Multiple Procedures and Staging in the Massive Weight Loss Population

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Background: Unlike traditional plastic surgery patients who present with a specific anatomical complaint, massive weight loss patients often have multiple regions of concern. No single procedure can address the whole-body deformities associated with massive weight loss. The authors sought to quantify their clinical experience to provide evidence-based analysis of procedural combination in body contouring.
Methods: Patients were enrolled in an institutional review board–approved prospective clinical database over a 5-year period. Procedure categories included breast, medial thigh lift, buttock and lateral thigh lift, upper back lift, brachioplasty, and abdomen. Analysis of variance was used to analyze differences between procedure combinations.
Results: Six hundred nine massive weight loss patients underwent 661 cases involving 1070 procedures. Length of hospital stay increased with the number of procedures performed ($p < 0.001$). Second-stage cases ($n = 60$) had similar complication rates and length of hospital stay. Seroma and dehiscence were strongly correlated with the number of procedures ($p < 0.001$), as were tissue necrosis and infection ($p = 0.02$), whereas hematoma was unrelated ($p = 0.25$). Major complications did not increase in multiple-procedure cases.
Conclusions: In a large experience at a high-volume center, concomitant procedures were performed safely in carefully selected patients with low major complication rates. Although aggregate minor complication rates were predictably higher than in single-procedure cases, there was no significant increase on a per-procedure basis. Multiple procedures can be combined safely in the body contouring patient, with surgical staging offering a viable alternative for patients who are unable to undergo combined procedures. (*Plast. Reconstr. Surg.* 125: 691, 2010.)

Body contouring procedures following massive weight loss continue to increase as a result of the rapidly growing number of patients undergoing bariatric procedures. Unlike traditional plastic surgery patients who present with specific anatomical complaints, massive weight loss patients often have multiple regions of concern. No single procedure can address the whole-body deformities associated with massive weight loss. Accordingly, patients frequently seek to have multiple procedures performed concomitantly to reduce costs and recovery time.

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The decision to combine procedures requires careful preoperative consideration. Factors that need to be evaluated include the patient's overall medical condition, surgeon experience, length of surgery, vectors of tension, and cost to the patient. Numerous authors have advocated strategies for approaching this problem; however, there is relatively little evidence assessing how staging and different combination strategies affect clinical outcomes.[1–3] We sought to quantify our experience with combined procedures to provide evidence-based analysis of staging and outcomes in post–bariatric surgery body contouring.

PATIENTS AND METHODS

Patients were enrolled from 2005 to 2009 in an institutional review board–approved prospective clinical database established to analyze post–bariat-

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ric surgery patient outcomes. The primary inclusion criterion was weight loss greater than or equal to 50 pounds. Body contouring procedures were separated into six major surgical categories: abdominal contouring; breast; buttock and lateral thigh (lower back) lift; upper back lift; brachioplasty; and medial thigh lift. Adjunctive liposuction was not counted as a separate procedure. Breast surgery included mastopexy, implant augmentation, reduction, gynecomastia, or mastopexy with augmentation (considered one procedure). Mastopexy was performed using our dermal suspension and parenchymal reshaping technique.[4–6] Lateral thigh/buttock lift was defined as the excision of buttock and lateral thigh tissue typically with gluteal autoaugmentation and often performed in a circumferential approach with abdominoplasty.

Patients who underwent procedures other than these major categories were excluded. Complication rates were assessed for both single and combined procedures. Complications included wound dehiscence, seroma, hematoma, infection, tissue necrosis, blood transfusion, deep venous thrombosis, pulmonary embolism, and reoperation secondary to postoperative complication.

Patients with a history of smoking were asked to stop smoking 1 month before and after surgery. Preoperative compliance with smoking cessation was confirmed by means of urine cotinine tests, with a positive test resulting in delay of surgery. Post–weight loss diabetes and hypertension were defined as the continued use of medication at the time of initial presentation. Sequential compression devices were placed before induction in 97 percent of cases, and the remainder had sequential compression devices placed after induction. Before 2006, our deep venous thrombosis protocol consisted of sequential compression devices and early ambulation. After this point, we instituted a protocol in which subcutaneous enoxaparin was administered postoperatively and continued until discharge. There was no change in complication rates as a result of this protocol (data not shown).

Statistical analysis was performed using Stata/SE version 10.0 (StataCorp., College Station, Texas). The *t* test and Mann-Whitney *U* test were used for comparison of dichotomous groups for normal and nonnormally distributed variables, respectively; whereas linear and Spearman regression were used to correlate continuous variables. Univariate logistic regression was used to examine the impact of individual factors on the development of particular complications with multivariate regression for possible confounders and ordinal regression for factors affecting the number of procedures performed. The Hosmer-Lemeshow test was used to assess regression model goodness of fit. All statistical tests were two-sided and significance was set to the level of $p < 0.05$.

RESULTS

Seven hundred five cases were analyzed. Forty-four cases were excluded based on the involvement of non–body contouring procedures, most commonly facial aesthetic surgery. Six hundred nine patients had 1070 body contouring procedures performed in 661 cases. Of these cases, 269 (40.7 percent) involved multiple procedures. Table 1 summarizes key demographic characteristics by number of procedures. The mean weight loss for all patients was 133 pounds (range, 50 to 408 pounds). Six hundred twelve patients (92.6 percent) lost weight through surgical methods. Patients undergoing multiple procedures tended to be women ($p = 0.06$) and have a lower body mass index ($p = 0.007$) but otherwise were similar to those undergoing single procedures.

Overall Procedure Combination

Intraoperative time was highly correlated to the number of procedures performed ($p < 0.001$; $r = 0.82$). The distribution of procedures by body region

Table 1. Patient Demographics by Number of Major Procedures

	All Cases ($n = 661$)	1 Procedure ($n = 392$)	2 Procedures ($n = 131$)	≥3 Procedures ($n = 138$)	p*
Age, years (mean ± SD)	45.2 ± 10.4	45.0 ± 10.7	45.9 ± 10.2	44.8 ± 9.6	0.6
Female sex, %	90.6	89.0	90.1	94.9	0.06
Current BMI (mean ± SD)	29.8 ± 6.0	30.5 ± 6.7	29.0 ± 4.7	28.6 ± 4.0	0.007
Maximum BMI	51.9 ± 9.8	51.9 ± 9.9	51.3 ± 9.5	52.6 ± 9.9	0.6
Presence of hypertension, %	19.2	17.2	22.2	21.9	0.25
Presence of diabetes, %	5.5	5.2	5.6	6.3	0.7
Operative time, hours (mean ± SD)	4.5 ± 3.2	2.7 ± 1.4	6.2 ± 2.3	9.2 ± 2.3	<0.001
EBL, cc (median ± IQR)	200 ± 100	150 ± 100	250 ± 50	300 ± 175	<0.001

BMI, body mass index; EBL, estimated blood loss.
*Difference by number of procedures using analysis of variance (continuous), χ^2 (categorical), or Kruskal-Wallis (estimated blood loss).

and the rates of their combination are listed in Table 2. Length of hospital stay increased continuously with the number of procedures performed, ranging from 1.6 days with one procedure to 2.2 with three or more procedures ($p < 0.001$). Figure 1 illustrates the frequency of complications for each incremental level of procedure combination. Rates of dehiscence, seroma, infection, and necrosis were correlated with the number of procedures performed, whereas hematoma was not. Patients tended to reach lower minimum temperatures as the number of procedures increased (35.7°C for a single procedure to 35.2°C for three or more procedures; $p < 0.001$). No patients experienced thromboembolic events, major systemic complications, or death.

Overall, 267 patients (40.4 percent) experienced complications. Total complication rates were higher in multiple-procedure cases (55.4 percent versus 30.1 percent; $p < 0.001$). Twenty patients (3.0 percent) had a local complication in more than one of the six defined areas. Fifteen of these were patients who experienced wound dehiscence in more than one area, whereas the remaining five represented multiple seromas. Figure 2 shows the frequency of complications divided by the number of procedures performed in the case, accounting for multiple complications of the same type.

Four patients had major wound complications requiring operative treatment: two dehiscences, one wound infection, and a complete loss of the umbilicus. The umbilical loss occurred in a three-procedure case and was attributed retrospectively to excess stalk tension during the closure, whereas the other major wound complications occurred in single-procedure cases. The transfusion rate trended upward but did not increase significantly with the number of procedures ($p = 0.12$).

Sixty cases (9 percent) represented a second-stage operation. Figure 3 shows our most frequently used staging strategy for total body contouring. These cases tended to be longer (5.3 hours versus 4.4 hours; $p = 0.05$) but did not have a higher rate of individual or overall complications ($p = 0.7$). Hospital stays were comparable between the two groups ($p = 0.2$). Because secondary stages were less likely to involve abdominoplasty (23.2 percent versus 85.5 percent of unstaged cases; $p < 0.001$), abdominal complication rates could not be compared. Figures 4 and 5 show representative patient results.

Table 2. Distribution of Body Contouring Procedures

Type of Procedure	No.	Percentage Performed with Multiple Procedures
Abdomen		
Abdominoplasty		
Without FDL	391	37.7
With FDL	176	62.3
Breast		
Mastopexy	124	93.5
Reduction	31	45.2
Augmentation	25	96.0
Gynecomastia excision	15	86.7
Brachioplasty	124	89.5
Lateral thigh/buttock lift	104	97.1
Medial thigh lift	68	98.5
Upper back lift	12	91.7
Total	1070	

FDL, Fleur-de-lis vertical incision.

Abdominoplasty and Procedure Combination

Five hundred sixty-seven cases included abdominoplasty (84.8 percent), 226 of which involved combination with other body contouring

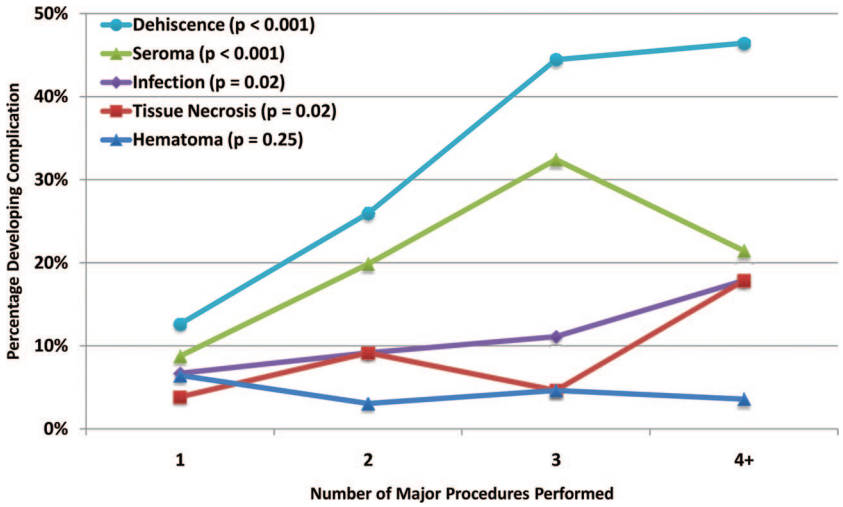

Fig. 1. The number of major procedures performed in a case versus the incidence of each complication.

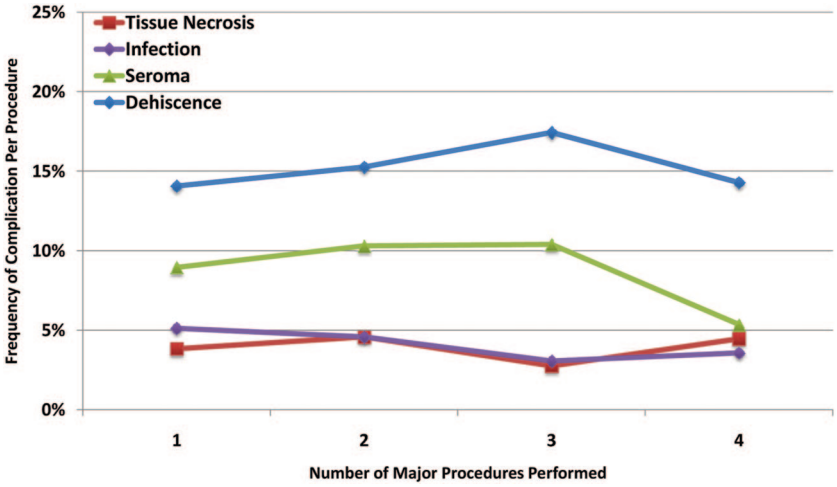

Fig. 2. The number of major procedures versus the rate of complications per procedure performed.

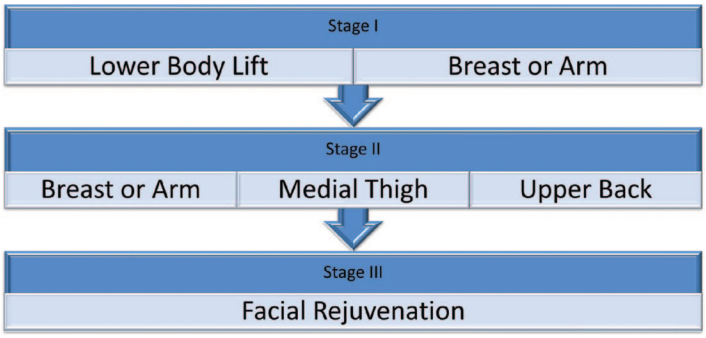

Fig. 3. A typical approach to staging for massive weight loss patients desiring total body contouring.

procedures (40.0 percent). Table 3 summarizes the most commonly combined procedures. Addition of other procedures did not increase the abdominoplasty complication rate: there was no significant increase in abdominal complications ($p > 0.2$) when performed alone versus in combination with one or more procedures.

DISCUSSION

Body contouring procedures after massive weight loss continue to be an area of growth in our specialty. Because they desire correction of multiple anatomical regions, patients will frequently ask whether these procedures can be combined. At our center, our operative team is composed of a senior surgeon, a dedicated body contouring fellow, a physician assistant, and often a plastic surgery resident. This large, coordinated team affords us the opportunity to combine procedures into fewer stages. We currently perform multiple procedures on over 40 percent of our patients, with 20 percent undergoing three or more procedures. Patient safety must be paramount in any combined body contouring procedure, yet the literature is limited regarding the safety and complication rates of combined procedures.

Interest in the idea of combining abdominal contouring with other procedures developed well before the relatively recent advent of a sizable massive weight loss population. Hester et al. published a large series of over 500 abdominoplasty patients in 1989, with 216 having additional aesthetic procedures, predominantly breast surgery.[7] Complexity of procedures performed did not predict complications. A more recent review of 268 predominantly non–massive weight loss patients undergoing abdominoplasty combined with breast and facial cosmetic surgery did not report a significant increase in complication rates.[8,9] Few authors have assessed the impact of procedure combination and staging specifically in massive weight loss patients, who differ substantially both in physiology and in magnitude of

Fig. 4. A 35-year-old woman went from a pre–gastric bypass body mass index of 44 to a body mass index of 24 and desired correction of abdominal laxity and ptotic breasts in one operation. (*Above*) Preoperative views. (*Below*) Postoperative views 9 months after combined abdominoplasty with dermal suspension and parenchymal reshaping mastopexy demonstrate improved breast and abdominal contour. This popular combination has a powerful impact on the entire torso.

procedures combined.[10–12] Early authors such as Pitanguy and Ceravolo presented case reports describing the successful combination of multiple body contouring procedures.[13–15]

In one of the few studies to specifically analyze multiple procedures and complications in body contouring, Gmür and colleagues studied 73 consecutive massive weight loss abdominoplasties.[16] Thirty-six percent involved concomitant procedures, comparable to our cohort. Complications and duration of hospital stay were no greater in the multiple-procedures group. Neaman and Hansen reviewed 206 abdominoplasty patients, approximately 15 percent of whom had undergone gastric bypass.[17] Other body contouring procedures were performed approximately 25 percent of the time and did not correlate with increased complications.

Hurwitz et al.[3] examined 75 total body lift patients. Patients were equally likely to undergo single- or multiple-stage total body lift. Multiple-stage

Fig. 5. A 38-year-old woman desired total body contouring after a weight loss of 209 pounds. (*Above*) Preoperative views. (*Center*) Postoperative views 5 months after stage I, consisting of fleur-de-lis abdominoplasty, lateral thigh/buttock lift, and brachioplasty. (*Below*) Postoperative views 9 months after stage II, consisting of dermal suspension and parenchymal reshaping mastopexy, upper back lift, and vertical medial thigh lift.

Table 3. Most Common Abdominoplasty Procedure Combinations

Procedure	No.
Abdominoplasty alone	335
Procedures in addition to abdominoplasty	
Mastopexy	26
LT/BL	26
LT/BL and brachioplasty	25
Other breast (augmentation/reduction/ gynecomastia)	20
Brachioplasty and mastopexy	19
LT/BL and mastopexy	13
Mastopexy and breast augmentation	11
Medial thigh lift and mastopexy	10
LT/BL and medial thigh lift	9
Medial thigh lift and brachioplasty	7
Medial thigh lift	6
LT/BL and mastopexy and breast augmentation	4
LT/BL and medial thigh lift and mastopexy	4

LT/BL, lateral thigh/buttock lift.

total body lift was associated with increased wound-healing problems, and there was no correlation between complications and the number of procedures performed. Shermak et al. reviewed 139 body contouring patients, 92 percent of whom underwent abdominoplasty.[18] Of the abdominoplasty patients, 26 percent had a circumferential procedure and 33 percent had thigh lifts. Combination of three or more procedures was associated with an increased likelihood of transfusion and a hospital stay greater than 2 days, but no differences in other complications were found. We observed an increased hospital stay with an incremental increase in procedures performed but no increase in transfusion rates.

Several authors have suggested that stages should be separated by a minimum of 3 months and that 7 hours be considered as a flexible upper limit to operative time.[2,19–21] Although we separate stages by several months, we do not have an explicit cutoff for maximum operative time. In summary, most existing studies have failed to find correlations between additional procedures and complications, although sample sizes have typically not been large enough to analyze specific rather than total complications.

Our results demonstrate that overall complication rate and hospital stay increased with the incremental increase of procedures performed, as one might expect. Minor complications such as dehiscence and seroma were predictably correlated to the number of procedures performed. The exception to this trend was hematoma formation. We believe that this was because most hematomas were associated with abdominal contouring, and the addition of other procedures added less additional risk of hematoma at the respective anatomical sites. We saw no increases in either aggregate or specific abdominal complications when additional procedures were performed with abdominoplasty. Importantly, per-procedure complication rates were not increased with higher procedure counts, making total complication rates equivalent to the sum of the individual procedural complication rates. This suggests that spreading procedures into multiple stages may not significantly reduce total complication rates for appropriately selected patients.

Patients undergoing multiple procedures were demographically similar to those undergoing single procedures with the exception of slightly lower body mass indexes and a trend toward female sex. We attribute the higher body mass in the single-procedure group primarily to a small subset of patients presenting with a "giant pannus." Otherwise, these results are consistent with our anecdotal impression that it is relatively uncommon to encounter a patient who is a good candidate for body contouring surgery but not multiple procedures. Instead, the decision between combination and staging is typically based on patient desires and whether the requested procedures can be combined safely into a single stage.

Staging procedures is common in post–bariatric surgery body contouring, although there are no widely accepted algorithms to guide decision making. When staging procedures, we ask the patients to prioritize the anatomical regions of highest concern. Based on these priorities, we will discuss different safe staging options. We attempt to combine procedures that avoid opposing vectors of tension. The frequency of particular procedure combinations seen in our cohort is thus a function of both patient preference and surgical planning.

In our practice, most patients desiring total body reshaping require two stages, and sometimes three if they desire facial rejuvenation (Fig. 3). Patients first undergo abdominal, buttock, lateral thigh, and breast or arm correction. The second stage typically addresses the medial thigh and may also address remaining arm, breast, or upper back deformities if desired. We begin with the patient in the prone position when addressing posterior deformities and the position the patient supine for the remaining procedures.[22] For plastic surgeons that do not have a large team, four to five stages may be required. Advantages to staging procedures include the potential for decreased blood loss and the avoidance of opposing tension vectors. Staging also allows for the correction of any contour irregularities and skin laxity that may have occurred as a result of previously performed procedures.

Buttock and lateral thigh contouring was nearly always combined with other procedures, most commonly abdominoplasty (i.e., a lower body lift). Fleur-de-lis abdominoplasty was much more commonly combined with other procedures than abdominoplasty without a vertical component. We typically avoid combining lower body lifts with a medial thigh or upper back lift because of the opposing vectors of tension, although we have performed them together on occasion without adverse results. Similarly, when combining fleur-de-lis abdominoplasty with mastopexy, we evaluate the inframammary fold for laxity and consider a staged approach if the fold is very loose.

Patient safety is always the foremost consideration when performing multiple procedures in a massive weight loss patient. Close communication between the surgeon and anesthesia team is vital. We inform all of our patients that if there is any intraoperative concern regarding their condition, the surgery will be truncated. It has been our experience that this discussion enhances the surgeon-patient relationship.

We recommend that surgeons consider the following criteria when deciding to combine procedures: the medical condition of the patient, the operative team (i.e., number of surgeons and extenders), the surgeon's experience with major body contouring procedures, the operative facility and resources (i.e., outpatient center versus hospital), and the anesthesia team. At our focused Life After Weight Loss center, we routinely take advantage of our strong institutional support to offer combined procedures safely.

CONCLUSIONS

In a large experience at a high-volume center, concomitant body contouring procedures in carefully selected massive weight loss patients were performed safely. Major complication rates in our cohort were low. Although overall minor complication rates were predictably higher than in single-procedure cases, there was no significant increase on a per-procedure basis. Staging offers a viable alternative for patients who are not ideal candidates for combined procedures or who desire combinations that cannot be safely performed.

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