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Plastic surgery after massive weight loss following biliopancreatic diversion

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ABSTRACT

Objective. To develop patient selection criteria and requirements for surgery, to evaluate the results of plastic surgeries in patients after massive weight loss following pylorus-preserving modifications of biliopancreatic diversion (BPD).

Material and methods. The study included 65 patients who underwent BPD surgery in SADI (*n*=34) and Hess-Marceau (BPD-DS; *n*=31) modifications and subsequent post-bariatric plastic surgeries (PBPS). Patient satisfaction with postoperative aesthetic and functional results was assessed using the Likert scale.

Results. PBPS in the SADI group was performed in 27.4±13.6 months after BPD, in the BPD-DS group — after 27.9±14.9 months. Combined plastic surgeries with gastrointestinal tract reconstruction were carried out in 10 (29.4%) and 6 (19.4%) patients, respectively. Combined surgeries were performed in 28 (82.4%) and 23 (74.2%) patients in SADI and BPD-DS groups, respectively. Complication rate was 26.5% and 45.2%, respectively. Most of events didn't require hospital-stay and regressed within 1—2 months under conservative treatment. For most patients, maximum scores in assessing the contour, location of postoperative scars, and aesthetics of umbilicus were obtained.

Conclusion. PBPS is an integral part of treatment in patients with morbid obesity. These procedures are often performed as a part of combined surgery. They can be successfully used in combination with reconstructive bariatric surgeries without increase of postoperative complication rate. Patient satisfaction with PBPS outcomes reaches 100%.

Keywords: *abdominoplasty, brachioplasty, hernia repair, mammoplasty, lower body lifting, combined plastic surgeries, biliopancreatic diversion.*

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Introduction

Obesity is one of the leading public health problems, and its prevalence has been rapidly increasing worldwide in recent decades. Numerous comorbidities, unacceptable appearance, abnormal condition of skin and unpleasant odor associated with severe obesity make this problem not only a medical one, but often primarily a social one [1, 2].

Bariatric surgery leads to significant and stable body weight, elimination of multiple comorbidities, primarily type 2 diabetes mellitus, sleep apnea and arterial hypertension, reduction of early mortality [3]. Higher body weight is followed by more significant changes in appearance after bariatric surgery and final weight loss. In desire to reduce weight, improve health and appearance, more and more patients decide in favor of bariatric surgery [4]. However, body weight loss results excess flabby skin folds on the torso, sagging of soft tissues of shoulders, hips, ptosis of the breasts, buttocks and finally maceration in these folds and unpleasant odor. Despite normalization of weight, persistent aesthetic body abnormalities lead to social isolation, physical discomfort, psychological difficulties and deterioration in quality of life [4].

The problems associated with excessive skin folds cannot be significantly resolved by lifestyle changes, dietary adjustments or exercises, cosmetic procedures [5]. Post-bariatric plastic surgery or reconstructive plastic surgery implies removal of excess skin and adipose tissue from the body, shoulders, torso and hips after significant weight loss within a short period, as well as breast and buttock lifting [6, 7].

Post-bariatric plastic surgery significantly improves or restores body contours, increases physical activity and also improves body hygiene [8]. According to the latest

available data of the International Society for Aesthetic Plastic Surgery, these interventions have become more frequent by 7% within a year. To date, their number has reached almost 3.5 million per year [9]. According to the same reports, the number of post-bariatric plastic procedures such as lower body lifting and brachioplasty has increased by 4284% and 5235% in the United States between 2017 and 2020 [10].

Despite the potentially positive effects and high prevalence [11], post-bariatric plastic surgery is not a standard plastic intervention in Russia. There are no clear timing and selection criteria; pre- and postoperative management of such patients is unclear. There are no statistical data on these procedures. At the same time, post-bariatric abdominoplasty is performed according to medical care standards in the USA and many European countries [10]. According to the ASPS protocol, the criteria for abdominoplasty as a part of compulsory medical insurance after massive weight loss are body weight decrease by at least 20 kg and body mass index decrease by 10 kg/m^2 [10].

The purpose of the study was to develop patient selection criteria and requirements for surgery, to evaluate the results of plastic surgeries in patients after massive weight loss following pylorus-preserving modifications of biliopancreatic diversion (BPD).

Material and methods

The study included 65 patients who underwent BPD surgery in SADI (*n*=34) and Hess-Marceau (BPD-DS; *n*=31) modifications and subsequent post-bariatric plastic surgeries (PBPS).

The requirements for plastic surgery in these patients were complete weight loss (weight decreased to the minimum values and did not change for at least 3 months), period after primary bariatric surgery at least 12 months, BMI ⩽ 34 kg/m^2, compensation of comorbidities (type 2 diabetes mellitus, arterial hypertension, sleep apnea), no side effects of primary bariatric surgery, acceptable ASA score, hemoglobin ⩾ 120 g/l, serum protein ⩾ 66 g/l (albumin ⩾ 34 g/l), normal serum vitamin D, parathyroid hormone, iron, ferritin, vitamin B12 and signed informed consent. Patients who smoked were advised to stop smoking one month before surgery and not to smoke for a month after surgery.

In addition to standard clinical, laboratory and instrumental preoperative examination, we assessed serum albumin, vitamin B12, folic acid, ferritin, iron, vitamins A, E, D, parathyroid hormone and alkaline phosphatase. Anthropometric indicators, comorbidities and period after post-bariatric plastic surgery were analyzed. We performed ultrasound and computed tomography of the abdomen in case of postoperative ventral hernia. Immediately before surgery, we discussed further surgical procedure, behavior in postoperative period and wound care with patients. Patients were photographed immediately before surgery, within the first postoperative week and for a year after surgery. Patient satisfaction with aesthetic and functional outcomes was assessed using a 5-point subjective Likert scale. To assess aesthetics of the navel in postoperative period, we analyzed its position and shape. Navel location in the midline, 11-12 cm from the lower incision and 2-3 cm above the level of superior iliac spine was recognized as a favorable result.

Patients underwent the following plastic surgeries: abdominoplasty, brachioplasty, hernia repair, reduction mammoplasty, mammoplasty, augmentation mammoplasty and lower body lifting.

Preoperative marking, surgical technique

Most often, these patients underwent abdominoplasty via T-shaped Fleur-de-lis combined approach, since isolated lower transverse incision was unadvisable due to excessive tissues above the umbilicus **(Fig. 1)**. Standard

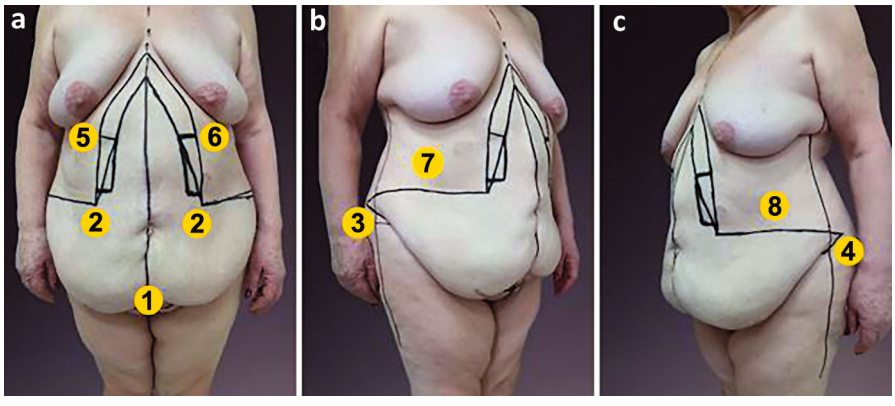


Fig. 1. **Direct (a), right lateral (b), left lateral (c) projections of anterior abdominal wall with marking for T-shaped abdominoplasty via Fleur-de-lis access combined with hernia repair and sub-lay mesh implantation, navel repair after massive weight loss.**

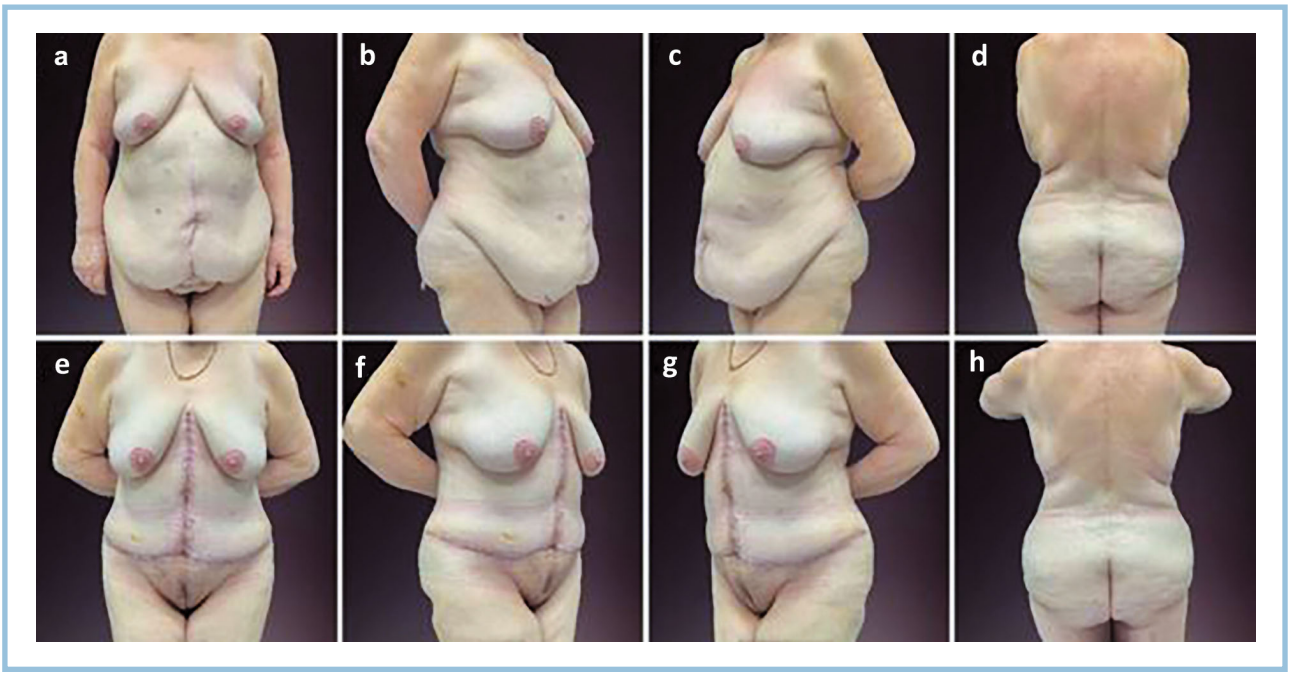


Fig. 2. **Images before and one month after T-shaped abdominoplasty via Fleur-de-lis access combined with hernia repair and sub-lay mesh implantation, navel repair after previous massive weight loss.**

Pinch test was used for preoperative marking. We analyzed the boundaries and thickness of excessive skin fold in different parts of the body using this test. Skin fold was fixed between the thumb (point 1) and the middle finger (point 2), i.e. we simulated wound closure after flap resection with maximum tension. First, we marked a median vertical line on anterior abdominal wall (through the xiphoid process, navel, genital fissure) and lateral vertical lines (from the middle of the armpit through the middle of the trochanter). Then, we marked the lower horizontal line (point 1 — 7.0 cm above the genital fissure in women and 5.0 cm above the root of the penis in men; points 3 and 4 on the lateral surfaces of the body, i.e. anterosuperior iliac spine on both sides on lateral vertical lines). We connected points 3 and 4 with point 1 placing the line along the inguinal fold or 1.0 cm above this fold depending on excess tissue in this area. Thus, this line was located in bikini area after closure of the wound. Planning the lower incision line, we achieved a significant improvement in not only surface of anterior abdominal wall, but also the contour of anterior surface of the upper third of the thigh. We also used Pinch test when marking the vertical component focusing on the middle vertical line and marked points 5 and 6. Then, we formed the upper border of the flap marking points 7 and 8 and alternately connecting points 1 and 7, 8. The second upper horizontal line was marked less aggressively to avoid excessive tension on the edges of the wound after cutting off the flap.

Plastic surgeries after massive weight loss in bariatric patients after previous SADI and BPD-DS procedures are presented in **Fig. 2–5**.

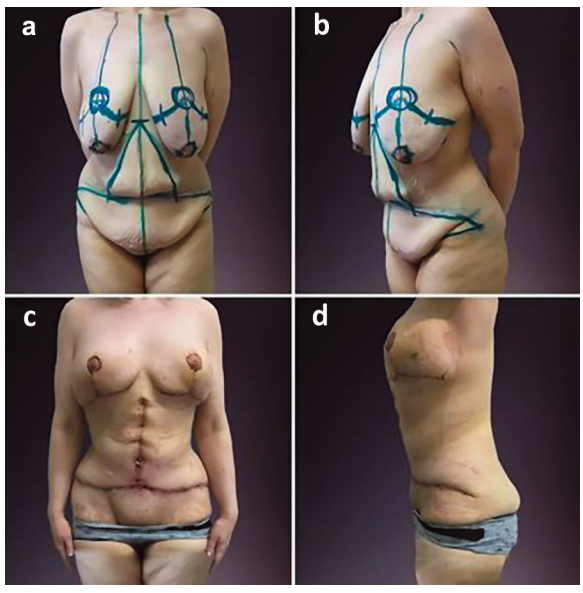


Fig. 3. **Direct (a, c) and lateral (b, d) projections before and one month after T-shaped abdominoplasty via Fleur-de-lis access combined with reduction mammoplasty, mastopexy after previous massive weight loss.**

Statistica 12.0 software was used for statistical analysis of data. Normality of distribution was assessed using the Kolmogorov–Smirnov test. Data were presented as M±SD (M — mean, SD — standard deviation) for normal distribution and median with percentiles for abnormal distribution. We used the Mann-Whitney to compare two groups. Differences were significant at $p<0.05$.

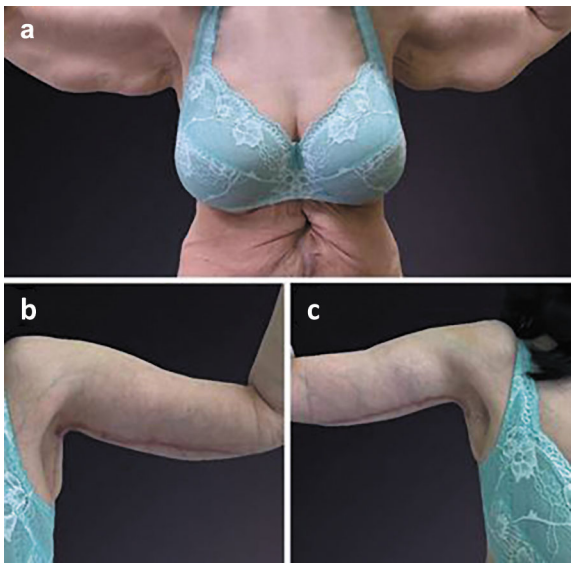


Fig. 4. **Direct projection of shoulders before and one month after brachioplasty for massive weight loss.**

Results

There were 73.8% of women and 26.2% of men ($p<0.001$) **(Fig. 6)**. Men with indications for PBPS accounted less than one third.

Age of patients was 40.8±10.3 years (43.7±10.6 (20-61) in the SADI group and 37.6±9.2 (17-55) in the BPD-DS group).

Post-bariatric plastic surgery in the SADI group was most often performed in 12 or 36 months after BPD (mean 27.4±13.6 months), in the BPD-DS group — after 12, 24 and 36 months (mean 27.9±14.9 months) **(Table 2)**.

The greatest loss of excess body weight was 89.1 kg [82.1; 98.0] after BPD-SADI surgery and 89.1 kg [78.9; 97.7] after BPD-DS surgery ($p>0.05$). Final loss of excess body weight (60 months after onset of the study) was 78.1 kg [67.3; 84.8] after BPD-SADI surgery and 74.1 kg [61.0; 87.6] after BPD-DS surgery ($p>0.05$).

BMI before BPD was 49.5±6.9 and 48.2±7.0 kg/m^2, respectively, prior to plastic surgery — 30.4±4.9 and 29.6±3.7 kg/m^2, respectively. Immediately before plastic



Fig. 5. **Direct (a, d), lateral (c) and posterior view (b, e) before (upper row) and one month after (lower row) thigh plasty for massive weight loss.**

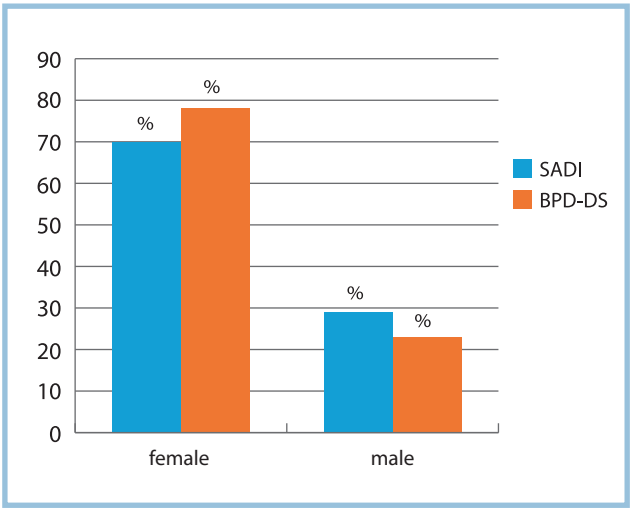


Fig. 6. **Distribution of patients by sex.**

surgery, body weight loss was 55.4±23.1 and 53.4±16.0 kg, respectively.

In the SADI group, 10 (29.4%) patients underwent plastic surgery combined with gastrointestinal reconstruction for improvement of outcomes in 4 (11.8%) cases and elimination of side effects of primary bariatric surgeries in 6 (17.6%) cases.

One patient required transferring of duodenoenterostomy at a higher level in combination with abdominoplasty in 9 months after surgery due to excessive protein malabsorption and diarrheal syndrome. One patient developed intermittent adhesive abdominal disease in 1 year and 3 months after surgery. Therefore, Brown interintestinal anastomosis combined hernia repair with mesh implant was performed. Two patients with severe bile reflux underwent Hess-Marceau reconstruction combined with abdominoplasty, pubis repair (*n*=1) and Hess-Marceau procedure combined with abdominoplasty and hernia repair with mesh implant (*n*=1).

Six patients with recurrent weight gain after surgery underwent the following reconstructive interventions: gastric stump resection combined with abdominoplasty and hernia repair with mesh implant (*n*=1); Hess-Marceau procedure combined with abdominoplasty (*n*=1); Hess-Marceau procedure combined with abdominoplasty, hernia repair with mesh implant and brachioplasty (*n*=1); Hess-Marceau procedure combined with sleeve-pl, abdominoplasty and hernia repair with mesh implant (*n*=1); sleeve-pl, installation of biological plate "Cardioplant" on the upper third of the stomach stump combined with brachioplasty (*n*=1); Hess-Marceau procedure combined with sleeve-pl, abdominoplasty and hernia repair with mesh implant (no compensation of type 2 diabetes mellitus and insufficient body weight loss).

In the BPD-DS group, 3 patients with excessive protein malabsorption, diarrheal syndrome, ascites and polyneuropathy required translocation of interintestinal anastomosis by 100 cm in 3 years after surgery combined with abdominoplasty and hernia repair with mesh implant (*n*=1); abdominoplasty and brachioplasty (*n*=1); abdominoplasty, brachioplasty, hip and shoulder repair, face-lifting (*n*=1).

Three patients gained weight after surgery and required translocation of interintestinal anastomosis by 50 cm combined with abdominoplasty and hernia repair with mesh implant (*n*=1); laparoscopic plication of the stomach stump, installation of biological plate "Cardioplant" after previous translocation of interintestinal anastomosis for excessive weight loss and excessive protein malabsorption (*n*=1) combined with abdominoplasty and brachioplasty; gastroplication combined with abdominoplasty and hernia repair with mesh implant (*n*=1).

Most patients underwent several plastic surgeries at once. Thus, 28 (82.4%) patients underwent simultaneous operations in the SADI group: abdominoplasty and hernia repair — 16 (57.1%) patients (including mesh implant in 10 (35.7%) cases); abdominoplasty and hernia repair with mesh implant combined with face-lifting — 1 (3.6%) patient, with abdominoplasty in 1 (3.6%) patient and augmentation mammoplasty in 1 (3.6%) patient; abdominoplasty combined with brachioplasty — 3 (10.7%)

Table 1. **Characteristics of comorbidities**

Comorbidity	Period	SADI (*n*=34)	BPD-DS (*n*=31)
Type 2 diabetes mellitus	Before BPD	18 (52.9)	7 (22.6)
	Prior to plastic surgery	3 (8.8)	1 (3.2)
Arterial hypertension	Before BPD	25 (73.5)	20 (64.5)
	Prior to plastic surgery	5 (14.7)	3 (9.7)

Table 2. **Distribution of patients by the period of plastic surgery after BPD**

Period, months	SADI, *n*=34 (%)	BPD-DS, *n*=31 (%)	Total (%)
12	9 (26.5)	7 (22.6)	16 (24.6)
18	5 (14.7)	2 (6.5)	7 (10.8)
24	5 (14.7)	12 (38.7)	17 (26.2)
36	10 (29.4)	6 (19.4)	16 (24.6)
48	4 (11.8)	—	4 (6.2)
60	1 (2.9)	4 (12.9)	5 (7.7)

Table 3. **Distribution of patients depending on plastic surgery**

Surgery	SADI (*n*=34)	BPD-DS (*n*=31)
Abdominoplasty	30 (88.2)	29 (93.5)
Hernia repair	19 (55.9)	14 (45.2)
Brachioplasty	9 (26.5)	7 (22.6)
Thigh repair	1 (2.9)	—
Mammoplasty	4 (11.8)	3 (9.7)
Other	9 (26.5)	8 (25.8)
Combined plastic surgeries	28 (82.4)	23 (74.2)
Plastic surgeries combined with reconstructive interventions	10 (29.4)	6 (19.4)

Table 4. **Postoperative complications**

Complication	SADI (*n*=34)	BPD-DS (*n*=31)
Seroma	5 (14.7)	7 (22.6)
Wound dehiscence	1 (2.9)	1 (3.2)
Wound infection	—	—
Hematoma	1 (2.9)	3 (9.7)
Skin necrosis	—	—
Scar revision	2 (5.9)	3 (9.7)
Thromboembolism, deep vein thrombosis	—	—
Pneumonia	—	—
Total	9 (26.5)	14 (45.2)

patients; lower body lifting combined with brachioplasty — 1 (3.6%) patient; abdominoplasty with brachioplasty combined with augmentation mammoplasty — 2 (7.1%) patients, with reduction mammoplasty — 1 (3.6%) patient, with torsoplasty — 1 (3.6%) patient; abdominoplasty combined with pubis repair — 1 (3.6%) patient.

In the BPD-DS group, 23 (74.2%) simultaneous surgeries were performed: abdominoplasty combined with hernia repair in 7 (30.4%) patients (including mesh implant in 3 (13.0%) cases); abdominoplasty combined with brachioplasty — 5 (21.7%) patients, mastopexy — 2 (8.7%) patients, augmentation mammoplasty — 1 (4.3%) patient, reduction mammoplasty — 2 (8.7%) patients, leg repair — 1 (4.3%) patient; brachioplasty combined with hip repair — 1 (4.3%) patient; abdominoplasty with brachioplasty combined with hernia repair with mesh implant — 1 (4.3%) patient, hernia repair without mesh implant — 1 (4.3%) patient, supravaginal uterine amputation — 1 (4.3%) patient, hip and shoulder repair with face-lifting — 1 (4.3%) patient.

Characteristics of surgeries in both groups are presented in **Table 3**.

Mean surgery time was 5.2±1.4 hours, postoperative hospital-stay — 3±1 days. Mean duration of combined plastic surgeries was 4.8±1.1 h, hospital-stay after these procedures — 3±1 days. Time of plastic surgeries combined with reconstructive ones was 6.3±1.9 h, hospital-stay — 3±1 days. Duration of isolated plastic surgeries was — 3.1±0.4 h, postoperative hospital-stay — 2±1 days.

Incidence of postoperative complications was 26.5 and 45.2%, respectively. Most of these events did not require in-hospital treatment and regressed spontaneously within 1-2 months under therapy **(Table 4)**. Seroma was the most common postoperative complication. Some patients had two or more complications (3 (8.8%) and 8 (25.8%) patients, respectively).

Analyzing Likert scores of satisfaction with postoperative outcomes, we observed maximum scores in assessing the contours, location of postoperative scars and aesthetics of the navel in majority of patients. There were no unfavorable results in this sample **(Table 5)**.

We found significant correlation between the incidence of complications and age of patients (r=0.659; p<0.01), smoking (r=0.472; p<0.01) and nutritional status (serum protein, r=0.614; p <0.01).

Table 5. **Likert grading system in assessing satisfaction with postoperative outcomes**

Likert score	SADI, *n*=34 (%)	BPD-DS, *n*=31 (%)
Satisfaction with contour		
Excellent	26 (76.5)	23 (74.2)
Good	5 (14.7)	4 (12.9)
Satisfactory	3 (8.8)	4 (12.9)
Satisfaction with location of postoperative scars		
Excellent	26 (76.5)	25 (80.6)
Good	6 (17.6)	3 (9.7)
Satisfactory	2 (5.9)	3 (9.7)
Satisfaction with aesthetics of the navel		
Excellent	31 (91.2)	26 (83.9)
Good	2 (5.9)	4 (12.9)
Satisfactory	1 (2.9)	1 (3.2)

Conclusion

Rapid weight loss after bariatric surgery results significant sagging of skin on the torso, buttocks, chest, arms and legs because skin often lacks elasticity to accommodate less body dimensions. Post-bariatric plastic surgery allows removal of excess skin and restructuring of the underlying tissues to create smooth body contours and proportional aesthetic appearance in these patients [12].

Yashkov Yu. I. put forward and presented the concept of combination of post-bariatric plastic surgery with other operations at the 17th All-Russian Symposium on Endocrine Surgery in 2017. He was one of the founders of bariatric surgery in Russia and the first president of the Society of Bariatric Surgeons of Russia [13]. It consists of the following theses: plastic surgery does not cure obesity and not prevent its progression; post-bariatric plastic surgery does not affect the course of comorbidities. Patients and surgeons are often dissatisfied with the results of plastic surgery at maximum weight, and it is usually performed after completion of weight loss and its stabiliza-

tion. Post-bariatric plastic surgery significantly improves the aesthetic and functional results of bariatric surgery and can be safely performed in combination with repeated bariatric surgeries. In some cases, post-bariatric plastic surgery can be performed in combination with primary bariatric surgery.

In our practice, this is the first systematic analysis of the results of post-bariatric plastic surgery. Analyzing the results of 367 post-bariatric plastic surgeries over the past 10 years including abdominoplasty in 85.7% of cases, we came to conclusion that scale for assessing ptosis of soft tissues of anterior abdominal wall is required. Creation of the scale allowed us to develop tactics for determining surgical intervention:

1. Ptosis grade 1 — sagging (excessive flabby fold) within the same anatomical zone;

2. Ptosis grade 2 — sagging (excessive flabby fold) within two anatomical zones (a — one excess fold; b — two or more folds);

3. Ptosis grade 3 — sagging (excessive flabby fold) outside of two anatomical zones (a — one excess fold; b — two or more folds; N: no anterior abdominal wall hernia; A — anterior abdominal wall hernia).

We evaluated epigastric and hypogastric zones, lateral parts of the trunk and pubic zone in our patients.

In 32% of our patients, we observed ptosis grade 2b and 3a/b of soft tissues of anterior abdominal wall with ⩾ 2 excess flabby folds. This required abdominoplasty via inverted T-shaped Fleur-de-lis approach. T-shaped access allows the best way to remove excess folds in epigastrium and lateral parts of the body. Also, all these patients had excessive flabby folds in other zones: ptosis of shoulders, hips, buttocks, sagging and excess of soft tissues of the neck and face. Choosing the volume of surgery, we were guided by the following criterion: combined plastic surgeries, for example, abdominoplasty combined with brachioplasty or mammoplasty was advisable for ptosis grade 1 and 2a, 1A, 1N, 2aN, 2aA. Isolated abdominoplasty was preferred for ptosis grade 3. Advanced surgery prolonged surgery and increased blood loss and the number of postoperative complications in patients with ptosis grade 2b and 3.

In our practice, this is the first systematic analysis of post-bariatric plastic surgery. The present study showed that the majority of patients were women, as in other studies [14–18]. Mean age of patients is also similar (40.8 years) [17, 19].

Mean BMI before plastic surgery was 30.4±4.9 and 29.6±3.7 kg/m^2 in the SADI and BPD-DS groups, respectively. Other authors reported similar values [14-17]. Shermak M.A. et al. [20] reported significantly higher BMI (35.6 kg/m^2).

Mean weight loss before post-bariatric repair was 55.4±23.1 and 53.4±16.0 kg in the SADI and BPD-DS groups, respectively. Other authors reported similar values [20, 21]. Some researchers reported lower values (33-40 kg) [18].

Mean period between bariatric surgery and reconstructive body contouring was 27 months that was longer than 22 months reported in other studies [20, 22]. This may be explained by longer period of weight loss after BPD-DS compared to other surgeries.

Incidence of combining abdominoplasty with other surgical interventions is quite high (82.4% and 74.2% in the SADI and BPD-DS groups, respectively). According to literature data, up to 40% of patients undergo simultaneous abdominoplasty and other surgical interventions (brachioplasty and mammoplasty) without significant increase in the incidence of postoperative complications [15, 22]. A feature of this sample is that plastic surgery was performed in combination with reconstructive bariatric surgery (29.4% and 19.4% in the SADI and BPD-DS groups, respectively). This is our priority and more in line with the needs of patients.

According to many authors, post-bariatric patients have a higher risk of postoperative complications [23-25]. These one may present with overt or hidden vitamin and micronutrient deficiencies, side effects of primary bariatric surgery, unresolved comorbidities, nutritional deficiencies and psychological problems associated with high dissatisfaction with their appearance even after significant weight loss. These aspects make these patients more susceptible to risk of postoperative complications [26-28]. Moreover, these patients have poor skin quality: many stretch marks, maceration, prone to infection, low collagen levels, no elasticity and contractility [23-25]. In our patients, we did not encounter explorations for bleeding, wound infections, umbilical necrosis, flap necrosis, wound dehiscence. However, such complications occurred in overall sample of patients. In addition, there were no thromboembolic complications and pneumonia.

The overall rate of postoperative complications in our post-bariatric patients was 26.5 and 45.2% in the SADI and BPD-DS groups, respectively. Other authors reported similar values [15, 20, 22]. De Kerviler S. and et al. [14] reported lower values. The most common complication was seroma, as in other studies [15, 22]. Thromboembolic complications have not been identified, but other studies indicate their low prevalence (0.3-1%) [16, 17]. Some authors emphasize higher incidence of complications after combined operations [29]. We found no similar correlation. In our opinion, incidence of postoperative complications remains low after combined procedures if well-experienced surgeons perform surgery within 4-5 hours.

Post-bariatric plastic surgery is an integral part of treatment in patients with morbid obesity. We revealed that post-bariatric plastic surgery is more often performed in the form of combined operations and can be successfully used in combination with reconstructive bariatric surgeries without increase in the number of postoperative complications. Patient satisfaction with the results of post-bariatric plastic surgery reaches 95.6%.

Author contribution:

Concept and design of the study — Manturova N.E., Bordan N.S., Yashkov Yu.I.

Collection and analysis of data — Bordan N.S., Del Pino Poxo C., Avala M.

Statistical analysis — Zelenchenkova P.I., Orlova A.S.

Writing the text — Bordan N.S., Zelenchenkova P.I.

Editing — Yashkov Yu.I., Manturova N.E., Orlova A.S.

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