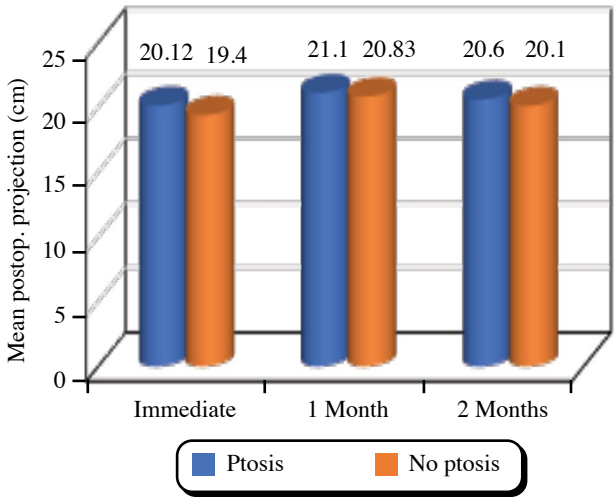

Fig. (10): Comparing gluteal projection, preoperative and post-operative (immediate, at 1-month and at 2-months.

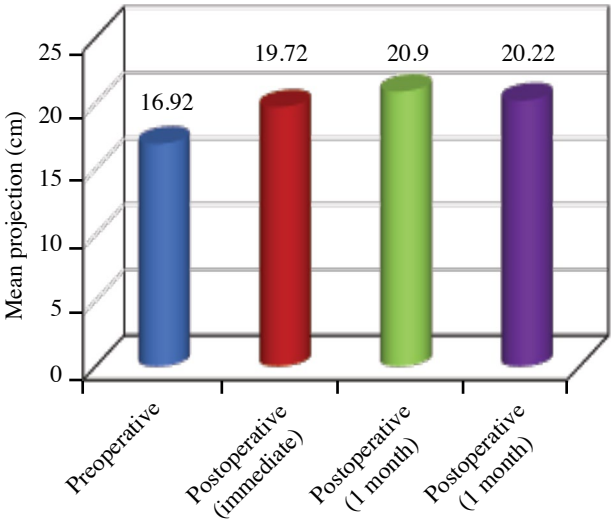

Fig. (11): Postoperative gluteal projection in patients with and without preoperative gluteal ptosis.

Discussion

Appealing buttocks are considered an important element of the aesthetic body figure. Gluteal region contouring became increasingly popular among cosmetic operations. Gluteal augmentation, fat grafting, liposculpting, and buttock lifting have seen a substantial surge among people seeking a perfect shape **[5]**.

Gluteal fat transfer serves the purpose to sculpt the waist as the liposuction that is needed for the fat harvesting is typically removed from the lower back, the flanks and the abdomen; then to transfer the fat to the buttocks **[14,15]**. This transforms the waist-hip region's shape from square to hourglass, approaching the desired waist-to-hip ratio **[16]**.

Edoardo et al., 2023 mentioned that as the waist hip ratio plays a role in anterior view but it differs according to the culture of each population the race (ideal buttock aesthetics) from the back view ideal buttock have angle 170 from two line stretched between vertical line passing through ASIS and a tangent line to middle point of the lower lateral edge as well as the pleasant lumbosacral curve and 2 supragluteal dimples **[17]**.

In this study we used the waist hip ratio as well as mixing between subtraction in the form of liposuction and adding in the form of lipografting.

While gluteal fat transfer procedures are being performed more frequently, with favorable results, however, there is a scarcity of information for surgeons to help them determine the amount of fat that need to be injected to get the optimum aesthetic result, and how that would be affected by gluteal ptosis **[5]**. This would definitely help to choose the best techniques, choose the right patients, and to give realistic advice to patients about outcomes and potential complications.

This study is a prospective interventional case series, that included 20 female patients. 75% of patients had no gluteal ptosis, while 25% had gluteal ptosis. Patients with high grade ptosis were excluded from this study as they would need a different management approach. This is congruent with the study by Rosique & Rosique (2018) **[2]**.

The injected volume of fat in each patient, as well as the injected buttock surface area were analyzed. It was found that the volume of fat injected per cm^2 of buttock area ranged from 2.91 to 7.88ml/cm^2 (mean = 5.24ml/cm^2).

Although the mean volume injected was not significantly linked to the presence or absence of gluteal ptosis (p-value >0.05), but the mean buttock area injected was significantly higher in cases of ptosis (p-value <0.05). Therefore, the presence of ptosis might explain the variation in volumes injected per unit area, along with other anatomical and structural factors.

Many of the studies published in literature including Khallaf (2017), Willemsen et al. (2013), Cansancao et al. (2019), showed wide variation of the fat volume injected to the buttocks **[17,18,19]**.

The amount of fat to be injected per side to get the optimum aesthetic result, in terms of buttock size and projection, is still a surgeon's preference and does not follow any exact rule or formula **[20]**.

Using our method for gluteal projection measurement in prone position, our results showed that all mean records for postoperatively achieved projection (immediately: 19.72cm, at 1-month: 20.90 cm, at 2-months: 20.22cm) were significantly higher than preoperative projection (16.92cm); with mean difference 2.8cm, 3.98cm and 3.3cm respectively (p-value <0.05).

This is congruent with results by Swanson (2016) where photographic measurements revealed a significant increase (p-value <0.01) in buttock projection (right, 0.44cm; left, 0.54cm) for treated patients **[20]**. Also El Naggary & Aziz, (2020) found that there was a significant difference between the preoperative gluteal projection and 6 months postoperative projection (p-value <0.0001) **[21,22]**.

In our results, the mean increase of postoperative gluteal projection at 1-month and 2-months were significantly higher than the immediate postoperative projection increase (p-value <0.05). Also, the mean increase of postoperative projection

at 1-month was significantly higher than the mean increase of postoperative projection at 2-months (p-value <0.05). The highest value for mean measured projection was at 1-month postoperatively. This is probably as the postoperative edema at 1-month was higher than at the immediate measurement, and has not yet subsided as it would at 2-months; at the same time, at 1-month, fat resorption has not been complete yet.

Ramon and Jorge Quezada 2004 based on 4 points to access the gluteal projection which is in the form of point A at the greater trochanter point B is the point of maximum projection at the mons, point C at the maximum point of projection point D is at the superior iliac spine with CB lines points to the maximum ideal projection. The ideal one is with ratio 2:1 between AB and AC line **[23]**.

The final amount of fat to be accepted by the body cannot be accurately anticipated with many interacting factors: Fat retention, resorption and fat necrosis **[5]**.

We understand that the main limitation to this study is the limited number of cases. We plan a multi-center study with a greater number of patients to achieve more solid outcomes. Another limitation is the lack of longer term follow-up for the fat transfer results.

It is also necessary to mention that these results are not valid with patients with high grade ptosis who will benefit more from lifting surgeries, with or without fat transfer.

Conclusion:

There's not yet a standard rule or formula for the amount of fat that needs to be transferred to the gluteal region to achieve the esthetically pleasing shape. In our cohort of patients 2.91-7.88ml of fat were injected per cm^2 of gluteal surface area (mean = 5.24ml/cm^2). The surface area injected was higher in cases with gluteal ptosis, with statistical significance. Postoperative buttock projection was significantly higher than pre-operative projection. The highest gluteal projection was recorded at the 1-month postoperative visit.

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