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The Energy a Plastic Surgeon Expends during Liposuction

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Background: It is generally accepted that liposuction requires a significant amount of energy from surgeons. This procedure involves the use of specialized equipment and techniques to remove fat cells from the body, which can be physically demanding for surgeons. The amount of effort required for liposuction must be evaluated in terms of energy consumption. Our goal was to conduct a study to record the energy that the surgeon uses during liposuction and correlate these results with the volume of fat obtained as well as other variables.

Methods: A series of cases was carried out from April 2022 to November 1, 2022, in three different plastic surgery centers. Three plastic surgeons recorded the procedures using an Apple Watch, choosing from among Apple Watch training options and free indoor walking. The surgeon then concluded the registration at the time of finishing the surgery and removed the surgical gloves and gowns.

Results: Complete data were obtained for 63 patients. The average fat obtained per 1 kcal of energy was 6.14 cm^3 of fat, and 160 cal to obtain 1 cm^3 of fat by liposuction. Other data that demonstrated statistically significant correlations were fat volume versus average pace (km), total fat volume versus average heart rate, fat volume versus surgical time, and fat volume versus distance.

Conclusions: Liposuction is a surgical procedure that requires considerable effort. This study demonstrates the amount of energy required for regular liposuction. Compared with other single procedures, three times more energy is required to complete liposuction. *(Plast Reconstr Surg Glob Open 2023; 11:e5001; doi: 10.1097/GOX.0000000000005001; Published online 25 May 2023.)*

INTRODUCTION

It is generally accepted that liposuction requires a significant amount of energy from surgeons. This procedure involves the use of specialized equipment and techniques to remove fat cells from the body, which can be physically demanding for surgeons. The energy expenditure required may vary depending on the technique used, amount of fat removed, and specific area being treated. The amount of effort required for liposuction must be evaluated in terms of the energy consumption. The energy required can be determined for each activity performed by any organism. The amount of energy expended during a specific period is called metabolic expenditure[1] and can be measured in kilocalories (kcal) or calories (cal) per unit of time. The measurement of oxygen consumption is the most accurate method for determining oxygen consumption, but it requires devices that cannot be placed on the surgeon during surgery. However, simpler devices, such as those focused on measuring energy expenditure during exercise, determine energy expenditure through technology and predictive equations. The Apple Watch is a tool that has revolutionized the way watches are used and their functions. Currently, this device allows the measurement of different biological variables, including heart rate, as well as derived calculations, such as measuring the caloric expenditure of any activity. The procedure was performed using photoplethysmography.[2] The Apple Watch uses green LED lights along with light-sensitive photodiodes to detect the amount of blood running down the wrist at any given time. When the heart beats, the blood flow that runs through the skin where it

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is placed is greater, as is the absorption of the green light. Owing to these sensors and motion sensors, the software allows for consistent calculation of the consumption of calories during an activity, such as active calories that are used during training or walking and total calories that are a sum of active calories and calories at rest. This allowed us to obtain a global calculation of the energy expended during any activity, including liposuction, and correlate these results with the volume of fat obtained and with other variables.

MATERIAL AND METHODS

A series of cases was carried out from April 2022 to November 1, 2022, in three different plastic surgery centers. The surgeons' ages at the time of the study were 49, 43, and 43 years, respectively, with equivalent cardiovascular capacity. Patients with buttock fat infiltration who underwent primary liposuction of the abdomen, trunk, and back were included in this study. The exclusion criteria were patients with liposuction performed in small body areas only, secondary liposuction, or those in whom other procedures were performed simultaneously.

We also measured energy consumption during one rhinoplasty, one breast augmentation, and one lipectomy, although these were not included in the calculations. These were recorded only as a comparison.

Three plastic surgeons recorded the procedures using an Apple Watch (Apple Inc, Cupertino, Calif.), one using a 44-mm Apple Watch 5 and two using a 45-mm Apple Watch 7. To enable its use during surgery, a bracelet (Action Sleeve 2[3] of the Twelve South brand) was used to place the Apple Watch on the left arm (Fig. 1). Registration on the Apple Watch was initiated by the surgeon at the time of surgical scrubs, choosing from the Apple Watch training options the free indoor walk. The surgeon then concluded the registration at the time of finishing the surgery and removed the surgical gloves and gowns. An image of the record was taken on an Apple Watch, and the data were entered into an Excel spreadsheet (Microsoft Corp, Redmond, Wash.). Subsequently, data analysis was performed. The variables obtained from the Apple Watch were surgery time, distance, kilocalories (kcal), total kcal, average heart rate, volume of fat obtained from liposuction, and volume of infiltrated fat. GraphPad Prism software, version 9,[4] was used for

Takeaways

Question: What is a plastic surgeon's energy consumption while performing liposuction?

Findings: When performing liposuction, a plastic surgeon spends, on average, 1 kcal of energy to obtain 6.14 cc^3 of liposuctioned fat.

Meaning: Performing liposuction implies a huge energy consumption for the plastic surgeon. Taking this study as a baseline, further comparisons between techniques and devices can be made in order to know which ones can be better.

Fig. 1. Action Sleeve band: a device for using an Apple Watch on the arm. A, Device on arm. B, Details of device.

statistical analyses. We calculated a sample size before investigation, according to our universe; the calculation for our sample size was 53 participants to obtain a 95% confidence level, 5% margin of error. Anyway, we decided to sum more cases.

For the effort data to be equivalent, they were asked to perform the procedures using an ultrasound device for emulsification of fat before starting liposuction (Heus or Vaser), and then a power-assisted liposuction microaire with a pump at 1 atm for liposuction and 4 mm cannulas. Fat infiltration in the buttocks was performed in all cases using 60 mL syringes and 4 mm cannulas. We also included a surgeon's different biometrics for comparison.

RESULTS

Data for a total of 73 patients were obtained, of which 10 were excluded because they did not have complete data or the patient did not meet the inclusion criteria. The data were obtained from 63 patients.

Statistical Analysis

It was possible to identify variables that presented a normal distribution (checked using the Shapiro-Wilk test $P > 0.05$). In the descriptive analysis of the data (Table 1), the mean of the patients was 32 years old, 1.60 m height, 63.3 kg weight, and an average of 24.6 BMI. According to the data obtained, the average distance was as if the surgeon had run 5.7 km at an average pace of 31.6 minutes per kilometer for a 3-hour surgery. Active kilocalories per liposuction was 717 kcal; total kilocalories, 1114; and mean frequency, 90 beats per minute when a total of 4407 cm^3 of fat was extracted and a volume of 1402 cm^3 of fat was infiltrated. Analyzing these data in a simple way, we calculated a volume of 3.95 cm^3 of fat for each kilocalorie or 30 cm^3 of fat for each calorie (average volume of liposuction fat/average of total kilocalories).

When performing the statistical analysis to look for a correlation between the variables by means of Pearson P, we observed the following valid relationships between the variables: the average fat obtained per 1 kcal of energy was 6.14 cm^3 of fat (average volume of total liposuction fat/average of active kcal), and 160 cal to obtain 1 cm^3 of fat by liposuction (with statistical significance of $P = 0.0063$; CI, 0.1011–0.5424). Other data that demonstrated a statistically significant correlation were fat volume versus average pace ($P < 0.0001$; CI, −0.7229 to −0.3586), total fat volume versus average heart rate, fat volume versus surgery time ($P = 0.0145$; CI, −0.5152 to −0.06361), and fat volume versus distance ($P = 0.0001$; CI, 0.2447 to 0.6386). The remaining relationships with the fat volume were not statistically significant. The surgeons' biometrics are included in Table 2.

DISCUSSION

The main concern at the start of our analysis was the reliability of the energy expenditure records obtained using the Apple Watch. After examining various sources, we determined that multiple independent studies have demonstrated that the Apple Watch's measurements of energy expenditure are accurate and can be compared with those obtained with specialized medical devices in various groups of people. Therefore, we are confident of the reliability of the energy expenditure records obtained using the Apple Watch in this study.[5–12]

Our research indicated that liposuction has the highest energy output among plastic surgeons. This physical activity requires covering 5.7 km in 31 minutes, representing an impressive and considerable effort—far exceeding any other type of operation—to obtain 4407 cm^3 of fat at a heart rate of 90 beats per minute. Statistically significant correlations showed that a greater amount of fat obtained by liposuction required more energy expenditure by the surgeon, higher heart

Table 1. Descriptive Statistics

	Age	Height	Weight	BMI	Distance	Mean Rythm	Active Kcal	Total Kcal	Mean HR	Low HR	High HR	Fat Volume	Infiltrated Fat
Number of values	63	63	63	63	63	56	63	63	63	63	63	63	63
Minimum	19	1.46	44.4	19.48	0.27	15.58	428	654	64	52	80	1250	0
Maximum	51	1.75	84	32.41	10.24	53.59	1128	1612	123	95	146	9000	2880
Range	32	0.29	39.6	12.93	9.97	38.01	700	958	59	43	66	7750	2880
Mean	32.38	1.601	63.39	24.67	5.757	31.68	717.4	1114	90.3	69.98	113.5	4407	1402
SD	6.978	0.06301	8.622	2.558	1.886	11.24	146.3	218.6	16.86	12.62	18.54	1814	629.3
SE of mean	0.8791	0.007939	1.086	0.3223	0.2376	1.502	18.43	27.54	2.124	1.59	2.336	228.5	79.28
Lower 95% CI of mean	30.62	1.585	61.22	24.03	5.283	28.68	680.6	1059	86.05	66.81	108.8	3950	1244
Upper 95% CI of mean	34.14	1.617	65.56	25.32	6.232	34.69	754.3	1169	94.55	73.16	118.1	4864	1561

Table 2. Surgeons Biometrics and Comparison

Surgeon	Age	Height (cm)	Weight (kg)	BMI	Resting Heart Rate	Basal Energy Expenditure	Kcal Active	Kcal Total	Mean HR
A	43	1.72	79.5	26.9	69	1682	784	1061	92
B	43	1.78	85	26.7	75	1730	773	1024	110
C	49	1.73	95	31.7	54	1936	683	1158	85

rates, longer surgery times, and longer distances. In other words, the greater the volume of fat obtained by liposuction, the greater the energy expenditure of the surgeon. This can also be interpreted as requiring 160 cal to obtain 1 cm^3 of fat by liposuction or 1 kcal of energy for each 6.14 cm^3 of fat.

As reference values, measurements were obtained for other types of surgery. The average expenditure of active kcal for liposuction was 717 kcal; breast augmentation required 103 kcal for a 50-minute surgery; lipectomy, expenditure of 192 kcal active for a 1 hour 45 minute surgery; and rhinoplasty, 105 kcal for a 1-hour surgery. (**See figure, Supplemental Digital Content 1,** which shows correlation between active kilocalories and fat volume. **http://links.lww.com/PRSGO/C560**.)

This study opens a new vision for liposculpture, including potential risks to the surgeon's health (motion and cardiovascular risks). Currently, it is unknown whether this large energy expenditure, which is equivalent to several kilometers traveled per day, can be considered cardiovascular activity or how it impacts the general health of the surgeon. If so, surgeons who focus their greatest activity on body contouring based on liposculpture may have better cardiovascular outcomes. The impact of this energy required after two to three liposuctions performed in one day allows us to recommend that the surgeon have good nutrition and hydration before and between liposuctions.

We believe that this new approach can be used to compare the differences between efforts when performing surgery with or without technology. Perhaps, we could answer if the use of technology (power- or ultrasound-assisted) is beneficial for the surgeon and if it really translates into an execution that requires lower energy expenditure. The effort required to perform primary versus secondary liposuction can be evaluated. Likewise, the surgeon can re-evaluate the value of his procedures by determining not only the skill, technology, risk, and experience of which liposculpture can be performed, but also the energy expenditure or effort required to perform it.

This study had some limitations. Other factors may also contribute to the observed relationships between the variables, and further research is needed to fully understand the underlying mechanisms. Additionally, it is important to consider the limitations of the study, including sample size and potential biases that may have influenced the results. The measurement of energy expenditure depends on the accuracy of the device. According to the information obtained,[2] this measurement is very accurate but is still an indirect measurement. Likewise, the surgeons included in the study had extensive experience in performing liposuction of large volumes frequently. This can also skew the study outcomes when comparing the results with those of less experienced surgeons or when performing smaller liposuctions. In addition, measurements were obtained from three surgeons with equivalent cardiovascular condition and age, but other surgeons could have different energy expenses for the same activity, such as those with different cardiovascular capacities, consumption of medications (B-blockers), technology used, and thickness of the cannulas. Also, some patients have differences, such as the volume of fat to be removed and the ease with which some tissues can be penetrated with the liposuction cannula in a primary surgery compared with secondary liposuction with more fibrosis, where the fat is very compact and difficult to work with.

However, we also consider the implications of such measures extremely important. Certainly, more studies will emerge, and with that, we can adequately and objectively compare the questions asked by the authors.

CONCLUSIONS

Liposuction is a surgical procedure that requires significant physical effort from surgeons. According to this study, liposuction can be three times more energy demanding than other single procedures such as rhinoplasty or breast augmentation. This physical activity requires covering 5.7 km in 31 minutes, representing an impressive and considerable effort to obtain 4407 cm^3 of fat at a heart rate of 90 beats per minute. This new understanding of the energy requirements of the procedure can lead to recommendations for good nutrition and hydration before and between the procedures. It can also serve as a tool for comparing different surgical scenarios, such as primary versus secondary liposuction, or for evaluating or developing technologies that can assist surgeons in performing the procedure more efficiently.

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DISCLOSURE

The authors have no financial interest to declare in relation to the content of this article.

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