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The PRS Rainbow Classification for Assessing Postbariatric Contour Deformities

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Background: There is a need for a reliable classification system to grade contour deformities and to inform reimbursement of body contouring surgery after massive weight loss. We developed the PRS Rainbow Classification, which uses select photographs to provide standardized references for evaluating patient photographs, to classify contour deformities in postbariatric patients. To assess the reliability of the PRS Rainbow Classification to classify contour deformities in massive weight loss patients.

Methods: Ten independent experienced plastic surgeons, 7 experienced medical advisors of the healthcare insurance company, and 10 laypersons evaluated 50 photographs per anatomical region (arms, breast, abdomen, and medial thighs). Each participant rated the patient photographs on a scale of 1–3 in an online survey. The inter-observer and the intra-observer reliabilities were determined using intra-class correlation coefficients (ICCs). The ICC analyses were performed for each anatomical region.

Results: Inter-observer reliability was moderate to good in the body regions “arms,” “abdomen,” “medial thighs,” with mean ICC values of 0.678 [95% confidence interval (CI), 0.591–0.768], 0.685 (95% CI, 0.599–0.773), and 0.658 (95% CI, 0.569–0.751), respectively. Inter-observer reliability was comparable within the 3 different professional groups. Intra-observer reliability (test–retest reliability) was moderate to good, with a mean overall ICC value of 0.723 (95% CI, 0.572–0.874) for all groups and all 4 body regions.

Conclusions: The moderate to good reliability found in this study validates the use of the PRS Rainbow Classification as a reproducible and reliable classification system to assess contour deformities after massive weight loss. It holds promise as a key part of instruments to classify body contour deformities and to assess reimbursement of body contouring surgery. (*Plast Reconstr Surg Glob Open* 2020;8:e2874; doi: [10.1097/GOX.0000000000002874](https://doi.org/10.1097/GOX.0000000000002874); Published online 24 June 2020.)

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INTRODUCTION

Severe obesity is on the rise in most countries, and bariatric surgery is considered to be the most effective weight loss option.^{1–3} The subsequent massive weight loss, however, generally leaves patients with excess skin and a significant abnormal body contour. After bariatric surgery, 80%–90% of the patients described problems with excess skin.^{4–8} The excess skin can cause health and hygiene issues, which may lead to significant impairment of the activities of daily living, as well as severe psychologic problems due to disfigurement.^{5,6,9–18} Body contouring surgery (BCS) can be used to address these problems of redundant excess skin.^{19–21} BCS holds promise for significant improvement of health-related quality of life and better weight control after bariatric surgery.^{20–31} Studies reported that 62%–90% of the postbariatric patients desired additional

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reconstructive surgery.^{4,6,8,32–36} Due to the increasing number of people undergoing bariatric surgery, the number of postbariatric body contouring procedures performed annually continues to increase.^{37–39}

A standardized classification system for body contour deformities is warranted for surgical planning and outcome analysis of postbariatric body contouring procedures, as well as to inform reimbursement. The Pittsburgh Rating Scale (PRS) was the first validated classification system for contour deformities after massive weight loss.⁴⁰ In the Netherlands, the PRS is also used for the classification of excess skin, which is one of the criteria for reimbursement by health insurers.^{34,41} Although the PRS represents a useful starting point to inform reimbursement for body contouring surgery, a study by van der Beek et al⁴¹ demonstrated that the PRS did not yet show enough evidence of reliability for this purpose. It is likely that contour deformities were visually assessed without the presence of reference photographs of the PRS, making these assessments more biased by each individual interpretation.

The Rainbow Scale is an online system consisting of reference photographs of the deformity to be assessed, and using the scale has shown to be a reliable way for plastic surgeons to evaluate nasolabial fold severity and breast ptosis.^{42,43} We developed the PRS Rainbow Classification, which builds on the concepts and the work of the PRS and the Rainbow scale. In the PRS Rainbow Classification, the patient photographs were placed in the center for review and classified against the select photographs from the original PRS to provide standardized references. The purpose of this study was to evaluate the reliability of this newly developed PRS Rainbow Classification. The present study examined whether the classification of contour deformities were the same when assessed by different persons and different stakeholders (ie, plastic surgeons, medical advisors of the healthcare insurance company, and laypersons) (inter-observer reliability) and by the same persons at a different moment in time (intra-observer reliability).

METHODS

Between June 2018 and March 2019, 10 independent experienced plastic surgeons, 7 independent experienced medical advisors of the healthcare insurance company, and 10 independent laypersons were asked to rate the photographs. Each of them rated 50 anterior-posterior photographs of different grades of deformities per deformity region (arms, breast, abdomen, and medial thighs) against the most appropriate corresponding grade. For intra-observer reliability (test-retest reliability), the photographs were randomly displayed in a different order, with a time interval of at least 2 weeks. Patients signed informed consent before BCS for the use of photographs for both medical and scientific purposes. The photographs are anonymized when used for scientific purposes; therefore, no individual patient data were available (ie, medical history and surgical history) in this study. The Institutional Medical Ethics Committee approved this study.

Photography

Standardized preoperative patient photographs are required by the Dutch healthcare insurers in order for reimbursement of BCS and, therefore, are part of the preoperative evaluation of BCS.^{44–46} The photographs were selected from the Department of Medical Photography of the UMCG, Groningen, and from the Catharina Hospital, Eindhoven. Once the most adequate photographs were obtained, Adobe Photoshop CC 2018 19.1.5.61161 (Adobe Systems Inc., San Jose, Calif.) was used to further anonymize the photographs for this study by not displaying the faces of the patients.

The PRS Rainbow Classification

The method of van der Beek et al⁴¹ was used as a starting point of this study, and we built on it by adding the Rainbow Scale, a classification system called the PRS Rainbow Classification. The PRS includes 10 regions with a 4-point grading system per anatomical region to systematically describe the common deformities in each region of the body.⁴⁰ Each anatomical region is scored ranging from 0 (indicating normal appearance) to 3 (indicating the most severe deformity). The Rainbow Scale method has been adapted from the Merz Scales (Merz Pharmaceuticals GmbH, Frankfurt, Germany). The format of the Rainbow Scale has been previously used in nasolabial fold severity and in grading breast ptosis,^{42,43} in which 5 photographs are presented in a rainbow arch with increasing severity. An adapted version was created in the PRS Rainbow Classification by combining the best of both classification systems. Only photographs with grades 1–3 according to the PRS were used as standardized reference photographs in the PRS Rainbow Classification. The patient photograph to be reviewed was placed at the center position, which is surrounded by these 3 standardized photographs. The deformity severity of these standardized reference photographs are placed in increasing order while following the rainbow. The PRS Rainbow Classifications are shown in the **Supplemental Digital Content 1**. (See figures, Supplemental Digital Content 1, which display the PRS Rainbow Classification of each anatomical region. The photograph of the patient is located at the center of the lower row. Three grades of the PRS are placed around progressively as a rainbow. The photographs are reproduced from Song et al.⁴⁰ <http://links.lww.com/PRSGO/B397>.)

Data Collection

An online survey was created using Castor EDC (Castor Electronic Data Capture, Ciwit BV, Amsterdam, The Netherlands, 2018).

Statistical Analysis

Power analysis showed that a minimum of 42 photographs were necessary for 10 observers to provide a 95% CI of ± 0.1 for an estimated intra-class correlation coefficient (ICC) of 0.7. Therefore, we decided to include 50 photographs per observer and per deformity region. The inter-observer agreement was determined using ICC \pm 95% CI using a 2-way random-effects model for

Table 1. Overall Inter-observer Reliability

	Overall Intra-class Correlation	95% Confidence Interval	Test 1 Intra-class Correlation	95% Confidence Interval	Test 2 Intra-class Correlation	95% Confidence Interval
Arms	0.678	0.590–0.768	0.686	0.598–0.776	0.659	0.567–0.754
Breasts	0.368	0.284–0.480	0.372	0.283–0.487	0.362	0.272–0.479
Abdomen	0.685	0.599–0.773	0.672	0.582–0.764	0.698	0.610–0.785
Medial thighs	0.658	0.569–0.751	0.664	0.572–0.758	0.665	0.573–0.759

Table 2. Inter-observer Reliability within the 3 Different Professional Groups

	Medical Advisors of the Insurance Company								
	Plastic Surgeons			Medical Advisors of the Insurance Company			Laypersons		
	Overall ICC (95% CI)	Test 1 ICC (95% CI)	Test 2 ICC (95% CI)	Overall ICC (95% CI)	Test 1 ICC (95% CI)	Test 2 ICC (95% CI)	Overall ICC (95% CI)	Test 1 ICC (95% CI)	Test 2 ICC (95% CI)
Arms	0.701 (0.613–0.789)	0.714 (0.621–0.802)	0.664 (0.563–0.762)	0.631 (0.526–0.737)	0.636 (0.518–0.747)	0.558 (0.404–0.697)	0.730 (0.648–0.811)	0.741 (0.655–0.821)	0.711 (0.620–0.799)
Breasts	0.367 (0.274–0.486)	0.372 (0.263–0.504)	0.352 (0.248–0.480)	0.487 (0.381–0.608)	0.504 (0.388–0.630)	0.445 (0.285–0.603)	0.391 (0.298–0.509)	0.367 (0.264–0.495)	0.393 (0.289–0.520)
Abdomen	0.775 (0.702–0.845)	0.763 (0.683–0.837)	0.779 (0.701–0.850)	0.714 (0.623–0.800)	0.683 (0.577–0.781)	0.718 (0.607–0.813)	0.670 (0.580–0.762)	0.647 (0.548–0.748)	0.702 (0.611–0.791)
Medial thighs	0.678 (0.586–0.770)	0.674 (0.571–0.772)	0.704 (0.612–0.792)	0.744 (0.654–0.825)	0.738 (0.639–0.825)	0.723 (0.585–0.826)	0.646 (0.553–0.743)	0.653 (0.553–0.752)	0.645 (0.543–0.747)

single measurement and absolute agreement. The intra-observer agreement (test–retest reliability) was determined using ICC \pm 95% CI using a 2-way mixed-effects model for single measurement and absolute agreement. The ICC will be performed for each anatomical region. The ICC takes values in the range of 0 (no agreement) to 1 (perfect agreement). Consistent with the guideline of reporting ICC values for reliability studies, we considered ICC values <0.5 as “poor” reliability, values between 0.5 and 0.75 as “moderate” reliability, values between 0.75 and 0.9 as “good” reliability, and values >0.90 as “excellent” reliability.⁴⁷ A high ICC means that the total variance within the data is rather explained by differences between individuals than by that between the observers. All data were analyzed using SPSS 21.0 for Windows (SPSS Inc., Chicago, Ill.).

RESULTS

A total of 200 patient photographs (50 photographs of 4 deformity region: arms, breast, abdomen, and medial thighs) were included in the present study. All photographs of the breast, medial thighs, and arms were from women and 37 photographs of the abdomen were from women (74%).

Inter-observer Reliability

The PRS Rainbow Classification demonstrated a moderate to good inter-observer reliability in the body regions such as arms, abdomen, and medial thighs, with mean ICC values of 0.678 (95% CI, 0.591–0.768), 0.685 (95% CI, 0.599–0.773), and 0.658 (95% CI, 0.569–0.751), respectively (Table 1). The inter-observer reliability in the breasts was poor, with a mean ICC value of 0.368 (95% CI, 0.284–0.480) (Table 1). The mean ICC values of inter-observer reliability were comparable for the first and second test. In all different professional groups, moderate to good ICC values were seen in arms, abdomen, and

medial thighs and poor to moderate ICC values in breasts (Table 2).

Intra-observer Reliability (Test–Retest Reliability)

Ten plastic surgeons, 10 lay persons, and 4 medical advisors of the healthcare insurance company completed the second survey for intra-observer reliability (test–retest reliability). Intra-observer reliability per individual is available in the **Supplemental Digital Content 2**. (See table, **Supplemental Digital Content 2**, which displays intra-observer (test–retest) reliability per individual by professional groups (plastic surgeons, medical advisors of the healthcare insurance company, and laypersons), <http://links.lww.com/PRSGO/B398>.) Intra-observer reliability (test–retest reliability) was moderate to good, with a mean overall ICC value of 0.723 (95% CI, 0.572–0.874) for all professional groups and for all 4 body regions (Table 3). The intra-observer reliability for each single anatomical region was good in arms, abdomen, and medial thighs, with mean ICC values of 0.779 (95% CI, 0.662–0.896), 0.787 (95% CI, 0.689–0.885), and 0.755 (95% CI, 0.649–0.861), respectively. The intra-observer reliability of the breasts was poor, with a mean ICC value of 0.570 (95% CI, 0.407–0.734). The mean ICC values in the different groups (plastic surgeons, medical advisors of the healthcare insurance company, and laypersons) were 0.721

Table 3. Intra-observer (Test–Retest) Reliability by Professional Group

	Mean ICC		
	Plastic Surgeons	Medical Advisors of the Insurance Company	Laypersons
Arms	0.765	0.842	0.767
Breasts	0.557	0.649	0.552
Abdomen	0.819	0.842	0.734
Medial thighs	0.743	0.871	0.720

(95% CI, 0.578–0.864), 0.801 (95% CI, 0.673–0.929) and 0.693 (95% CI, 0.534–0.852), respectively.

DISCUSSION

The present study demonstrates that the PRS Rainbow Classification is a reliable tool for the classification of contour deformities in postbariatric patients with a desire for BCS. In the arms, abdomen, and medial thighs, there was moderate to good inter-observer and intra-observer reliability, indicating that plastic surgeons, laypersons, and medical advisors of the healthcare insurance company rated photographs similarly. Intra-observer reliability was good in arms, abdomen, and medial thighs for all raters, which means that individuals consistently rated the photographs. In arms, abdomen, and medial thighs, the PRS Rainbow Classification showed higher ICC values compared with the breasts, which describes that the classification of the photographs pertaining to these body regions was more consistent across different persons and within the same person compared with those related to breasts.

An objective and easy-to-use tool is not only essential for reliable classification of contour deformities, but also to select those patients who may qualify for BCS reimbursement. Patient access to body contouring procedures following bariatric surgery is limited due to the lack of personal financial resources, and therefore patients primarily rely on their healthcare insurer.^{34,48–57} Many insurance policies, however, currently use the length of overhanging skin as an objective means of quantifying excess loose skin deformities, which is not a reliable measure.^{51,52,58,59} Researchers from several countries have raised the issue of unclear reimbursement.^{34,48–53,59–61} Originally, the PRS was designed to describe preoperative deformities in a standardized manner. It was never intended as a tool for insurance companies to determine whether or not the deformity is reimbursed for BCS.⁴⁰ In clinical practice, a significant discrepancy exists between the PRS assessment by plastic surgeons or medical advisors of the healthcare insurance company. This probably also reflects the different viewpoints and concerns of both professionals (ie, plastic surgeon serving patients and getting work; insurance companies limiting costs) and emphasizes the need for a better classification tool to decide which patients should be reimbursed. The PRS Rainbow Classification, as evaluated in this study, is a classification tool that results in reliable scoring across different stakeholder groups. The comparable rating scores of the postbariatric patient photographs among and within plastic surgeons, medical advisors of the healthcare insurance company, and laypersons indicated that the PRS Rainbow Classification is a reliable classification system for different purposes.

Only in the breasts, the PRS Rainbow Classification demonstrated poor inter-observer and intra-observer reliabilities. We hypothesize that this difference is due to the variability in breast deformities after massive weight loss. Breast deformities vary more significantly compared with deformities of other body regions.⁶² Postbariatric patients present with a wide range of different breast deformities, different breast volumes, and additional deformities (ie,

nipples deformities or lateral chest rolls) that are not adequately described with the 3 deformity scales of anterior–posterior photographs presented in the original PRS. For better classification of breast deformities, the PRS Rainbow Classification should be further enhanced using different views (eg, oblique and lateral views). Furthermore, the steps between the different grades of breast deformities vary more significantly compared with the steps between the different grades of other body regions. The PRS Rainbow Classification could be further improved with computer-simulated photography of one person to avoid inevitable differences in photographs of different persons as seen in the original PRS and in this PRS Rainbow Classification. A specific increase in the length of overhang per anatomical region will be incorporated into the photographs with image morphing techniques to create a representative grading classification with equal steps between the grades. This equal stepwise variation of morphed photographs used in a classification scale has already been shown to be reliable in the Merz Scales (Merz Pharmaceuticals GmbH, Frankfurt, Germany). Moreover, image morphing techniques will allow for additional improvements in the photographs (eg, knees are not visible on the PRS photographs of the abdomen, even though this is an essential point of reference in the judgment of excessive skin of the abdomen). These next steps will be undertaken to further improve the PRS Rainbow Classification.

A limitation in the use of the PRS Rainbow Classification is the lack of anthropometry. On the other hand, not using anthropometry makes the PRS Rainbow Classification a quick and straightforward tool for use in daily practice. Another limitation of this study is that the PRS Rainbow Classification was only tested for the indication of body contouring procedures. Moreover, while excess loose skin can be functionally and psychologically bothersome, these issues are not incorporated in the current PRS Rainbow Classification. Excess loose skin may hamper the health-related quality of life of patients and can lead to medical complaints, and body contouring procedures (ie, abdominoplasty, lower body lift, upper body lift) are the only effective treatments to remove excess skin.^{5,6,9–21} Not only should all these aspects be evaluated when selecting patients to qualify for BCS reimbursement, but the factors that can affect the development of excess skin, such as preoperative ptosis, body mass index, and circumference, have to be considered too.^{55,58,63} The PRS Rainbow Classification should be used as an objective tool for classifying excess loose skin in addition to the screening tools that take into account medical, psychological, and physical complaints, as well as the predictors of excess skin (eg, the Dutch Rebec tool) to justify insurance coverage.⁶⁴ A pilot study combining the improved version of the PRS Rainbow Classification and the Dutch Rebec Scale is currently underway.

CONCLUSIONS

The moderate to good reliability found in this study validates the use of the PRS Rainbow Classification, which uses select photographs from the original PRS to

provide standardized references for evaluating patient photographs, as a reproducible and reliable classification system to assess body contour deformities after massive weight loss. This classification system holds promise as a key part of instruments to classify body contour deformities and to assess reimbursement of BCS and should be further improved, especially for the breast deformities.

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REFERENCES

- Christou NV, Sampalis JS, Liberman M, et al. Surgery decreases long-term mortality, morbidity, and health care use in morbidly obese patients. *Ann Surg.* 2004;240:416–423; discussion 423.
- Maggard MA, Shugarman LR, Suttorp M, et al. Meta-analysis: surgical treatment of obesity. *Ann Intern Med.* 2005;142:547–559.
- Ng M, Fleming T, Robinson M, et al. Global, regional, and national prevalence of overweight and obesity in children and adults during 1980–2013: a systematic analysis for the Global Burden of Disease Study 2013. *Lancet.* 2014;384:766–781.
- Aldaql SM, Samargandi OA, El-Deek BS, et al. Prevalence and desire for body contouring surgery in postbariatric patients in Saudi Arabia. *N Am J Med Sci.* 2012;4:94–98.
- Biörserud C, Olbers T, Fagevik Olsén M. Patients' experience of surplus skin after laparoscopic gastric bypass. *Obes Surg.* 2011;21:273–277.
- Kitzinger HB, Abayev S, Pittermann A, et al. After massive weight loss: patients' expectations of body contouring surgery. *Obes Surg.* 2012;22:544–548.
- Staalesen T, Olbers T, Dahlgren J, et al. Development of excess skin and request for body-contouring surgery in postbariatric adolescents. *Plast Reconstr Surg.* 2014;134:627–636.
- Wagenblast AL, Laessoe L, Printzlau A. Self-reported problems and wishes for plastic surgery after bariatric surgery. *J Plast Surg Hand Surg.* 2014;48:115–121.
- 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.
- Aldaql SM, Makhdoum AM, Turki AM, et al. Post-bariatric surgery satisfaction and body-contouring consideration after massive weight loss. *N Am J Med Sci.* 2013;5:301–305.
- Baillot A, Asselin M, Comeau E, et al. Impact of excess skin from massive weight loss on the practice of physical activity in women. *Obes Surg.* 2013;23:1826–1834.
- Baillot A, Brais-Dussault E, Bastin A, et al. What is known about the correlates and impact of excess skin after bariatric surgery: a scoping review. *Obes Surg.* 2017;27:2488–2498.
- Biörserud C, Olbers T, Søvik TT, et al. Experience of excess skin after gastric bypass or duodenal switch in patients with super obesity. *Surg Obes Relat Dis.* 2014;10:891–896.
- Gilmartin J. Body image concerns amongst massive weight loss patients. *J Clin Nurs.* 2013;22:1299–1309.
- Giordano S, Victorzon M, Koskivuo I, et al. Physical discomfort due to redundant skin in post-bariatric surgery patients. *J Plast Reconstr Aesthet Surg.* 2013;66:950–955.
- Groven KS, Råheim M, Engelsrud G. Dis-appearance and dys-appearance anew: living with excess skin and intestinal changes following weight loss surgery. *Med Health Care Philos.* 2013;16:507–523.
- Lier HØ, Aastrom S, Rørtveit K. Patients' daily life experiences five years after gastric bypass surgery—a qualitative study. *J Clin Nurs.* 2016;25:322–331.
- Poulsen L, Klassen A, Jhanwar S, et al. Patient expectations of bariatric and body contouring surgery. *Plast Reconstr Surg Glob Open.* 2016;4:e694.
- Elander A, Biörserud C, Staalesen T, et al. Aspects of excess skin in obesity, after weight loss, after body contouring surgery and in a reference population. *Surg Obes Relat Dis.* 2019;15:305–311.
- Modarressi A, Balagué N, Huber O, et al. Plastic surgery after gastric bypass improves long-term quality of life. *Obes Surg.* 2013;23:24–30.
- 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).* 2006;14:1626–1636.
- de Zwaan M, Georgiadou E, Stroh CE, et al. Body image and quality of life in patients with and without body contouring surgery following bariatric surgery: a comparison of pre- and post-surgery groups. *Front Psychol.* 2014;5:1310.
- Gilmartin J, Bath-Hextall F, Maclean J, et al. Quality of life among adults following bariatric and body contouring surgery: a systematic review. *JBI Database System Rev Implement Rep.* 2016;14:240–270.
- Poulsen L, Klassen A, Rose M, et al. Patient-reported outcomes in weight loss and body contouring surgery: a cross-sectional analysis using the BODY-Q. *Plast Reconstr Surg.* 2017;140:491–500.
- Toma T, Harling L, Athanasiou T, et al. Does body contouring after bariatric weight loss enhance quality of life? A systematic review of QOL studies. *Obes Surg.* 2018;28:3333–3341.
- 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;20:36–41.
- Balagué N, Combesure C, Huber O, et al. Plastic surgery improves long-term weight control after bariatric surgery. *Plast Reconstr Surg.* 2013;132:826–833.
- Froylich D, Corcelles R, Daigle CR, et al. Weight loss is higher among patients who undergo body contouring procedures after bariatric surgery. *Surg Obes Relat Dis.* 2016;12:1731–1736.
- Smith OJ, Hachach-Haram N, Greenfield M, et al. Body contouring surgery and the maintenance of weight-loss following roux-En-Y Gastric Bypass: a retrospective study. *Aesthet Surg J.* 2018;38:176–182.
- Wiser I, Avinoah E, Ziv O, et al. Body contouring surgery decreases long-term weight regain following laparoscopic adjustable gastric banding: a matched retrospective cohort study. *J Plast Reconstr Aesthet Surg.* 2016;69:1490–1496.
- Wiser I, Heller L, Spector C, et al. Body contouring procedures in three or more anatomical areas are associated with long-term body mass index decrease in massive weight loss patients: a retrospective cohort study. *J Plast Reconstr Aesthet Surg.* 2017;70:1181–1185.
- 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;34:96–105.
- Kitzinger HB, Abayev S, Pittermann A, et al. The prevalence of body contouring surgery after gastric bypass surgery. *Obes Surg.* 2012;22:8–12.
- Monpellier VM, Antoniou EE, Mulkens S, et al. Body contouring surgery after massive weight loss: excess skin, body satisfaction,

- and qualification for reimbursement in a dutch post-bariatric surgery population. *Plast Reconstr Surg*. 2019;143:1353–1360.
35. Mitchell JE, Crosby RD, Ertelt TW, et al. The desire for body contouring surgery after bariatric surgery. *Obes Surg*. 2008;18:1308–1312.
 36. Sioka E, Tzouvaras G, Katsogridaki G, et al. Desire for body contouring surgery after laparoscopic sleeve gastrectomy. *Aesthetic Plast Surg*. 2015;39:978–984.
 37. Altieri MS, Yang J, Park J, et al. Utilization of body contouring procedures following weight loss surgery: a study of 37,806 patients. *Obes Surg*. 2017;27:2981–2987.
 38. The American Society for Aesthetic Plastic Surgery's Cosmetic Surgery National Data Bank: Statistics 2018. *Aesthet Surg J*. 2019;39:1–27.
 39. American Society for Aesthetic Plastic Surgery (2018). Cosmetic Surgery National Data Bank Statistics. Available at <https://www.surgery.org/sites/default/files/ASAPS-Stats2018.pdf>. Accessed May 16, 2019.
 40. Song AY, Jean RD, Hurwitz DJ, et al. A classification of contour deformities after bariatric weight loss: the Pittsburgh Rating Scale. *Plast Reconstr Surg*. 2005;116:1535–1544; discussion 1545.
 41. van der Beek ES, Verveld CJ, van Ramshorst B, et al. Classification of contour deformities after massive weight loss: the applicability of the Pittsburgh Rating Scale in The Netherlands. *J Plast Reconstr Aesthet Surg*. 2013;66:1039–1044.
 42. Eyck BM, van Dongen JA, Athanassopoulos T, et al. The rainbow scale for assessing breast ptosis: validation of three different views. *Aesthet Surg J*. 2016;36:1010–1016.
 43. van Dongen JA, Eyck BM, van der Lei B, et al. The rainbow scale: a simple, validated online method to score the outcome of aesthetic treatments. *Aesthet Surg J*. 2016;36:NP128–NP130.
 44. Dietl M, Kompatscher P. Basic photographic standards for abdominal contouring procedures and abdominoplasty/lipectomy. *Aesthetic Plast Surg*. 2018;42:1065–1070.
 45. Gherardini G, Matarasso A, Serure AS, et al. Standardization in photography for body contour surgery and suction-assisted lipectomy. *Plast Reconstr Surg*. 1997;100:227–237.
 46. Wong MS, Vinyard WJ. Photographic standards for the massive weight loss patient. *Ann Plast Surg*. 2014;73(Suppl 1):S82–S87.
 47. Koo TK, Li MY. A guideline of selecting and reporting intraclass correlation coefficients for reliability research. *J Chiropr Med*. 2016;15:155–163.
 48. Azin A, Zhou C, Jackson T, et al. Body contouring surgery after bariatric surgery: a study of cost as a barrier and impact on psychological well-being. *Plast Reconstr Surg*. 2014;133:776e–782e.
 49. Mukherjee S, Kamat S, Adegbola S, et al. Funding for postbariatric body-contouring (bari-*plastic*) surgery in England: a postcode lottery. *Plast Surg Int*. 2014;2014:153194
 50. Gusenoff JA, Messing S, O'Malley W, et al. Patterns of plastic surgical use after gastric bypass: who can afford it and who will return for more. *Plast Reconstr Surg*. 2008;122:951–958.
 51. Ngaage LM, Rose J, Pace L, et al. A review of national insurance coverage of post-bariatric upper body lift. *Aesthetic Plast Surg*. 2019;43:1250–1256.
 52. Gurunluoglu R. Panniculectomy and redundant skin surgery in massive weight loss patients: current guidelines and recommendations for medical necessity determination. *Ann Plast Surg*. 2008;61:654–657.
 53. Dunne JA, Wormald JC, Ghedia R, et al. Implementation of national body contouring surgery guidelines following massive weight loss: a national cross-sectional survey of commissioning in England. *J Plast Reconstr Aesthet Surg*. 2017;70:54–59.
 54. Aherrera AS, Pandya SN. A cohort analysis of postbariatric panniculectomy—current trends in surgeon reimbursement. *Ann Plast Surg*. 2016;76:99–101.
 55. Marek RJ, Steffen KJ, Flum DR, et al. Psychosocial functioning and quality of life in patients with loose redundant skin 4 to 5 years after bariatric surgery. *Surg Obes Relat Dis*. 2018;14:1740–1747.
 56. Reiffel AJ, Jimenez N, Burrell WA, et al. Body contouring after bariatric surgery: how much is really being done? *Ann Plast Surg*. 2013;70:350–353.
 57. Sati S, Pandya S. Should a panniculectomy/abdominoplasty after massive weight loss be covered by insurance? *Ann Plast Surg*. 2008;60:502–504.
 58. Børsnerud C, Olbers T, Staalesen T, et al. Understanding excess skin in postbariatric patients: objective measurements and subjective experiences. *Surg Obes Relat Dis*. 2016;12:1410–1417.
 59. Soldin M, Mughal M, Al-Hadithy N; Department of Health; British association of Plastic, Reconstructive and Aesthetic Surgeons; Royal College of Surgeons England. National commissioning guidelines: body contouring surgery after massive weight loss. *J Plast Reconstr Aesthet Surg*. 2014;67:1076–1081.
 60. Iglesias M, Butron P, Abarca L, et al. An anthropometric classification of body contour deformities after massive weight loss. *Ann Plast Surg*. 2010;65:129–134.
 61. Dreifuss SE, Rubin JP. Insurance coverage for massive weight loss panniculectomy: a national survey and implications for policy. *Surg Obes Relat Dis*. 2016;12:412–416.
 62. Hurwitz DJ, Golla D. Breast reshaping after massive weight loss. *Semin Plast Surg*. 2004;18:179–187.
 63. Steffen KJ, Sarwer DB, Thompson JK, et al. Predictors of satisfaction with excess skin and desire for body contouring after bariatric surgery. *Surg Obes Relat Dis*. 2012;8:92–97.
 64. Montpellier VM, de Vries CEE, Janssen IMC, et al. The BAPRAS screening tool for reimbursement in a postbariatric population. *J Plast Reconstr Aesthet Surg*. 2020 [E-pub ahead of print].