Obesity Surgery (2019) 29:1563–1570
https://doi.org/10.1007/s11695-018-03697-0

ORIGINAL CONTRIBUTIONS

Operating on the Edge? Body Contouring Procedures in Patients with Body Mass Index Greater 35

Theresa Hauck[1] · Marweh Schmitz[1] · Raymund E. Horch[1] · Andreas Arkudas[1] · Anja M. Boos[1,2] · Aijia Cai[1] · Ingo Ludolph[1]

Published online: 7 January 2019

Abstract

Background Body contouring surgery after massive weight loss was shown to ameliorate the patient's quality of life and to enhance physical and psychological well-being. However, numerous patients are still obese when presenting for body contouring surgery, not able to lose additional weight for various reasons. Data regarding general feasibility, outcome, and postoperative complications in obese patients is rare. The aim of this study was to investigate the outcome in body contouring procedures in obese patients.

Methods A retrospective chart review of 65 cases in 42 patients was performed. Patients with a body mass index (BMI) > 35 kg/m^2 at the time of operation were enrolled and all different types of body contouring surgery were included. Complications were classified as major (need for surgical intervention) and minor complications.

Results The median BMI of all patients was 38 kg/m^2 (range 35.1–65.1 kg/m^2). The majority of performed types of body contouring was abdominal body contouring (panniculectomy $n = 27$ (42%), abdominoplasty $n = 12$ (18%)). Complications occurred in 27 cases (41.5%). Twenty-one cases (32.3%) were classified as minor complications, six (9.2%) as major complications. The most common major complications were hematoma and wound dehiscence; the most common minor complication was seroma.

Conclusion A reasonable risk for complications is well known in body contouring surgery especially in obese patients. It is imperative to discuss related risks and expected results. Taking several points into account concerning the perioperative management, reduction of major complications is possible even in still obese patients, making body contouring surgery a discussible option.

Keywords Body contouring surgery · Bariatric surgery · Obesity · Complications

Introduction

Prevalence of global obesity (BMI > 30 kg/m^2) in adults continues to increase [1], and with it associated health consequences such as hypertension, coronary artery disease, stroke, type 2 diabetes, certain forms of cancer, and musculoskeletal disorders [2, 3]. The failure to achieve a long-term weight reduction with lifestyle and dietary modifications has led to an increasing number of bariatric surgery procedures. Bariatric surgery is a method to achieve rapid, distinct, and sustained weight reduction to bring patients closer to their ideal body weight. It has been shown to be the most effective long-term treatment for obesity [4]. However, massive weight loss results in excess skin, which again impairs the patient's

✉ Theresa Hauck
Theresa.Hauck@uk-erlangen.de

Marweh Schmitz
Marweh.Schmitz@uk-erlangen.de

Raymund E. Horch
Raymund.Horch@uk-erlangen.de

Andreas Arkudas
Andreas.Arkudas@uk-erlangen.de

Anja M. Boos
aboos@ukaachen.de

Aijia Cai
Aijia.Cai@uk-erlangen.de

Ingo Ludolph
Ingo.Ludolph@uk-erlangen.de

[1] Department of Plastic and Hand Surgery, University Hospital of Erlangen, Friedrich-Alexander-University of Erlangen-Nürnberg (FAU), Krankenhausstr. 12, 91054 Erlangen, Germany

[2] Present address: Department of Plastic Surgery, Hand and Burn Surgery, University Hospital of Aachen, RWTH University of Aachen, Pauwelsstraße 30, 52074 Aachen, Germany

quality of life. Loose and hanging skin causes recurrent eruptions, intertriginous mycotic infection, abscess formation, profound odor, pain or physical discomfort, and hampers physical activity. Body contouring surgery seeks to improve those problems and therefore plays a significant role in the accomplishment of the entire weight loss process. It was shown to be able to ameliorate patient's quality of life and to enhance the patient's body image and physical and psychological well-being [5–8]. Nevertheless, it is associated with postoperative complications that might negatively impact initially adequate results. Particularly this certain patient population is at increased risk for postoperative complications after body contouring surgery due to inferior quality tissue, malnutrition, and often persistent obesity [9, 10]. Often described problems are, i. a., wound dehiscence, seroma, and necrosis [11–13]. Previous studies showed a correlation of preoperative BMI and the incidence of postoperative complications [14–18]. Thus, a maximal reduction in BMI should be strived preoperatively to reduce the risk of postoperative complications. However, this reduction in body weight is unachievable for some patients. In patients with end-stage renal disease in preparation for renal transplant, pretransplant panniculectomy may convert previously ineligible patients into transplant candidates and may result in lower rates of wound complications after their transplant [19–21]. Thus, in some cases, body contouring surgery at BMI > 35 kg/m^2 has to be discussed. Data regarding general feasibility, the outcome, and the postoperative complications is rare. Therefore, we aimed to conduct a single center analysis of patients with a BMI > 35 kg/m^2 who underwent one or more body contouring procedures and to study the minor and major postoperative complications.

Materials and Methods

We performed a retrospective chart review of 65 cases of body contouring between October 2003 and February 2017. All different types of body contouring surgery were included. With some patients undergoing several types of operations, altogether 42 patients were enrolled. We included only patients with a BMI > 35 kg/m^2 at the time of operation. BMIs were calculated from documented weight and height data. Further data assessed included age at the time of operation, sex, duration of hospitalization, American Society of Anesthesiologist score (ASA), resection weight, and weight loss procedure. Weight loss was achieved either by gastric banding, gastric bypass, gastric sleeve, or by diet and exercise. Additionally, complications were recorded and categorized. In the current study, we defined complications as major or minor complications. A major complication was defined as a condition that required surgical intervention, such as bleeding or wound infection. Minor complications included seroma, hematoma, localized wound dehiscence, or superficial wound infection not requiring surgical intervention.

Perioperative Management and Intraoperative Procedure

Patients were treated in an interdisciplinary team consisting of an obesity center, plastic surgery, general surgery, internal medicine, dermatology, and/or nephrology/urology. We aimed to optimize weight reduction and skin condition preoperatively (i.e., in case of active cellulitis or fungal infection/acute infection). Further, concomitant diseases like hypertension or other cardiac diseases, diabetes, or coagulation disorders had to be evaluated and optimized. Additionally, the nephrologist and the urologist were involved in the treatment of patients suffering from end-stage renal disease presenting for a panniculectomy prior to renal transplant. In case of an upcoming panniculectomy or an abdominoplasty, preoperative abdominal imaging was performed in order to evaluate the presence of an abdominal hernia. Due to unreliable results of ultrasound in obese patients, we indicated a computed tomographic (CT) scan of the abdomen.

In the event of detected abdominal hernia, the patient was presented to the department of general surgery. Subsequently, dependent on size and difficulty of hernia repair, hernia reconstruction was planned within the same operation in case of small hernias, or prior to body contouring surgery in case of challenging and extensive hernias. Thereby, a laparoscopic technique was preferred.

Preoperatively, patients had to show stable weight for at least 6 months.

During the operation, we performed tissue reduction without unnecessary mobilization of tissue. Additionally, we attached great importance to extensive hemostasis. In case of abdominal body contouring, omphalectomy was liberally indicated. Overall, we focused on restoration of function and reduction of complications instead of trying to obtain the best possible esthetic result.

Immediately after the operation, we applied an abdominal bandage or an elastic roller bandage, depending on the surgical area. On postoperative day 1, compression clothes were customized and from then on worn consequently for 6–10 weeks after surgery. Throughout the patient's hospital course, low molecular weight heparin or unfractionated heparin was administered.

Several wound drains were used routinely. A drain was removed once output decreased to less than 30 mL per day.

Statistics

We used descriptive data analysis for this study. Demographic data was demonstrated as mean ± standard deviation (SD), or as median for non-normalized scores, respectively, and range.

Results

Altogether, we enrolled 42 patients, representing 65 separate surgical cases. The demographic data of our patient collective is demonstrated in Table 1. Most of the patients were female (71.4% of patients, 70.8% of body contouring cases), and the age ranged between 25 and 71 years. Twenty-six patients had undergone a bariatric procedure. The most common bariatric surgery was gastric bypass (11 patients), followed by gastric banding (10 patients) and gastric sleeve (4 patients). One patient had undergone both a gastric bypass and gastric sleeve operation. Eight patients achieved weight reduction by diet and physical activity. Mean weight reduction prior to body contouring procedure was 67.9 ± 31.7 kg (range 30–154 kg). Eight patients did not achieve any weight reduction and were excluded from calculation of weight reduction; thereof, four patients suffered from Madelung's Disease and insurance coverage for bariatric procedure was refused in another four patients. Each patient still had a BMI > 35 kg/m^2 at the time of body contouring surgery; median BMI was 38.0 kg/m^2 (range 35.1–62.1 kg/m^2). ASA classification of patients ranged from ASA 1 to ASA 3 and was most likely to be ASA 2 (69.1%).

Perioperative Management

In two cases, we detected extensive abdominal wall hernias in the preoperative CT scan. These patients underwent laparoscopic hernia repair prior to panniculectomy in a separate operation. Six other patients suffered from small hernias, which were treated concomitant to the body contouring procedure.

Median length of hospital stay was 11 days (range 5–43).

Table 1 Demographic data

Characteristic	Value
Number of patients	42
Sex, female/male, no. (%)	30 (71.4)/12 (28.6)
Number of body contouring procedures	65
Sex, female/male, no. (%)	46 (70.8)/19 (29.2)
Age at operation date, mean, range [years]	46.3, 25–71
Body mass index (BMI), median, range [kg/m^2]	38.0, 35.1–62.1
ASA score, no. of patients (%)	
ASA 1	3 (7.1)
ASA 2	29 (69.1)
ASA 3	10 (23.8)
Weight reduction, mean ± SD, range [kg]	67.9 ± 31.7, 30–154
No. of patients without weight reduction	8
Procedure of weight loss, no. of patients (%)	
Gastric banding	10 (23.8)
Gastric bypass	11 (26.2)
Gastric sleeve	4 (9.6)
Gastric bypass + sleeve	1 (2,4)
Diet + sports	8 (19.0)
No weight reduction	8 (19.0)
Length of hospital stay, median (days)	11 (5–43)

Body Contouring Procedures

Overall, 65 cases of different types of body contouring surgery were performed, including the following procedures: panniculectomy (27 cases, 42%), abdominoplasty (12 cases, 18%; Figs. 1, 2), thigh lift (7 cases, 11%), brachioplasty (5 cases, 8%), breast reduction (6 cases, 9%, Figs. 1, 2), breast autoaugmentation (1 case, 2%), upper body lift (5 cases, 8%), and thoracic lift (2 cases, 3%, Fig. 1). Mean resection weight was 4010 g (1200–7500 g) for abdominoplasty, 7324 g (2100–25,500 g) for panniculectomy (no documented resection weight in three cases), 1716 g (340–2600 g) for brachioplasty, 1410 g (710–1960 g) for thigh lift (no documented resection weight in two cases), 1343 g (150–2470 g) for breast reduction, 1722 g (1000–2210 g) for upper body lift, and 1200 g for thoracic lift, respectively. This data is summarized in Table 2.

Complications

Altogether, complications occurred in 27 cases (41.5%). Twenty-one cases (32.3%) were classified as minor complications, six (9.2%) as major complications. The most common minor complication was seroma (15.4%), followed by wound dehiscence (12.3%), infection (7.7%), and scar neuroma (1.5%). Thereby, every smallest wound healing complication not necessitating any surgical treatment was scored. All of these complications were treated conservatively without another operation. We dealt with seroma in an outpatient setting by repeated aspiration. Regarding major complications, hematoma/bleeding (3.1%) and wound dehiscence (3.1%) were the main reasons for revision surgery. Furthermore, we observed one case of infection (1.5%) and one case of scar granuloma (1.5%) that required surgical intervention. Table 3 summarizes data of the noted complications according to the type of body contouring and their associated frequencies.

Discussion

In the past, several studies focusing on abdominal body contouring procedures showed higher complication rates in obese patients with an increasing BMI being a risk factor for postoperative complications [11, 14, 18]. On the other hand, previous findings demonstrated that abdominal contouring can be safely performed also in extreme obese patients [22, 23]. However, in patients that underwent bariatric surgery, there is also a high desire for contouring other body regions

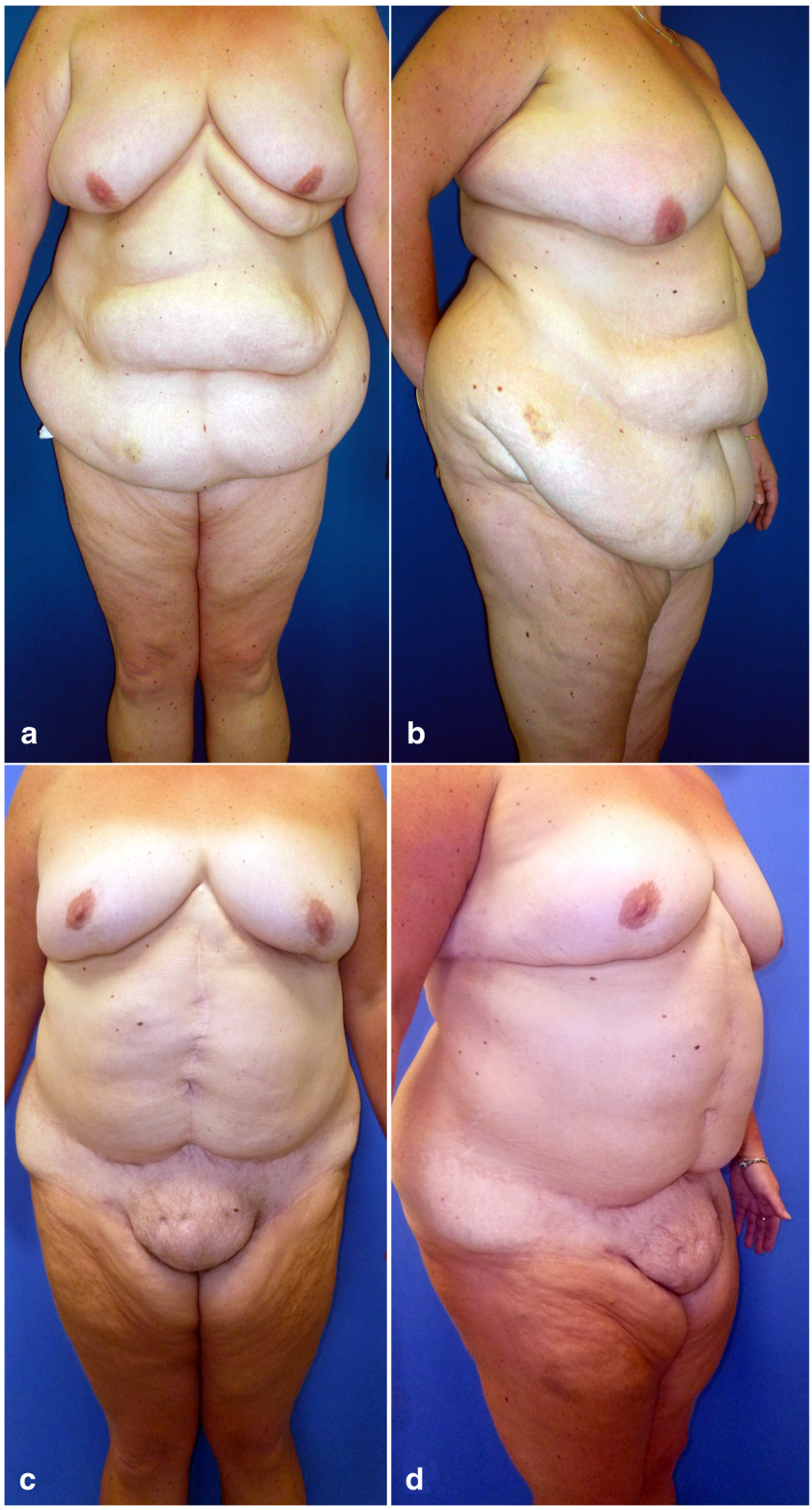

Fig. 1 Pre- (**a**, **b**) and postoperative (**c**, **d**) photograph of a 45-year-old woman with a BMI of 38.7 kg/m^2. The patient received a gastric band and achieved a weight reduction of 40 kg. Following this, she underwent abdominoplasty, thoracic lift, brachioplasty, and breast reduction

[24], and there is still a lack of data investigating different types of body contouring procedures in obese patients. We therefore decided to examine the outcome of patients with a BMI > 35 kg/m^2 that underwent different types of body contouring procedures.

Of course, in order to realize optimal results in body contouring surgery, we should aim for ideal preoperative conditions. Ideally, postbariatric surgery patients should approach normal and stable weight and present with low-fat content of the excess skin. Even if there is no distinct definition of the

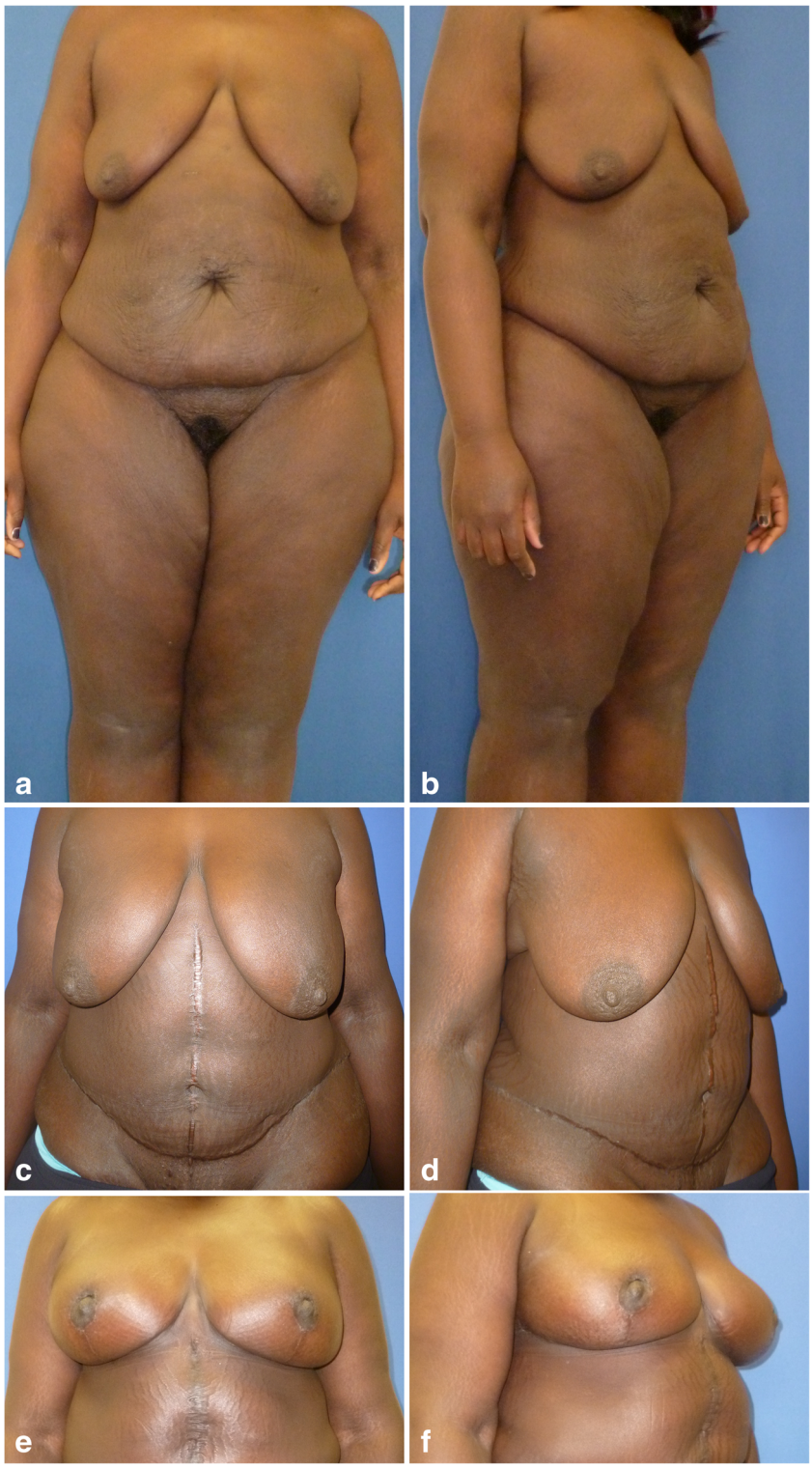

Fig. 2 A 29-year-old woman with a BMI of 35.5 kg/m^2 before (**a**, **b**) and after abdominoplasty (**c**, **d**) and breast reduction (**e**, **f**). She received a gastric bypass and achieved a weight reduction of 70 kg

ideal BMI prior to body contouring surgery, a strong consensus exists postulating a BMI at least smaller than 35 kg/m^2. Nevertheless, despite significant weight loss after bariatric surgery, numerous patients are still obese when presenting for body contouring procedure because of stagnating weight reduction. Additionally, some patients are not able to achieve sufficient weight reduction by themselves. Although they would benefit from a bariatric procedure, insurance coverage for the surgery is often limited. Obese patients do not only suffer from comorbidities like cardiovascular diseases, diabetes, etc., they are also afflicted with skin infections and functional limitations [25]. Furthermore, in cases presenting with a

Table 2 Body contouring procedure and resection weight

Body contouring procedure	No. of cases (%)	Resection weight total [kg]	Resection weight mean (range) [kg]
Abdominal contouring (abdominoplasty and panniculectomy)	36 (55)	223.90	6.22 (1.20–25.50)
Cases without documented resection weight	3 (5)		
Other body contouring procedures	23 (35)	34.70	1.51 (0.30–2.60)
Cases without documented resection weight	2 (3)		
Cases of breast autoaugmentation without breast tissue resection	1 (2)		
Total	65 (100)	258.60	3.98 (0.30–25.50)

large panniculus adiposus, surgical management of abdominal procedures, for example for gynecologic surgery [26–28] or renal transplantation, is often complicated. Body contouring procedures contribute to improve those aspects and are therefore necessarily performed also in obese patients.

The overall complication rate in this study including all minor or major side events and including all types of body contouring was 41.5%, but we found a low major complication rate of 9.2% with an acceptable minor complication rate of 32.3%. In those cases, every smallest wound healing disorder was scored and included. Concerning abdominal body contouring surgery, we found a major complication rate of 10.3% and a minor complication rate of 25.6%. All patients progressed to a well-healed wound. As compared with previously published studies on body contouring procedures, especially the occurrence of major complications was found to be comparatively low. For example, Momeni et al. found a major complication rate in abdominoplasty of 20.8% in obese (BMI > 30 kg/m^2) patients and a minor complication rate of 29.2% in non-obese patients [11]. Higher complication rates in abdominoplasty were described by Neaman and Hansen [16]. They found a major complication rate of 31.5% and a minor complication rate of 53.4% in obese patients (≥ 30 kg/m^2). Rogliani et al. found 76% complications in obese patients after abdominoplasty [14]. In comparison to the overall minor and major complication rates or the minor and major complication rates in abdominal contouring of our present study, the complication rates for obese patients shown in the literature are relatively high in comparison to our data, despite our overall high resection weight. On the other hand, Mericli et al.

Table 3 Complications of body contouring surgery

Body contouring procedure	No. of cases	Type of major complication, no. of cases (%)	Total major complications, no. of cases (%)	Type of minor complication, no. of cases (%)	Total minor complications, no. of cases (%)
Panniculectomy	27	Hematoma/bleeding: 2 (7.4) Infection: 1 (3.7) Wound dehiscence: 1 (3.7)	4 (14.8)	Seroma: 4 (14.8) Wound dehiscence: 2 (7.4)	6 (22.2)
Abdominoplasty	12		0	Seroma: 2 (16.7) Wound dehiscence: 2 (16.7)	4 (33.3)
Brachioplasty	5	Scar granuloma: 1 (20) Wound dehiscence: 1 (20)	2 (40)		0
Thigh lift	7		0	Seroma: 2 (28.6) Infection: 2 (28.6) Wound dehiscence: 1 (14.3)	5 (71.4)
Breast reduction	6		0	Wound dehiscence: 1 (16.7) Infection: 1 (16.7) Seroma: 1 (16.7)	3 (50)
Breast autoaugmentation	1		0	Infection: 1 (100)	1 (100)
Upper body lift	5		0	Scar neuroma: 1 (20)	1 (20)
Thoracic lift	2		0	Seroma: 1 (50)	1 (50)
Total	65	Hematoma/bleeding: 2 (3.1) Wound dehiscence: 2 (3.1) Infection: 1 (1.5) Scar granuloma: 1 (1.5)	6 (9.2)	Seroma: 10 (15.4) Wound dehiscence: 6 (9.2) Infection: 4 (6.2) Scar neuroma: 1 (1.5)	21 (32.3)

could show a lower major complication rate of 4.5% [23]. Nevertheless, comparison of complications should be critically evaluated because of non-consistent definitions of major and minor complications in the literature.

As concerns findings about different types of body contouring, Nemerofsky et al. found a complication rate of 50% in lower body lift procedures, including obese and non-obese patients [29]. Different body contouring procedures (including panniculectomy, abdominoplasty, brachioplasty, mastopexy, lower body lift, thigh lift, breast augmentation, and upper body lift) were performed by Coon et al. [30]. They found precontouring BMI to be a predictor of complications in single-procedure cases. A statement about the type of intervention and expected complications was not made. Within our study group, complications occurred in each type of body contouring procedure. Major complications were observed only in panniculectomy and brachioplasty. This could be related to the high resection weight in panniculectomy and also in brachioplasty. Regarding our data with admittedly low number of different types of procedures, we cannot detect a correlation between the occurrence of minor complications and the type of intervention.

Most frequently observed complications in this study were seroma, wound dehiscence, and infection, which is in accordance with the existing literature [14, 16, 29]. Umbilical necrosis, deep venous thrombosis, or pulmonary embolism rarely occurs in the literature. In our study, none of the latter events were observed. The reason for these absent complications can be attributed to our generous indication for omphalectomy in the course of panniculectomy and in extended abdominoplasty. Further, we attached importance to early ambulation and thrombosis prophylaxis. As concerns blood transfusions, necessity is described up to 20% [31]. Additionally, the authors of that study, which included only obese patients, observed complicated wound healing in more than 50%. They performed additional skin reduction surgery at the time of panniculectomy, which is associated with a large wound surface and possibly increased the likelihood of blood transfusions requirements. Further, it was previously demonstrated that the rate of wound dehiscence increased in multiple-procedure cases [30]. Therefore, in cases with multiple body contouring procedures scheduled, we prefer a step-by-step procedure with an interval for regeneration between each surgical intervention. Additionally, we suggest considering several further points so that postbariatric patients are at reasonable risk for undergoing surgery. Obese patients are often multimorbid and should therefore be treated in an experienced, interdisciplinary team for preoperative risk optimization [32]. We feel that it is evident to inform patients about the expectable outcome of the surgery—body contouring surgery in obese patients is not an esthetic procedure but rather a procedure to restore function. The patient should not be exposed to unnecessary risks only to achieve better esthetic results. In case of a planned panniculectomy or abdominoplasty, we prefer a generous indication for omphalectomy. Further, preoperative abdominal imaging should be performed to evaluate the presence of an abdominal hernia. Thereby, ultrasound is often unreliable so that a CT scan might be indicated [33]. In the event of a detected small abdominal hernia, hernia reconstruction can be planned within the same operation. We prefer a separate, ideally laparoscopic procedure prior to body contouring surgery in case of challenging and extensive hernias [34–36].

With appropriate preoperative counseling, it is possible to achieve satisfying results with an acceptable complication rate and a low need for revision surgery to manage these complications.

There are some limitations of the present study to be discussed. The variety and partially low number of different procedures and the lack of an equal distribution of different types of body contouring makes it impossible to predict the occurrence of complications according to the type of intervention. Further, with this study, we cannot directly correlate the association of existing comorbidities with an increasing incidence of complications. Nevertheless, we did not aim to provide another risk factor analysis; we rather wanted to show the feasibility of body contouring surgery in obese patients. We also cannot provide any information about the postoperative development of body weight and the patient satisfaction or the quality of life, respectively, after surgery due to the retrospective study design and the long observation period. Given the comparatively small number of major complications, it can be concluded from our study that postbariatric body contouring surgery can be performed safely in patients with a BMI > 35 kg/m^2 in selected cases.

Conclusion

After massive weight loss, many patients are not able to achieve the recommended body mass category. Nevertheless, several problems remain due to excessive skin including functional impairment and dermatological findings.

There is a reasonable risk for complications in body contouring surgery in obese patients. Our data show that obesity is not an absolute contraindication to body contouring surgery independent of the body region if an interdisciplinary and elaborate approach is followed. Procedures can be performed safely and with satisfactory outcome, so that those patients should not be denied access to the possibility of a life-changing surgery.

Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

Ethical Approval For this type of study, formal consent is not required.

References

1. NCD Risk Factor Collaboration (NCD-RisC). Trends in adult body-mass index in 200 countries from 1975 to 2014: a pooled analysis of 1698 population-based measurement studies with 19.2 million participants. Lancet. 2016; 87(10026):1377–96.
2. Lauby-Secretan B, Scoccianti C, Loomis D, et al. Body fatness and cancer—viewpoint of the IARC Working Group. N Engl J Med. 2016;375(8):794–8.
3. Lementowski PW, Zelicof SB. Obesity and osteoarthritis. Am J Orthop (Belle Mead, NJ). 2008;37(3):148–51.
4. Colquitt JL, Pickett K, Loveman E, et al. Surgery for weight loss in adults. Cochrane Database Syst Rev. 2014;8(8):Cd003641.
5. van der Beek ES, Te Riele W, Specken TF, et al. The impact of reconstructive procedures following bariatric surgery on patient well-being and quality of life. Obes Surg. 2010;20(1):36–41.
6. Song AY, Rubin JP, Thomas V, et al. Body image and quality of life in post massive weight loss body contouring patients. Obesity (Silver Spring, MD). 2006;14(9):1626–36.
7. Modarressi A, Balague N, Huber O, et al. Plastic surgery after gastric bypass improves long-term quality of life. Obes Surg. 2013;23(1):24–30.
8. Klassen AF, Cano SJ, Scott A, et al. Satisfaction and quality-of-life issues in body contouring surgery patients: a qualitative study. Obes Surg. 2012;22(10):1527–34.
9. Kavalukas SL, Barbul A. Nutrition and wound healing: an update. Plast Reconstr Surg. 2011;127(Suppl 1):38s–43s.
10. Pierpont YN, Dinh TP, Salas RE, et al. Obesity and surgical wound healing: a current review. ISRN Obes. 2014;2014:638936.
11. Momeni A, Heier M, Bannasch H, et al. Complications in abdominoplasty: a risk factor analysis. J Plast Reconstr Aesthet Surg. 2009;62(10):1250–4.
12. Dragu A, Schnurer S, Unglaub F, et al. Wide topical negative pressure wound dressing treatment for patients undergoing abdominal dermolipectomy following massive weight loss. Obes Surg. 2011;21(11):1781–6.
13. Ludolph I, Fried FW, Kneppe K, et al. Negative pressure wound treatment with computer-controlled irrigation/instillation decreases bacterial load in contaminated wounds and facilitates wound closure. Int Wound J. 2018;15:978–84.
14. Rogliani M, Silvi E, Labardi L, et al. Obese and nonobese patients: complications of abdominoplasty. Ann Plast Surg. 2006;57(3):336–8.
15. Vastine VL, Morgan RF, Williams GS, et al. Wound complications of abdominoplasty in obese patients. Ann Plast Surg. 1999;42(1):34–9.
16. Neaman KC, Hansen JE. Analysis of complications from abdominoplasty: a review of 206 cases at a university hospital. Ann Plast Surg. 2007;58(3):292–8.
17. Arthurs ZM, Cuadrado D, Sohn V, et al. Post-bariatric panniculectomy: pre-panniculectomy body mass index impacts the complication profile. Am J Surg. 2007;193(5):567–70. discussion 70
18. Ghnnam W, Elrahawy A, Moghazy ME. The effect of body mass index on outcome of abdominoplasty operations. World J Plast Surg. 2016;5(3):244–51.
19. Troppmann C, Santhanakrishnan C, Kuo JH, et al. Impact of panniculectomy on transplant candidacy of obese patients with chronic kidney disease declined for kidney transplantation because of a high-risk abdominal panniculus: a pilot study. Surgery. 2016;159(6):1612–22.
20. Bailey CM, Troppmann C, Kuo J, et al. Panniculectomy in end-stage renal disease: six-year experience of performing panniculectomy in preparation for renal transplant. Ann Plast Surg. 2015;74(Suppl 1):S9–11.
21. Kuo JH, Troppmann C, Perez RV, et al. Panniculectomy in preparation for renal transplantation: a new indication for an old procedure to reduce renal transplantation-associated wound complications. Plast Reconstr Surg. 2011;128(6):1236–40.
22. Zuelzer HB, Ratliff CR, Drake DB. Complications of abdominal contouring surgery in obese patients: current status. Ann Plast Surg. 2010;64(5):598–604.
23. Mericli AF, Drake DB. Abdominal contouring in super obese patients: a single-surgeon review of 22 cases. Ann Plast Surg. 2011;66(5):523–7.
24. Giordano S, Victorzon M, Stormi T, et al. Desire for body contouring surgery after bariatric surgery: do body mass index and weight loss matter? Aesthet Surg J. 2014;34(1):96–105.
25. Evers Larsson U, Mattsson E. Functional limitations linked to high body mass index, age and current pain in obese women. Int J Obes Relat Metab Disord. 2001;25(6):893–9.
26. Powell JL, Kasparek DK, Connor GP. Panniculectomy to facilitate gynecologic surgery in morbidly obese women. Obstet Gynecol. 1999;94(4):528–31.
27. Pearl ML, Valea FA, Disilvestro PA, et al. Panniculectomy in morbidly obese gynecologic oncology patients. Int J Surg Investig. 2000;2(1):59–64.
28. Rasmussen RW, Patibandla JR, Hopkins MP. Evaluation of indicated non-cosmetic panniculectomy at time of gynecologic surgery. Int J Gynaecol Obstet. 2017;138(2):207–11.
29. Nemerofsky RB, Oliak DA, Capella JF. Body lift: an account of 200 consecutive cases in the massive weight loss patient. Plast Reconstr Surg. 2006;117(2):414–30.
30. Coon D, Gusenoff JA, Kannan N, et al. Body mass and surgical complications in the postbariatric reconstructive patient: analysis of 511 cases. Ann Surg. 2009;249(3):397–401.
31. Manahan MA, Shermak MA. Massive panniculectomy after massive weight loss. Plast Reconstr Surg. 2006;117(7):2191–7. discussion 8-9
32. Dragu A, Horch RE. Concept of reconstructive body shaping in obesity. Evidence-based therapy algorithm. Chirurg. 2014;85(1): 37–41. Plastische Korperkorrektur im Gesamtkonzept der Adipositastherapie. Evidenzbasierter Therapiealgorithmus ger
33. Hillenbrand A, Henne-Bruns D, Wolf AM. Panniculus, giant hernias and surgical problems in patients with morbid obesity. GMS Interdiscip Plast Reconstr Surg DGPW. 2012;1:Doc05.
34. Birgisson G, Park AE, Mastrangelo Jr MJ, et al. Obesity and laparoscopic repair of ventral hernias. Surg Endosc. 2001;15(12):1419–22.
35. Tsereteli Z, Pryor BA, Heniford BT, et al. Laparoscopic ventral hernia repair (LVHR) in morbidly obese patients. Hernia. 2008;12(3):233–8.
36. Novitsky YW, Cobb WS, Kercher KW, et al. Laparoscopic ventral hernia repair in obese patients: a new standard of care. Arch Surg. 2006;141(1):57–61.