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ORIGINAL ARTICLE
Cosmetic

Complications of Lower Body Lift Surgery in Postbariatric Patients

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Background: There is an exponential rise of patients with massive weight loss because of bariatric surgery or lifestyle changes. The result is an increase of patients with folds of redundant skin that may cause physical and psychological problems. The lower body lift is a procedure to correct deformities in the abdomen, mons, flanks, lateral thighs, and buttocks. Complication rates are quite high and could negatively affect the positive outcomes. The purpose of this study is to assess complication rates and to identify predictors of complications to optimize outcomes for patients after lower body lift surgery.

Methods: A retrospective analysis of 100 patients who underwent a lower body lift procedure was performed. The patients were reviewed for complications, demographic data, comorbidities, smoking, highest lifetime body mass index, body mass index before lower body lift surgery, percentage of excess weight loss, and amount of tissue excised.

Results: The overall complication rate was 78%. Twenty-two percent of the patients had major complications and 56% had minor complications. There is a linear relationship between body mass index before lower body lift surgery and complications ($P = 0.03$). The percentage of excess weight loss (odds ratio [OR] 0.97; 95% confidence interval [CI] 0.92–1.00), highest lifetime body mass index (OR 1.08; 95% CI 1.01–1.15), body mass index before lower body lift surgery (OR 1.17; 95% CI 1.02–1.33), and smoking (OR 7.74; CI 0.98–61.16) are significantly associated with the development of complications.

Conclusions: This study emphasizes the importance of a good weight status before surgery and cessation of smoking to minimize the risk of complications. *(Plast Reconstr Surg Glob Open 2016;4:e1030; doi: 10.1097/GOX.0000000000001030; Published online 29 September 2016.)*

As a consequence of the treatment of obesity as one of the major health risks, there is an exponential increase of patients with massive weight loss because of bariatric surgery or lifestyle changes.[1] The result of this is a parallel increase of patients seeking plastic surgery consultation.[1] In the Catharina Hospital Eindhoven, the Netherlands, we have a multidisciplinary approach for the treatment of patients with obesity.

The goal of bariatric surgery is to gain a long-term, sustained weight loss and a decrease in comorbidities that are associated with obesity.[2] One of the major setbacks following bariatric surgery is the excessive and lax skin in some patients.[3] The skin does not always contract after weight loss and cannot be addressed adequately with exercise or diet. For patients with an excess and laxity of skin of the lower trunk, thighs, and buttock region, a lower body lift is a good surgical treatment.[4] Lower body lift surgery includes an abdominoplasty, mons lift, lateral thigh lift, and buttock lift. Auto-augmentation of the buttock is possible if loss of volume and projection is present. The fleur-de-lis variant of abdominoplasty may be applied to tighten the skin of the abdomen in horizontal and vertical directions. Plication of the anterior rectus sheath can correct rectus

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Presented at a Dutch congress for plastic surgeons, Amsterdam (Nederlandse vereniging plastische chirurgie, NVPC, March 10, 2015).

Received for publication May 13, 2016; accepted July 22, 2016.

DOI: 10.1097/GOX.0000000000001030

Disclosure: *The authors have no financial interest to declare in relation to the content of this article. The Article Processing Charge was paid for by the authors.*

diastasis, and liposuction is used selectively in case of persistent fullness in particular regions.[4]

Lower body lifts are considered elective surgery, and thus require a careful risk/benefit evaluation for each patient. Although these operations are associated with an increase in quality of life and high patient satisfaction,[5,6] the relative high complication rates can affect these positive experiences negatively.[7,8]

Most of the published work related to this issue summarizes complication rates and risk factors among different types of body contouring surgery, but concrete data associated with a lower body lift are limited.[7–14]

The aim of this study is to identify complications and possible risk factors of lower body lift surgery to optimize patient selection and timing for this particular procedure.

PATIENTS AND METHODS

Patients

All patients who underwent lower body lift surgery in the Catharina Hospital Eindhoven between January 2007 and January 2015 were included in this study. Patients were excluded if essential parts of the patient charts were missing.

Data Collection

A retrospective chart review was performed. The following data and variables were collected: age, sex, highest lifetime body mass index (BMI max), BMI before lower body lift surgery (BMI pre-LBL), type of weight loss, bariatric surgery or lifestyle change with diet and/or sports, percentage of excess weight loss, weight of resected tissue, operation time, duration of hospital stay, smoking history, use of nutritional supplements, and comorbidity.

Patients with a positive history of smoking were encouraged to stop smoking at least 6 weeks before surgery. Patients who smoked 6 weeks before surgery were qualified as smokers.

Outcome

Follow-up time was 6 months after lower body lift surgery.

The documentation of complications included wound dehiscence, seroma, hematoma, surgical site infection, skin necrosis, deep venous thrombosis, and pulmonary embolism. The interventions associated with a complication were documented, including aspiration of seroma, antibiotic treatment, debridement, VAC treatment, and reoperation.

Complications were categorized into 5 grades according to the modified Clavien–Dindo classification (Table 1).[15] The complications were divided in minor and major complications. Clavien–Dindo degree 1 and 2 were defined as minor complications and degree 3 to 5 as major complication.

SURGICAL TECHNIQUE

All operations were done by 2 plastic surgeons specialized in postbariatric body contouring surgery. Both the surgeons used the same marking and operation technique.

Markings

The patient is marked in standing position as described in 2008 by Richter et al.[4] First the markings of the back are made. The desired position of the scar is marked. The posterior upper incision line runs 2 to 3 fingers above this line. The inferior line of excision is estimated by strongly pinching the skin, while the patient bends slightly forward. Next, the anterior markings are made. This resembles the markings of an abdominoplasty with the incision lines continuing to the back. The lower incision line must be at 6 cm above the commissure. The dorsal inferior line and the anterior superior line should be checked during surgery and may be adjusted if necessary.[4]

General Preoperative Considerations

All operations were performed under general anesthesia and pre- and perioperative prophylactic antibiotics (cefazolin, 2 g preoperatively and 1 g repeated every 4 h during surgery).

Apart from preoperative low-molecular heparins, pneumatic intermittent compression devices were used for prophylaxis of thrombosis during the operation.

Surgery: Dorsal Contouring

With the patient in prone position, the incision is done according to the preoperative drawings along the superior mark down to the fascia of Scarpa. Next, the inferiorly based skin and fat flap are elevated over Scarpa's fascia to the level of the inferior marks. The fascia is then transected shortly before reaching the inferior resection line and adhesions in the area of the lateral buttocks are released caudally until the gluteal fold. Then the section is continued to the lateral thigh below the superficial fascia.[4]

For autologous buttock augmentations, a few sutures can be used from the side to the middle of the buttocks and from caudal to cranial through the fascia for rearrangement of the fat. This reduces tension on skin closure and leads to sculpting of the buttock. During traction of the buttock flap in cranial direction, clamps are used to determine the extent of resection. Before closure the entire dorsal wound surface is sprayed with platelet-rich plasma to promote wound healing and angiogenesis.[16,17] Two closed suction drains are left behind, 1 at each side. Closure of the wound is done by approximation of the superficial fascia, following closure in layers using resorbable sutures. The lateral dog-ear is temporary stapled for the process of turning the patient into the supine position.[4]

Surgery: Frontal Contouring

The frontal body contouring is performed as a "high lateral tension abdominoplasty."[18] The umbilicus is circumferentially incised and left in place. The lower abdominal incision is made down to the anterior rectus fascia and the abdominal flap is centrally elevated up to the level of the xiphoid. The more lateral undermining is carried out as limited as possible to preserve blood supply. In case of rectus diastases, plication is done in vertical direction.[4]

With the patient flexed at the waist, the amount of resection of excess tissue is assessed pulling the abdominal flap caudally. The new position of the umbilicus is marked

Table 1. Clavien–Dindo Classification of Surgical Complications

Degree	Definition
I	Any deviation from the normal postoperative course without need of intervention beyond the administration of anti-emetics, antipyretics, analgesics, diuretics, electrolytes, and psychical therapy[a]
II	Complication requiring pharmacological treatment with other medicines beyond the ones used for complications of degree I
III	Complications requiring surgical, endoscopic, or radiological intervention
III-a	Intervention without general anesthesia
III-b	Intervention under general anesthesia
IV	Life-threatening complication requiring admission to intensive care unit
IV-a	Uniorgan dysfunction (including dialysis)
IV-b	Multiorgan dysfunction
V	Death

[a] This degree also includes wound infections opened at the bedside.

and incised, through which the umbilicus is pulled and sutured in. Again, 2 closed suction drains are left behind and a multilayer wound closure is performed after the wound surface is sprayed with platelet-rich plasma.[16,17]

In case of excessive horizontal surplus, a fleur-de-lis method was performed. Furthermore, liposuction was done in case of excessive fullness in particular regions.

General Postoperative Considerations

The patient is placed in a beach-chair position wearing a compression garment around the lower body. Thrombosis prophylaxis is administered using low-molecular heparins. Compressing stockings are worn until mobilization. The patient is given an individualized patient controlled analgesia pump and is mobilized on the first day postoperatively. A laboratory test for hemoglobin is performed 1 day postoperatively. Drains were removed when producing less than 30 cc in a 24-hour period. After discharge, the compression garment was worn for 6 weeks, day and night.

STATISTICAL ANALYSES

Statistical analyses were performed using SPSS for windows (IBM SPSS statistics 21). Univariate logistic regression analyses were used to define odds ratios (ORs). Student's *t* tests were used for parametric variables. Nominal variables were analyzed by Pearson's chi-square test. A 2-sided *P*-value ≤0.05 was considered statistically significant.

To assess possible differences of complications between the 2 surgeons and to evaluate the influence of a learning curve, we analyzed the complication rate between the surgeons and between the first and last procedures.

RESULTS

Patient Characteristics

A total of 101 patients underwent lower body lift surgery between January 2009 and January 2015 in the Catharina Hospital. One patient could not be included, because the operation file was missing.

The mean age was 43.6 years (23–64 y). Of the 100 patients (12 men and 88 women), 87 lost weight through bariatric surgery and 13 by lifestyle changes. Of these 87 patients, 42 patients underwent gastric bypass surgery, 26 patients underwent gastric sleeve surgery, and 19 patients had laparoscopic gastric banding as primary procedure. Because of the unsatisfactory results, 19 of these 20 laparoscopic gastric banding patients underwent a second procedure: 16 gastric bypass surgeries and 2 sleeves. Seven patients of the 26 sleeve patients underwent gastric bypass surgery as a secondary procedure.

The mean maximal weight was 337.1 lbs (222.3–604.1 lbs), with a mean maximal BMI of 52.9 kg/m^2 (34.0–86.8 kg/m^2). The patients experienced a mean excess weight loss of 85.2% at a mean interval of 43.9 months (10–370 mo), resulting at the time of lower body surgery in a mean weight of 187.0 lbs (123.5–269.0 lbs) and a mean BMI of 29.3 kg/m^2 (19.4–39.9 kg/m^2). They lost an average weight of 150.1 lbs (67.2–366.0 lbs) (Table 3).

Twenty-two patients were smokers, 17 patients had hypertension, and 7 patients were diabetic (Tables 2, 3). Fifty-two patients used nutritional supplements to optimize their nutritional state before operation.

Complications

The overall complication rate was 78%. Twenty-two percent of the patients had no complication. Complication grades according to the modified Clavien–Dindo classification were as follows: grade 1, 12.0%; grade 2, 44.0%; and grade 3, 22% (3a: 9% and 3b: 13%). No grade 4 and grade 5 complications were seen (Fig. 1).

Twenty-two percent were major complications (Clavien 3a and 3b) and 56% were minor complications (Clavien 1 and 2). Thirteen percent needed a surgical revision (Clavien 3b).

The most common complication was wound dehiscence, which occurred in 61 patients. The second and third most common complications were infection (44 patients) and seroma (32 patients). Other complications are listed in Table 4. Some patients had more than 1 complication (Table 5). From the 78 patients with a complication, 53 patients had 2 or more complications.

Risk Factor Analyses

Table 6 shows the results of the univariate analysis of development of complications after surgery. Table 7 shows the univariate analysis of development of major complications (Clavien–Dindo grade >3) after surgery.

BMI max (OR 1.08, $P = 0.03$), BMI pre-LBL (OR 1.17, $P = 0.02$), and percentage of excess weight loss (OR 0.97, $P = 0.04$) were significantly associated with the development of complications. Smoking increases the development of

Table 2. Comorbidities of Patients

Comorbidity	No.
Diabetes	7
Hypertension	17
Cardiovascular disease	7
Pulmonary disease	15

Table 3. Patient Demographics and Clinical Characteristics

All Patients (n = 100)	N	Mean (Range)
Age		43.6 (23–64); SD 10.3
Sex		
Female:male	88:12	
Weight loss		
Surgical:nonsurgical	77:13	
Method of weight loss		
Laparoscopic gastric banding	1	
Sleeve	21	
Gastric bypass	65	
Lifestyle change + diet	13	
Pre-bariatric surgery		
BMI max (kg/m^2)		52.9 (34.0–86.8); SD 9.3
Weight max (lbs)		152.9 (222.3–604.1); SD 32.3
Weight loss		
Weight reduction (lbs)		150.1 (67.2–366.0); SD 26.5
BMI (kg/m^2)		23.6 (11.1–61.0); SD 8.6
Excess weight loss (%)		85.2% (56.3–129.5); SD 14.8
Pre-lower body surgery		
BMI pre-LBL (kg/m^2)		29.3 (19.4–39.9); SD 4.1
Weight (lbs)		187.0 (123.5–269.0); SD 13.7
Interval between bariatric and body contouring surgery (mo)		43.9 (10–370); SD 45.4
Specimen weight during LBL (g)		5070.3 (1158–13,300); SD 2391.1
Duration of LBL operation (min)		307.8 (197–438); SD 46.3

complications with an OR of 7.74, $P = 0.05$. There were no variables significantly associated with the development of major complications (Table 7).

The patients were subdivided into categories based on BMI. There was a linear relationship between weight status and complication rate. A higher BMI pre-LBL, subdivided in three categories, is significantly associated with a higher complications rate (Fig. 2B).

Surgical Technique Analysis

There was no statistically significant difference in complications rate between the patient cohorts of each surgeon (Table 8).

To evaluate a learning curve over the 100 lower body lifts, we made an analysis among the first 50 lower body lifts and the last 50 lower body lifts. We found a slight, insignificant improvement in complication rate (Table 8).

Finally, we analyzed the influence of age in the development of complications. We operated on 16 patients older than 55 years, but there was no significant rise of complication rate in this group compared with the group of patients younger than 55 years.

DISCUSSION

Data available from the literature on lower body lift surgery and complications are limited.[7,8] Complication rates vary from 50% to 70%.[7,8] Other publications describe complication rates of surgical body contouring in general.[10–14,19] Among these, complication rates vary from 27.9% to 42%. Compared with these, our complication rate of 78% is quite high. This can be explained by the fact that the definition of complications was different between studies. In our study, every wound dehiscence was scored as a complication. Other studies classified dehiscence as a complication, when the dehiscence was >1 cm in length or even of greater length.[7,14] Furthermore, lower body lift surgery can be considered as an operation consisting of multiple procedures. Coon et al.[20] described a significant higher minor complication rate in combined multiple-procedure cases than in single-procedure cases. This can be an explanation of the higher complication rate in our study compared with other studies describing complication rates in single-procedure cases.[9–14,19]

This study is a retrospective analysis with its known shortcomings. The complications might have been reported and recorded less accurately and thus our complication rate might even be underestimated. Parameters such as hypothermia and malnutrition, which can be relevant for the development of complications, were not recorded in our study.[21]

Wound dehiscence was the most common complication in our patient population, which occurred in 61% of the cases. This finding fits with prior literature.[7,8]

Infection was the second most common complication with 44%, which is very high, compared with other stud-

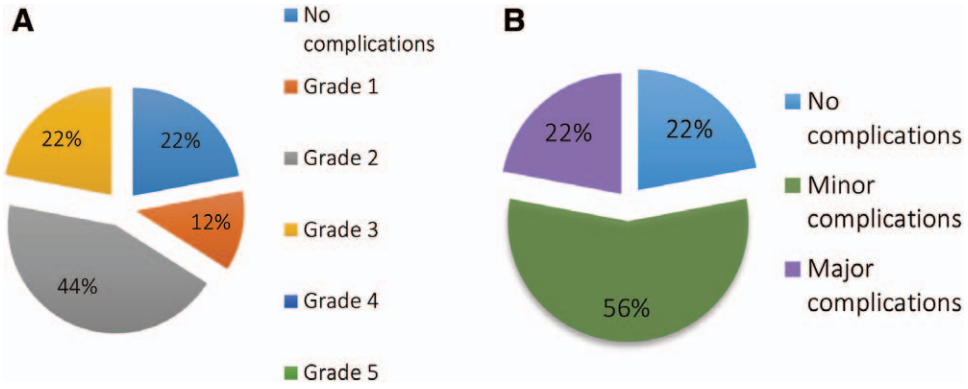

Fig. 1. A, Complications divided in grades according to the modified Clavien–Dindo classification (there were no patients in Clavien IV and V). B, Complications subdivided in no complications, minor complications, and major complications.

Table 4. Complications in Patients Undergoing Lower Body Lift after Massive Weight Loss

Complications	No.
Wound dehiscence	61
Infection	44
Seroma	32
Skin necrosis	13
Hematoma	8
Pulmonary embolism	1

Table 5. Number of Patients with an Infection, Necrosis, Hematoma, Seroma and Dehiscense Divided into Clavien–Dindo Grade

Clavien–Dindo Grade	Infection	Necrosis	Hematoma	Seroma	Dehiscence
0	56	87	92	68	39
1	0	2	0	2	33
2	32	7	5	25	20
3a	5	1	0	3	2
3b	7	3	3	2	6
4	0	0	0	0	0
5	0	0	0	0	0

Table 6. Factors Affecting Complication Development in All Cases (N = 100)[a]

Study Variables	OR	95% CI	*P*
BMI max	1.08	(1.01–1.15)	0.03
BMI pre-LBL	1.17	(1.02–1.33)	0.02
Percentage of excess weight loss	0.97	(0.94–1.00)	0.04
Weight reduction	1.01	(0.99–1.03)	0.29
BMI >30	2.53	(0.90–7.15)	0.08
Age	1.03	(0.98–1.08)	0.30
Weight of resected tissue	1.01	(0.99–1.03)	0.35
Tobacco use	7.74	(0.98–61.16)	0.05
Hypertension	1.39	(0.36–5.33)	0.64
Diabetes mellitus	0.34	(0.07–1.66)	0.18
Lifestyle change vs surgical	0.39	(0.11–1.34)	0.13
Comorbidity	1.58	(0.56–4.49)	0.39
Nutritional supplements	1.11	(0.43–2.86)	0.83

[a] Univariate analysis for one or more complications.

Table 7. Factors Affecting Major Complication Development (N = 22)[a]

Study Variables	OR	95% CI	*P*
BMI max	1.01	(0.96–1.06)	0.76
BMI pre-LBL	1.05	(0.94–1.18)	0.38
Percentage of excess weight loss	0.98	(0.94–1.01)	0.17
Weight reduction	1.00	(0.99–1.02)	0.77
BMI >30	1.73	(0.67–4.47)	0.26
Age	1.01	(0.97–1.06)	0.60
Weight of resected tissue	1.01	(0.99–1.03)	0.17
Tobacco use	0.74	(0.22–2.47)	0.63
Hypertension	0.42	(0.09–2.00)	0.28
Diabetes mellitus	0.57	(0.07–5.02)	0.61
Lifestyle change vs surgical	0.61	(0.13–2.98)	0.54
Comorbidity	1.08	(0.40–2.89)	0.88
Nutritional supplements	0.90	(0.35–2.33)	0.83

[a] Univariate analysis for one or more complications.

ies.[7,8,10–12] This could be explained by the definition of infection. In our study, all patients who used oral antibiotics postoperatively were considered to have an infection (Clavien 1). Furthermore, only 6 out of 44 had an infection as a solitary complication. In the other 38 patients, infection was in combination with other complications.

The third most common complication was seroma with 32%. Recent literature is highly variable as it comes to formation of seroma with 12.9% up to 37.5%.[7–10,12,14,19]

Pulmonary embolism was diagnosed in 1 patient (1%) who was symptomatic and treated successfully. There were no cases of deep venous thrombosis. This is comparable with the outcome of other studies.[7,8]

The risk factors already known for post-lower body lift complications are age and BMI max.[7,8,11] Our study parallels the finding of BMI max as a risk factor for postoperative complications, but not for age. Kitzinger et al[7] reported a significant association between age at the time of lower body lift surgery and the development of complications. Therefore, Kitzinger et al decided to avoid performing lower body lifts on patients greater than 55 years of age. In our study, we did not find a relationship between the age of the patient and the development of complications. Furthermore, we found a linear relationship between BMI at the time of the lower body lift and complication rate, which parallels the findings of van der Beek et al.[10] A higher BMI pre-LBL is a risk factor for postoperative complications. These findings are in contrast with Kitzinger et al,[7] Nemerofsky et al,[8] and Coon et al,[11] where complication rates were not significantly associated with BMI pre-LBL.

The percentage of excess weight loss before lower body lift surgery is also a predictor for postoperative complications. The closer the patient is to the ideal weight, the lower the complication rate. This is in contrast with the results of Kitzinger et al,[7] who only found a relation between formation of seroma and excess weight loss. Van der Beek et al[10] also found excess weight loss to be highly significant as a predictor of complications.

Smokers had significantly higher complication rates in our study. Patients were preoperatively instructed to quit smoking, but a preoperative compliance control was not performed. These data depend on reliability of patients and their answers were highly subjective. Literature was variable in smoking and associated complications.[7,8,10,22,23]

Of the 100 patients in our study, 35 had at least 1 comorbidity (hypertension, cardiovascular disease or diabetes mellitus, pulmonary disease), but none of these were predictors of complication rates.

All of our patients had a stable weight for at least 1 year before surgery. This is an important condition for health insurance coverage in the Netherlands. Van der Beek et al[10] described the hypothesis that patients with a minimal stable weight of 3 months or longer before body contouring surgery have a better nutrition status. Bariatric surgery may induce nutritional deficits because of a reduced intake and malabsorption.[13,24] In our study, 52 patients used nutritional supplements. The complication rate was not significantly related to the use of nutritional supplements.

The strength of our study, compared with other studies, is the relatively large population of 100 lower body lifts.[7,8] Another strong point is the fact that only patients with lower body lift surgery are included, whereas other

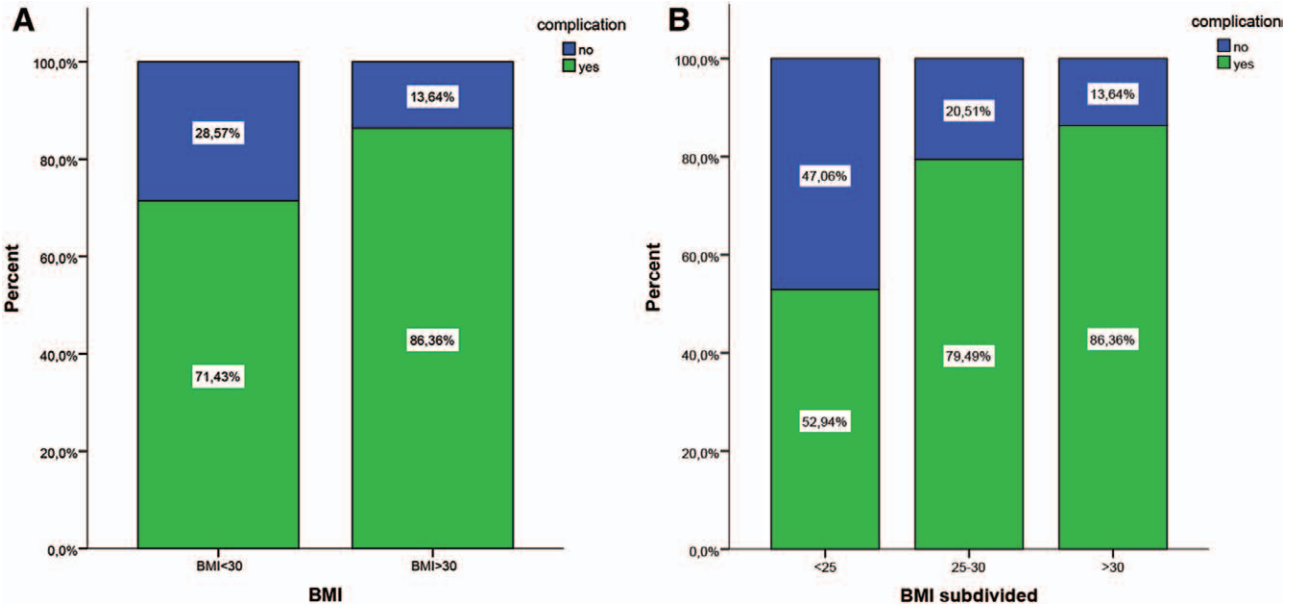

Fig. 2. A, Percentage of complications in relation to BMI pre-LBL <30 and BMI pre-LBL >30 ($P = 0.07$). B, Percentage of complications in relation to BMI pre-LBL subdivided into 3 categories ($P = 0.03$).

Table 8. Complication Rate per Surgeon ($P = 0.60$) and among the First 50 and Last 50 Lower Body Lifts ($P = 0.33$)

	Surgeon A	Surgeon B	First 50 LBL	Last 50 LBL
Number of procedures	63	37	50	50
Complication rate (%)	76.2	81.1	82.0	74

studies frequently include different types of body contouring surgery.[9–14] Kitzinger et al[7] and Nemerofsky et al[8] included patients with body lift surgery, but there are differences between the operation techniques used by the operators in these articles and ours.

Future studies should address larger sample sizes and long-term outcomes after lower body lift surgery. Furthermore, we will start a prospective database with documentation of comorbidities, nutritional state, patient satisfaction, surgical technique, and hypothermia during surgery.

Because of our significant complication rate in smokers, testing patients for preoperative smoking (cotinine urine test) can be considered.[25] The surgeon must encourage abstinence of smoking for at least 6 to 8 weeks before intervention and make sure the patient fully understands the risks of smoking.

CONCLUSIONS

The lower body lift as described above is a good surgical solution to treat surplus and laxity of the skin after massive weight loss. The overall complication rate of 78% is quite high, even though 56% were minor complications and could be treated conservatively. Furthermore, BMI max, BMI pre-LBL, percentage of excess weight loss, and smoking are significantly associated with the development of complications. This study emphasizes the importance of good weight status before surgery and cessation of smoking to minimize the risk of complications. Careful preoperative planning and patient selection are essential to optimize the results of lower body lift surgery of post-bariatric patients.

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REFERENCES

1. Mitchell JE, Crosby RD, Ertelt TW, et al. The desire for body contouring surgery after bariatric surgery. *Obes Surg.* 2008;18:1308–1312.
2. Buchwald H, Avidor Y, Braunwald E, et al. Bariatric surgery: a systematic review and meta-analysis. *JAMA.* 2004;292:1724–1737.
3. Zuelzer HB, Baugh NG. Bariatric and body-contouring surgery: a continuum of care for excess and lax skin. *Plast Surg Nurs.* 2007;27:3–13.
4. Richter DF, Stoff A, Velasco-Laguardia FJ, et al. Circumferential lower truncal dermatolipectomy. *Clin Plast Surg.* 2008;35:53–71.
5. Koller M, Schubhart S, Hintringer T. Quality of life and body image after circumferential body lifting of the lower trunk: a prospective clinical trial. *Obes Surg.* 2013;23:561–566.
6. 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;22:1527–1534.
7. Kitzinger HB, Cakl T, Wenger R, et al. Prospective study on complications following a lower body lift after massive weight loss. *J Plast Reconstr Aesthet Surg.* 2013;66:231–238.
8. Nemerofsky RB, Oliak DA, Capella JF. Body lift: an account of 200 consecutive cases in the massive weight loss patient. *Plast Reconstr Surg.* 2006;117:414–430.

9. Neaman KC, Hansen JE. Analysis of complications from abdominoplasty: a review of 206 cases at a university hospital. *Ann Plast Surg.* 2007;58:292–298.
10. Beek ESJ, Molen AM, Ramshorst B. Complications after body contouring surgery in post-bariatric patients: the importance of a stable weight close to normal. *Obes Facts.* 2001;4:61–66.
11. 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;249:397–401.
12. Michaels J 5th, Coon D, Rubin JP. Complications in postbariatric body contouring: postoperative management and treatment. *Plast Reconstr Surg.* 2011;127:1693–1700.
13. Hasanbegovic E, Sørensen JA. Complications following body contouring surgery after massive weight loss: a meta-analysis. *J Plast Reconstr Aesthet Surg.* 2014;67:295–301.
14. Shermak MA, Chang D, Magnuson TH, et al. An outcomes analysis of patients undergoing body contouring surgery after massive weight loss. *Plast Reconstr Surg.* 2006;118:1026–1031.
15. Clavien PA, Barkun J, de Oliveira ML, et al. The Clavien-Dindo classification of surgical complications: five-year experience. *Ann Surg.* 2009;250:187–196.
16. Martínez CE, Smith PC, Palma Alvarado VA. The influence of platelet-derived products on angiogenesis and tissue repair: a concise update. *Front Physiol.* 2015;6:290.
17. Mammoto T, Jiang A, Jiang E, et al. Platelet rich plasma extract promotes angiogenesis through the angiopoietin1-Tie2 pathway. *Microvasc Res.* 2013;89:15–24.
18. Lockwood T. High-lateral-tension abdominoplasty with superficial fascial system suspension. *Plast Reconstr Surg.* 1995;96:603–615.
19. Aly AS, Cram AE, Heddens C. Truncal body contouring surgery in the massive weight loss patient. *Clin Plast Surg.* 2004;31:611–24, vii.
20. Coon D, Michaels J 5th, Gusenoff JA, et al. Multiple procedures and staging in the massive weight loss population. *Plast Reconstr Surg.* 2010;125:691–698.
21. Michaels J 5th, Coon D, Rubin JP. Post-bariatric surgery body contouring: a learning curve. *Plast Reconstr Surg.* 2011;127:69e–70e.
22. Gravante G, Araco A, Sorge R, et al. Wound infections in postbariatric patients undergoing body contouring abdominoplasty: the role of smoking. *Obes Surg.* 2007;17:1325–1331.
23. Rogliani M, Labardi L, Silvi E, et al. Smokers: risks and complications in abdominal dermolipectomy. *Aesthetic Plast Surg.* 2006;30:422–4; discussion 425.
24. Davies DJ, Baxter JM, Baxter JN. Nutritional deficiencies after bariatric surgery. *Obes Surg.* 2007;17:1150–1158.
25. Reinbold C, Rausky J, Binder JP, et al. Urinary cotinine testing as pre-operative assessment of patients undergoing free flap surgery. *Ann Chir Plast Esthet.* 2015;60:e51–e57.