

Influence of Massive Weight Loss on the Perception of Facial Age: The Facial Age Perceptions Cohort

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Background: Knowledge is scarce about the role of massive weight loss in facial age perception. The aim of this study was to verify whether there is a change in the perception of facial age when comparing people with morbid obesity before surgery and 1 year after the procedure.

Methods: Patients with morbid obesity have been analyzed, through a prospective cohort, before and 1 year after undergoing bariatric surgery. Seven plastic surgeons estimated the age of each subject.

Results: Seventy patients participated. Five patients were excluded because of the exclusion criteria. There was no drop-off among the subjects participating in this cohort. Before surgery, the mean facial age perception was 40.8 years; after surgery, mean facial age perception was 43.7 years (95 percent CI, 0.58 to 2.95; $p = 0.004$). Men older than 40 years, with a preoperative body mass index between 40 and 49.9 kg/m², weight greater than 127.65 kg before surgery, and percentage of excess weight lost greater than 75.13 percent demonstrated greater perceived facial aging.

Conclusion: Massive weight loss appears to produce facial aging. (*Plast. Reconstr. Surg.* 142: 481e, 2018.)

CLINICAL QUESTION/LEVEL OF EVIDENCE: Therapeutic, IV.

The aging face shows characteristic changes, many of which are attributed solely to the effects of volume loss on skin, muscle, and fat.¹ From the age of 30 years onward, facial fat begins to diminish in a progressive and predictable way.² This leaves the face appearing older and deflated.³ Several treatments to replace volume loss in the face have been proven to rejuvenate facial appearance.⁴

Bariatric surgery provides benefits to obese people, and the period following this therapy is a time of rapid change.⁵ During this period, the

patient's body changes in different ways at different times.⁶ There is evidence showing body changes following bariatric surgery.⁷ However, knowledge regarding the impact that this treatment generates in terms of change in the facial contours because of rapid and intense weight loss is still lacking. The aim of this study was to verify whether there is a change in the perception of facial age in patients with morbid obesity before and 1 year after bariatric surgery.

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A "Hot Topic Video" by Editor-in-Chief Rod J. Rohrich, M.D., accompanies this article. Go to PRSJournal.com and click on "Plastic Surgery Hot Topics" in the "Digital Media" tab to watch.

PATIENTS AND METHODS

The research conducted in the preparation of this article was designed as a prospective cohort. The facial age perceptions cohort was approved by the Research Ethics Committee of our university hospital.

Study Participants

Participating in this experiment were morbidly obese patients who sought treatment at a university hospital. All participants were recruited by the plastic surgery staff of the bariatric center, and consented to participate in the trial during their initial assessment. The obese subjects formed group I, and these same individuals 1 year after having undergone gastric Roux-en-Y bypass surgery composed group II.

To be eligible, patients needed to be between 18 and 70 years of age, have a body mass index greater than 40 kg/m², and accept and sign the informed consent form, agreeing with its items after explanation of the study by the assistant researcher. Patients were excluded if any of the following criteria were met: any history of facial cosmetic or reconstructive plastic surgery; use of any facial dermatologic formula in the past 6 months; having dental implants; having used a permanent soft-tissue filler on the face; having received in the past 12 months a facial aesthetic treatment involving temporary fillers, botulinum toxin, or skin exfoliation procedures such as chemical peeling or the application of laser procedures on the face; men with facial hair longer than 1 cm; not obtaining a loss in the percentage of excess fat of 50 percent or more at the follow-up 1 year after the surgery; skin phototype V or VI based on the Fitzpatrick scale; or personal request to be removed from the study.

Experiment

From January of 2015 until February of 2017, patients who were consulted by one of the researchers of the study posed for photographs. The photographs obtained were randomly numbered and presented to seven different plastic surgeons on a 17-inch laptop with a high-definition screen (Apple, Inc., Cupertino, Calif.) with a 10-second display interval for each picture. During the evaluation, a spreadsheet was provided with the sequence of appearance numbered on the screen for each subject in the study, with a space left blank for the evaluator to write down the age that each person was believed to be. The evaluators were not allowed to go back in the

presentation or remain analyzing an image for more than 10 seconds.

During this presentation, all photographs were shown to all plastic surgeons at random sequence, and the postsurgical images were at least 1 year older in all patients. The evaluators were not aware that the objectives of the study were related to obesity. In addition, there were no indications of the division between groups, with only one cardinal number being placed for each photograph in the order displayed.

For each photograph, the lowest and highest values suggested by the evaluators were discarded, and the mean of the five values remaining was calculated. This methodology has been validated in a previously published study.⁸

For assessment of the interobserver agreement, the results obtained by each were compared. To numerically define the perception of rejuvenation and aging, the difference in the perception of facial age was calculated based on the mean measurement obtained for each research subject compared with his or her own chronologic age at the time the photograph was taken.

Sample Size

To detect a difference of 40 percent in the SD at the age before and at least 1 year after treatment, considering an $\alpha = 0.05$ and a power of 90 percent, 62 subjects in each group were calculated as being necessary. This sample size was also sufficient to compare groups with each other, detecting a difference between the means of up to 50 percent of the SD.

Statistical Analyses

Statistical analyses were performed using IBM SPSS Version 22.0 (IBM Corp., Armonk, N.Y.). To prevent possible biases, independent databases were created between groups, preventing changes in the other factors studied that could possibly be caused by the surgery. Observations with missing data on the response variable were listwise deleted from the analysis to avoid bias of unknown size and direction.

The categorical variables were described as percentages and frequencies, and the quantitative variables were described as mean \pm SD. Quantitative variables were compared before and after surgery by the *t* test for independent samples. The categorical variables were compared between groups using Fisher's exact test, whereas for the quantitative variables, the *t* test for independent samples was used. When comparing the quantitative variables

among three or more categories, analysis of variance was used, followed by the Tukey post hoc test. The intraclass correlation coefficient was used to assess the concordance between evaluators. The 95 percent confidence interval was calculated; a 5 percent significance level was considered, reflected by a value of $p < 0.05$.

Ethics

This study did not change anything in terms of the care provided to the patients. Regardless of their consent to participate in the study or not, their follow-up was the same, and the patients did not undergo any changes because of this decision. All procedures were performed in accordance with the guidelines and standards governing research involving humans and the international ethical guidelines for biomedical research involving human subjects.⁹ All subjects in this study read, agreed with, and signed the informed consent form.

RESULTS

Participant Characteristics

Seventy patients participated. Five patients were excluded because of the exclusion criteria. There was no drop-off among the subjects participating in this cohort.

Photographs of 65 individuals were assessed. Figures 1 and 2 show the photographs of subjects before and 1 year after the procedure. Table 1 lists the characteristics of these study patients.

Perception of Facial Age

Before surgery, the 30 percent trimmed mean facial age perception was 40.8 years; after surgery, it was 43.7 years (95 percent CI, 0.58 to 2.95; $p = 0.004$). The difference in perception of the facial age value obtained was 8.3 months in group I and 29.4 months ($p = 0.004$) in group II. Men older than 40 years, with a preoperative body mass index between 40 and 49.9 kg/m², weight greater than 127.65 kg before surgery, and percentage loss of excess weight greater than 75.13 percent, demonstrated greater perceived facial aging. Table 2 lists the different comparisons.

DISCUSSION

Bariatric surgery causes various changes in the corporal configuration of the patients who choose to be treated with this therapy.^{10,11} However, knowledge regarding the impact of this treatment in terms of facial appearance, and the changes that the facial skin undergoes following abrupt massive reduction in body weight, is still lacking. In the first year after bariatric surgery, there is a sudden and intense change in the weight of the respective patients.^{12,13} There is an abundance of publications showing changes in plastic surgery techniques following massive weight loss.^{14–16} However, we found only one publication regarding facial rejuvenation for patients who have lost large amounts of weight.¹⁷ Until now, there have been no publications that verify and quantify this phenomenon in the faces of people who have lost



Fig. 1. A 48-year-old patient (*left*) before surgery and (*right*) 1 year after surgery.



Fig. 2. A 42-year-old patient (*left*) before surgery and (*right*) 1 year after surgery.

Table 1. Characteristics of the Subjects

Characteristic	Value
Female sex	50 (76.9%)
Mean age ± SD, yr	40.1 ± 9.6
Mean weight ± SD, kg	127.7 ± 23.1
Mean height ± SD, m	1.64 ± 0.09
Mean BMI ± SD, kg/m ²	47.5 ± 7.20
Mean excess weight ± SD	60.3 ± 20.1
Mean weight loss ± SD, kg	43.2 ± 11.5
Mean %EWL ± SD, kg	75.1 ± 19.0

BMI, body mass index; %EWL, percentage estimated weight loss.

weight abruptly. The results from this study support the belief that this sudden change in body weight causes facial aging. It is noteworthy that

there are basically four different definitions of facial age, as follows: (1) chronologic age (accumulated in years and months from a person’s date of birth); (2) perceived age (indicated for each individual based on the evaluation of others); (3) estimated age (indicated for each person by computer-aided protocols); and (4) apparent age (combination of information regarding the age contained in the appearance of each person that serves to support the mathematical models and allows for the assumption of the mechanisms of human perception).^{18,19}

The change in the difference in the perception of facial age value is associated with the main

Table 2. Difference in the Perception of Facial Age in the Different Categories of Characteristics

	No.	Before Surgery*	After Surgery*	<i>p</i>	95% CI*
Sex					
Female	50	13.2 ± 69	29.7 ± 60.8	0.054	0.02–2.8
Male	15	-7.9 ± 76.9	28.3 ± 45.8	0.013†	0.8–5.3
Age					
<40 yr	34	18.4 ± 64.8	27.6 ± 60	0.296	0.8–5.3
>40 yr	31	-2.8 ± 79.6	31.4 ± 55	0.005†	0.9–4.8
BMI before					
<50 kg/m ²	41	1.2 ± 69.7	23.1 ± 56.5	0.023†	0.3–3.4
>50 kg/m ²	24	20.4 ± 72.7	40.2 ± 58.4	0.090	0.3–3.6
Weight					
<127 kg	35	7.3 ± 72.1	27.8 ± 58.2	0.064	0.1–3.5
>127 kg	30	9.3 ± 70.5	31.3 ± 57.2	0.025†	0.2–3.4
% EWL					
<75	34	21.6 ± 72.4	32.2 ± 61.4	0.256	-0.7–2.4
>75	31	-6.3 ± 67.2	26.4 ± 53.2	0.005†	0.9–4.6

BMI, body mass index; %EWL, percentage estimated weight loss.

*Data are presented in months, as mean ± SD, and compared by *t* test for paired samples.

†Statistically significant.

outcome of interest in this study. When the difference in the perception of facial age is positive, it is shown that the individual appears to be older than he or she is in reality, which is an indication of aging. However, when the difference in the perception of facial age value is negative, it can be seen that the subject appears to be younger than he or she is in reality (i.e., an expression of rejuvenation).²⁰ The methodology of using plastic surgeons as evaluators was chosen because it is one of the most practical, feasible, trustworthy, and economic ways of assessing facial aging change.

When analyzing the gender variable, we observed that, in women, despite a mean increase of 16.6 months after surgery being demonstrated, there was no statistical significance, whereas men showed a mean increase of 36.2 months after surgery with statistical significance. This can be explained by the fact that men tend to undergo bariatric surgery when they are older, with more advanced obesity and more complicated comorbidities.²¹ Another important factor to be considered is that the male facial skeleton undergoes changes with advancement of age different from women: with aging, women had more prominent maxillary bone resorption, and a marked downward and backward mandibular rotation; in contrast, men had more forward rotation of the mandible and increased chin prominence.²²⁻²⁴ These factors probably contribute to making men more susceptible to facial aging as a result of abrupt weight loss.

It is believed that age is inversely related to weight loss 2 years after bariatric surgery.²⁵ When comparing the mean difference in the perception of facial age between groups divided into the two age groups, it was observed that in subjects younger than 40 years, there was little change (not statistically significant); however, in those older than 40 years, an increase of 34.2 months was observed, with statistical significance. This finding demonstrates that older people are more susceptible to changes in facial volume caused by weight loss.

It is known that patients with a body mass index above 50 kg/m² have a higher resolution of comorbidities related to obesity²⁶; however, it is believed that the preoperative body mass index is inversely related to the percentage of excess weight lost after bariatric surgery.²⁷ The present study showed a statistically significant difference in the perception of facial age in patients with a body mass index below 50 kg/m² before the intervention of approximately 21.8 months. This finding may be attributable to the further reduction

in the percentage of excess of weight lost for this patient group.

Preoperative weight is an important predictor of weight loss after bariatric surgery²⁸: the lower the patient's weight before surgery, the lower the respective operative risks.²⁹ In this study, a comparison of the mean difference in the perception of facial age in patients with weight above the mean for the sample itself showed aging of approximately 22 months, with statistical significance, demonstrating that the aging perceived after surgery is related directly to preoperative weight.

The percentage of excess weight lost represents the proportion of excess weight lost after surgery compared with the ideal body weight. When making the comparison between the mean difference in the perception of facial age for the groups divided into two segments for this category, an aging of 32.6 months with statistical significance was observed in patients who had a weight loss above the mean for the sample. It is known that percentage of excess of weight lost is important in improving several comorbidities related to obesity³⁰; however, there was no information regarding its role in the perception of facial age.

In a previous debate in the Letters to the Editor section in this *Journal*, our research group and Narasimhan, Ramanadham, and Rohrich wondered about the role of bariatric surgery in facial aging.^{31,32} In the present study, we started to solve this puzzle, and it is now possible to state that individuals after bariatric surgery had higher values in the perception of facial age than they had before surgery, and this difference was statistically significant, reflecting that sudden weight loss causes facial appearance to become more aged.

It is plausible that a number of limitations could have influenced the results obtained. Only Caucasian patients were included in this study; some deviations may thus be expected, based on ethnicity. The individuals in this study agreed to have their facial photographs, revealing their identity, used for research purposes, which may have created a selection bias. A few years after the bariatric surgery, a significant number of patients gain weight in relation to the weight measured in the first year after surgery.³³ The patients in our study had not reached the period of regaining weight when their data were collected. In our forthcoming study, this cohort research following the same post-bariatric surgery patients 5 years after surgery will be performed to assess the fat regain phenomenon effect on facial age perception. We are planning to perform a three-dimensional

volume analysis and to use a validated facial furrows grading scale to further provide facial aging measurement. Given that our findings are based on a limited number of variables, the external validity of such analyses should consequently be treated with the utmost caution.

Post-massive weight loss plastic surgery has expanded in scope and case volume around the world during the past few years. As with any other surgical specialty, understanding the impact of surgical reconstruction on the patient is a crucial aspect in the evolution of treatment.³⁴ This research has the potential to start a debate about the financing of specific facial plastic surgery procedures for patients following bariatric surgery. Future work will look into a detailed analysis about how exactly facial adiposity contributes to facial aging, to state which areas of the face may be negatively impacted by abrupt massive weight loss and which areas may benefit. Further studies will also be conducted to determine the impact of the difference in the perception of facial age on quality of life.

CONCLUSION

The evidence from this study points toward the idea that people who have undergone bariatric surgery appear to be older than they were before the procedure.

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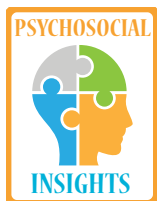
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PATIENT CONSENT

Patients provided written consent for the use of their images.

PSYCHOSOCIAL INSIGHTS

Dr. David B. Sarwer, Associate Dean for Research, Professor of Social and Behavioral Sciences, and Director of the Center for Obesity Research and Education, College of Public Health, Temple University, Philadelphia, Pa.



Just less than 10 percent of adults in the United States have extreme obesity, defined as a body mass index greater than or equal to 40 kg/m². Individuals with extreme obesity are typically 100 lbs above their recommended body weight. Many suf-

fer with a number of significant comorbidities, including type 2 diabetes, hypertension, heart disease, and sleep apnea. Most suffer with increased body image dissatisfaction as well as decreased self-esteem and quality of life. In addition, they are at increased risk of death.

Many individuals with extreme obesity routinely turn to self-directed diets, commercial weight loss programs, and either over-the-counter weight loss or prescription weight loss medications to lose weight. These treatments can help individuals lose 5 to 10 percent of their body weight, which can improve some weight-related health problems. Maintaining these losses, however, is difficult, and weight regain is common. As a result, many patients end up in an ongoing cycle of modest weight loss and regain, all while the excessive adiposity continues to take a toll on their physical and mental well being.

Bariatric surgery holds great promise for many of these individuals. Patients typically lose 25 to 35 percent of their weight in the first 12 to 18 months after surgery, and 80 percent of patients are largely successful in maintaining those losses for at least a decade. In addition, large percentages see dramatic improvements in their weight-related health problems. Despite these impressive outcomes, it is estimated that only 200,000 persons with extreme obesity undergo bariatric surgery annually, representing approximately only 1 percent of those persons with a body mass index of 40 kg/m² or greater. The underutilization of bariatric surgery is likely the result of many factors—lack of insurance coverage, concerns about the safety and efficacy of bariatric surgery for both patients and providers, and an overall lack of awareness of the significant health threats associated with obesity.

Concerns about physical appearance and body image, as well as other psychosocial issues, play an important role in the decision to have surgery. When patients are asked why they are interested in bariatric surgery now, they often first speak about the dissatisfaction, embarrassment, and shame they feel about their bodies. After surgery, many patients report improvement in their body image. Others, however, continue to experience dissatisfaction related to their loose, sagging skin, which can impact their sexual functioning and romantic relationships. As a woman who had undergone bariat-

ric surgery told me, “Everyone says I look great, but they wouldn’t want to see me undressed.”

In the present study, Valente and colleagues have made an interesting contribution to our understanding of bariatric surgery patients by assessing perceptions of changes in facial age following surgery. On average, patients were judged by a group of plastic surgeons to look approximately 3 years older only 1 year after bariatric surgery. Men over the age of 40, and individuals who lost the largest amounts of weight, were judged as having the most profound changes in perceived facial age.

In some respects, this finding is not surprising. Loss of facial volume is typically associated with an older-looking appearance. Furthermore, the great popularity of minimally invasive facial fillers reminds us that facial volume is associated with a more youthful appearance. At the same time, the result must be viewed with some degree of caution. The relatively small sample size of raters coupled with the lack of specific information on the study’s methodology raises questions about the validity of the findings. Replication from other investigators is recommended before the observations are used to inform clinical care. If the results are confirmed, would bariatric surgeons be obligated to inform patients that they will look older after surgery, even though bariatric surgery is not a cosmetic procedure? If the primary goal of bariatric surgery is to improve morbidity and mortality, with improvements in appearance and body image being secondary, would this information be an important element of the medical decision-making process? The answers to these questions would require further thought.

In 2013, the American Medical Association, for the first time, classified obesity as a disease. As such, it is important that researchers and clinicians talk about obesity in the same way that we talk about other diseases. All too often, persons with obesity are called “obese persons”—as if the disease defines them. We do not talk about “cancer persons” and we should similarly use person-first (“persons with obesity”) language in discussing women and men with the disease of obesity. The obesity community also has moved away from the term “morbid obesity,” as it is seen as unnecessarily pejorative. Extreme or severe obesity is now used. These changes in language have quickly become commonplace for research-

ers and clinicians in the field of obesity. The plastic surgery community should follow this lead to ensure that persons with obesity are not unnecessarily stigmatized by the professionals they turn to when they seek to improve their physical appearance.

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