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The Objective Buttocks Assessment Scale: A New and Complete Method to Assess the Gluteal Region

Giovanni Roccaro, M.D.
Barbara Hersant, M.D., Ph.D.
Rosita Pensato, M.D.
Chiara Pizza, M.D.
Umberto Rega, M.D.
Francesco D'Andrea, M.D.
Jean Paul Meningaud, M.D., Ph.D.
Simone La Padula, M.D., Ph.D.

Créteil, France; and Naples, Italy

Background: New treatment methods to improve and enhance the appearance of the buttocks require globally accepted scales for aesthetic research and patient evaluation. The purpose of this study was to develop a set of grading scales for objective assessment of the gluteal region and assess their reliability and validity.
Methods: Twelve photonumeric grading scales were created. Eleven aesthetic experts rated photographs of 650 women in two validation sessions. Responses were analyzed to assess interrater and intrarater reliability. The Rasch model was used as part of the validation process.
Results: All the scales exceeded criteria for acceptability, reliability, and validity. Overall interrater reliability and intrarater reliability were both "almost perfect" ($p = 0.15$ and $p = 0.16$, respectively).
Conclusion: Consistent outcomes between raters and by individual raters at two time points confirm the reliability of the Objective Buttocks Assessment Scale in female patients and suggest it will be a valuable tool for use in research and clinical practice. (*Plast. Reconstr. Surg.* 150: 1260, 2022.)

Buttocks have always been synonymous with femininity, especially nowadays. Thanks to the internet, magazines, and the media, the care of our body has become one of the most important aspects of our lives.[1] In fact, there has been a sudden increase in the number of patients requesting surgical and nonsurgical procedures to improve and enhance the appearance of their buttocks.[2,3] As a result, attempts have been made to create evaluation scores for the gluteal region.[4] However, a scale that objectively evaluates the totality of the buttocks and that can be simple to use and available immediately does not yet exist. We present a new scale that is more complete and easier to use, to objectively assess the appearance of the buttocks. This is the first study in which the authors have developed and validated a global and objective scale to assess the gluteal region: the Objective Buttocks Assessment Scale.

PATIENTS AND METHODS

We designed a prospective study assessing different characteristics of the gluteal region. The study design was approved by the ethics committee of our institution (reference no. 2020-A01482-90). Between January of 2017 and December of 2019, 671 patients were enrolled, informed about the study, and assessed. Patients to be included were chosen by four blinded examiners with different backgrounds (two external board-certified dermatologists and two external board-certified plastic surgeons, so that all the degrees in the scale could be included and assessed). A total of 650 women between 18 and 53 years of age with a body mass index ranging from 19.7 to 29.9 were included in the study. Exclusion criteria were previous buttock surgery or other aesthetic procedure in this area, body mass index above 30, and pregnancy. All patients were made aware of the objectives of the study and signed an informed consent form.

From the Department of Plastic, Reconstructive and Maxillofacial Surgery, Henri Mondor Hospital, University Paris XII; and Department of Plastic and Reconstructive Surgery, Università degli studi di Napoli Federico II.
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All procedures in the study involving human participants were performed in accordance with the ethical standards of institutional and/or national research committees and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Twelve numeric subscales were developed for the Objective Buttocks Assessment Scale. Each subscale score was set to range from zero (best gluteal appearance) to three (poorest gluteal appearance). The sum of the subscale scores would allow a final score ranging from zero (best score/best and ideal gluteal shape and cutaneous features) to 36 (worst score/gluteal shape and cutaneous features).

Bidimensional photographs were taken of each patient with a high-resolution photography system by two independent plastic surgeons under the same light conditions and with the patient in the same three positions: facing the surgeon, posterior view, and lateral view. A digital database containing the 650 patients' photographs was created. All patients were informed about the study purpose and gave their consent for data analysis and publication.

Eleven raters (four plastic surgeons, three dermatologists, two nurses, one psychologist, and one hospital secretary) who took part in the scale validation process—and were unaware of the patient selection criteria—were asked to rate the photographs. The scores were printed out and a blank field was left to enter the ratings for the 12 aesthetic subscales. Photographs were shown at the same time and in the same office to the raters using 15 identical computers with the same image settings. The raters were asked to assign scores ranging from zero to three and to fill in the blank fields next to the subscales with the ratings of the studied aesthetic characteristics. Each rater made the assessments independently in every evaluation cycle, assigning a total score derived from the sum of the specific subscales. The experts were instructed to assess patients independently and to return the printed scales with their ratings. The entire assessment process lasted 3 days and was repeated 1 month later to test intrarater consistency of the results.

Some cropped images were chosen from the 650 patients to be paired with the scores at the end of the validation process, based on the studied characteristics, image quality, and clarity. Some pictures from the photograph database were selected to represent the different gluteal appearance and were then associated with each numeric score of the 12 subscales. [**See Figure, Supplemental Digital Content 1**, which shows a representative example of photometrical rating scales for skin laxity: absence of skin laxity (*above, left*), mild skin laxity (*above, right*), moderate skin laxity (*below, left*), and severe skin laxity (*below, right*), ***http://links.lww.com/PRS/F467***.] The photographs were considered eligible to be associated with the scales if at least seven raters had assigned the same rating for a specific subscale in each given patient.

The evaluation criteria for construction of the 12 subscales (Table 1) are listed below and explained in detail.

The 12 Subscales

1. Cutaneous Laxity Grade

This criterion considers the degree of skin laxity. Analysis of the 650 patients examined in our clinic allowed us to identify four degrees of increasing severity of laxity or relaxation of the skin and helped us design a score between 0 and 3:

1. 3: Severe laxity or relaxation of skin
2. 2: Moderate laxity or relaxation of the skin
3. 1: Laxity or mild skin relaxation
4. 0: Absence of laxity or skin relaxation

2. Number of Stretch Marks per Buttock

Striae distensae are common. They evolve through two clinical phases: an early inflammatory phase (striae rubrae) and a chronic phase (striae albae).[5,6] The two types of striae distensae are included without distinction in our evaluation criteria.

1. 3: More than 20 per buttock
2. 2: Between 20 and 10 per buttock
3. 1: Fewer than 10 per buttock
4. 0: Absence of striae distensae

3. Cellulite

Cellulite affects millions of women but fewer men. It is considered lipodystrophy or, rather, a degeneration of the fatty tissue. The changes that occur during cellulite formation are attributable to fibrosis and sclerosis, which appear clinically as indentations of the skin surface and palpable subcutaneous nodules. When the process is advanced, nodules and sclerotic lesions are accompanied by pain, dryness, and thinning of the skin that covers the affected area. Cellulite formation accelerates during adolescence, during pregnancy, and around the age of menopause. It is estimated that up to 85 percent of women older than 20 years have cellulite.[7]

Table 1. Scoring Measures on the Objective Buttocks Assessment Scale

Characteristic	Score			
Degree of skin laxity	Absence of laxity or skin relaxation 0	Laxity or mild skin relaxation 1	Laxity or moderate skin relaxation 2	Laxity or severe skin relaxation 3
Number of stretch marks per buttock	Absence of striae albae	<10 striae albae	10–20 striae albae	>20 striae albae
Cellulite (classification scale by Nürnberger and Müller)	No cellulite 0	First-degree cellulite 1	Second-degree cellulite 2	Third-degree cellulite 3
Number of skin indentations	No skin indentations 0	1 to 4 skin indentations 1	5 to 9 skin indentations 2	>10 skin indentations 3
Vertical projection (waist-to-hip ratio)	0.65 ± 0.025 (very good projection) 0	0.65 ± 0.05 (good projection) 1	0.65 ± 0.10 (poor projection) 2	0.65 ± 0.15 (very poor projection) 3
Vertical ratio for lateral prominence	Inferior gluteal convexity (very good projection) 0	70:30 (good projection) 1	60:40 (poor projection) 2	Other (very poor projection) 3
Horizontal projection (waist-to-hip ratio)	0.70 ± 0.025 (very good projection) 0	0.70 ± 0.05 (good projection) 1	0.70 ± 0.10 (poor projection) 2	0.70 ± 0.15 (very poor projection) 3
Vertical ratio for posterior prominence	50:50 (very good projection) 0	40:60 (good projection) 1	30:70 (poor projection) 2	Other (very poor projection) 3
Upper third	Well-represented 0	Represented 1	Poorly represented 2	Absent 3
Medium third: maximum projection	Well-represented 0	Represented 1	Poorly represented 2	Absent 3
Lower third (inferior gluteal fold)	Well-represented 0	Represented 1	Poorly represented 2	Absent 3
Lateral gluteal fat deposit (saddlebags)	Absent 0	Slightly represented 1	Represented 2	Abundantly represented 3

For this subscale, four degrees of clinical presentation of this condition were identified according to the classification of Nürnberger and Müller[8] and associated with a progressive score from 0 to 3.

1. 3: Third-degree cellulite (presence of stage 2 alterations in greater number and over a larger area, accompanied by nodules and indentations of the skin)
2. 2: Second-degree cellulite (cellulite indentations present and visible without stressing the skin)
3. 1: First-degree cellulite (the affected skin is smooth, but signs of cellulite appear by pinching the skin or contracting the buttocks)
4. 0: No signs of cellulite

4. Number of Skin Indentations

We took into account the number of skin indentations found in 650 patients being treated in our service. The analysis of our data allowed us to classify this condition into four degrees of severity with a score from 0 to 3, as follows:

1. 3: More than 10 skin indentations
2. 2: Five to nine skin indentations
3. 1: One to four skin indentations
4. 0: Zero skin indentations

Projection

For this criterion, we took into account the classification of Wong et al.,[1] in which four criteria for the evaluation of buttocks projection are considered (Fig. 1).

Posterior View

The posterior view is divided into waist-to-hip ratio (Fig. 1, *above, left*) and vertical ratio for lateral prominence (Fig. 1, *above, right*).

Lateral View

The lateral view is divided into waist-to-hip ratio (Fig. 1, *below, left*) and vertical ratio for posterior prominence (Fig. 1, *below, right*).

5. Vertical Projection (Waist-to-Hip Ratio)

Vertical projection (waist-to-hip ratio; Fig. 1, *above, left*) examines the waist-to-hip ratio (in

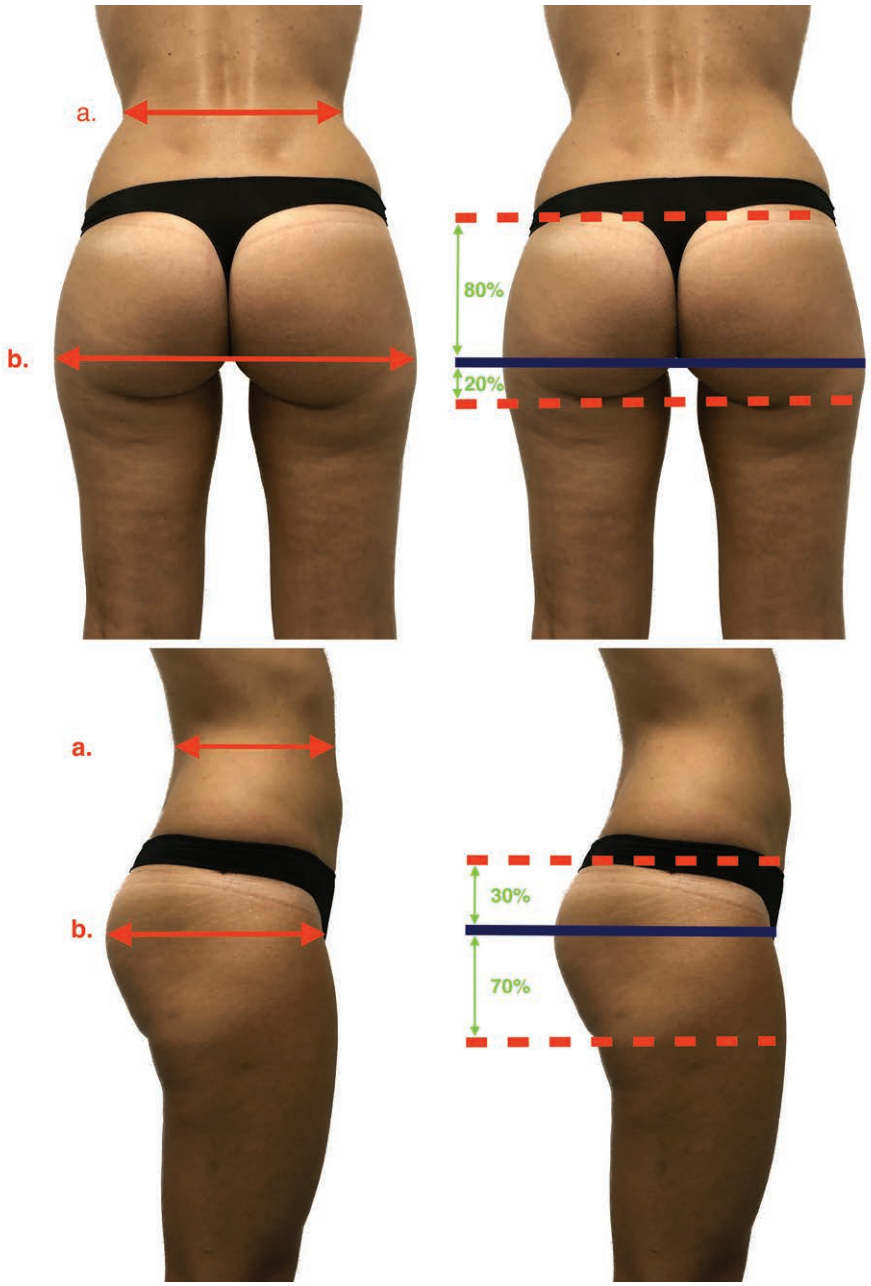

Fig. 1. Evaluation of buttocks projection: waist-to-hip ratio (*above, left*); vertical ratio for lateral prominence (*above, right*); waist-to-hip ratio (*below, left*); vertical ratio for posterior prominence (*below, right*).

centimeters) in vertical projections. On the basis of the results of the study, we have standardized four categories with an increasing score ranging from 0 to 3, where 0 represents the ideal projection.

1. 3: 0.65 ± 0.15, very poor projection
2. 2: 0.65 ± 0.10, poor projection
3. 1: 0.65 ± 0.05, good projection
4. 0: 0.65 ± 0.025, very good projection

6. Vertical Ratio for Lateral Prominence

Vertical ratio for lateral prominence (Fig. 1, *above, right*) studies at what level the maximum lateral projection of the buttocks is localized.

1. 3: Very poor projection
2. 2: 60:40, poor projection
3. 1: 70:30, good projection
4. 0: Inferior gluteal convexity, very good projection

7. Horizontal Projection (Waist-to-Hip Ratio)

Horizontal projection (waist-to-hip ratio; Fig. 1, *below, left*) examines the waist-to-hip ratio in the horizontal projections.

1. 3: 0.70 ± 0.15, very poor projection
2. 2: 0.70 ± 0.10, poor projection
3. 1: 0.70 ± 0.05, good projection
4. 0: 0.70 ± 0.025, very good projection

8. Horizontal Projection (Vertical Ratio for Posterior Prominence)

Horizontal projection (vertical ratio for posterior prominence; Fig. 1, *below, right*) examines at what level the maximum back projection of the buttocks is localized.

1. 3: Very poor projection
2. 2: 30:70, poor projection
3. 1: 40:60, good projection
4. 0: 50:50, very good projection

The Four Areas of the Buttocks

We have divided the buttocks into four areas, which represent the fundamental aesthetic units that are paramount in the aesthetic evaluation of the buttocks (Fig. 2).

9. Upper Third (over the Superior Gluteal Line)

The upper third measure represents the transition line from the back to the buttocks and reflects the upper margin of the buttocks. It corresponds to the projection of iliac crests and represents a fundamental area for the aesthetics of the buttocks. Different cosmetic surgical treatments tend to enhance this specific area. This area was assessed as follows:

1. 3: Absent
2. 2: Poorly represented
3. 1: Represented
4. 0: Well represented

10. Medium Third

The medium third measure represents the area of maximum projection. It gives the round and harmonious shape to the buttocks and represents a fundamental sector in the aesthetics of the buttocks. This is the area on which cosmetic procedures focus to enhance the overall projection of the buttocks. This area was assessed as follows:

1. 3: Absent
2. 2: Poorly represented
3. 1: Represented
4. 0: Well represented

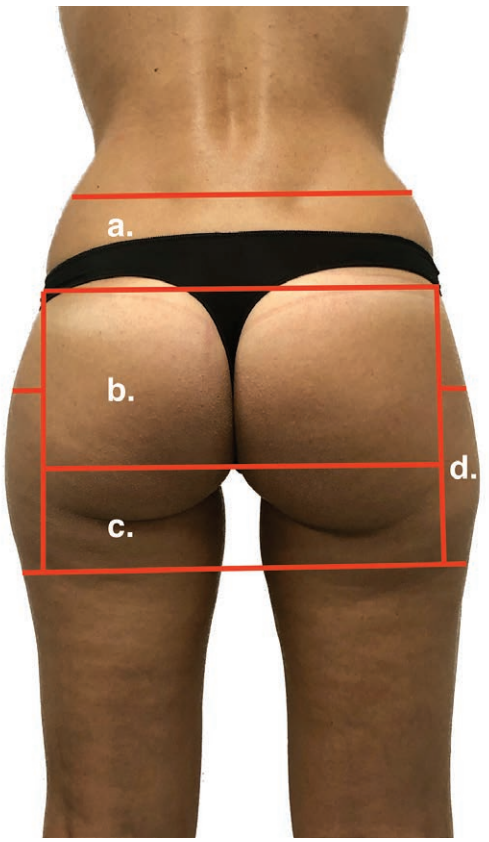

Fig. 2. Buttocks have been divided into four areas, which represent the fundamental aesthetic units that are paramount in the aesthetic evaluation of the gluteal area: (*a*) upper third (over the superior gluteal line); (*b*) medium third; (*c*) lower third (around the horizontal gluteal crease); (*d*) lateral gluteal fat deposit (saddlebags).

11. Lower Third (Gluteal Crease)

The gluteal crease is a skin fold that defines the lower area of the buttocks. It does not represent the lower limit of the gluteus maximus muscle, which runs obliquely. This is an important area in terms of the aesthetics of the buttocks. This area was assessed with a score ranging from 3 to 0.

1. 3: Absent
2. 2: Poorly represented
3. 1: Represented
4. 0: Well represented

12. Lateral Gluteal Fat Deposit (Saddlebags)

The lateral gluteal fat deposit (saddlebags) area was assessed as follows:

1. 0: Absent

2. 1: Slightly represented
3. 2: Represented
4. 3: Well represented

The scores were created in strict accordance with current guidelines to develop a scientifically reliable and clinically helpful tool.[9–13] Using an inductive methodologic approach, all scores were combined to obtain the sum of the 12 different cosmetic characteristics to calculate a total buttocks score. This score was used to investigate scale reliability. The Rasch model was used as part of the validation process. The interrater consistency and the test–retest reliability were also assessed.

The Rasch Measurement Theory

The Rasch measurement theory (RUMM2030 software) was used to assess the Objective Buttocks Assessment Scale.[14–17] This model examines the differences between the observed and the predicted answers to each item to determine the extent to which the data for a set of items matches a mathematical model. When the data match the Rasch model, the measurement theory (i.e., a score measures a specific construct) is supported by the data. The Rasch measurement theory examines the discrepancies (or the matching) between the observed scores (the raters' responses to each item) and the expected values predicted by the Rasch model. These are calculated using a range of statistical tests to assess the scores of each item.[16–18] This model allowed us to assess the overall score quality, as reported below.

Item Response Category

Each item of the Objective Buttocks Assessment Scale could be rated according to four categories (very good, good, poor, very poor), which reflected a progressive continuum for the construct of interest. A threshold is the limit at which the likelihood of responding in adjacent pairs of response options is 50 percent.[16,17] When the categories operate as expected, the thresholds are ordered. Disordered thresholds imply that the response categories for that item are not operating as expected. They occur when raters show difficulties in consistently distinguishing between the different response options.[19] When the response options operate as expected, the score reliability is confirmed.[20]

Item Matching Statistics

The items of a score must match between each other as a set, clinically and statistically. When the items do not match (mismatch), it would be inappropriate to sum the individual item responses to obtain a total score. Matching statistics are usually interpreted in the context of their clinical applications as a set item, but, in general, the residual match should always range between –2.5 and +2.5, and chi-square values should not be significant.[17]

Item Locations

The score items define a progressive continuum, and analyzing where the items are located on this continuum shows how well the items map out a construct. Items should be evenly distributed within a reasonable range.

Internal Consistency Reliability

The internal consistency assesses the extent to which the scale items are consistent to each other and reflect an underlying construct. The internal consistency of the Objective Buttocks Assessment Scale and its dimensions was estimated using the Cronbach α coefficient, ranging from 0 (no internal consistency) to 1 (high degree of internal consistency). This is a measurement of the scale's reliability.

Person Separation Index

These reliability statistics are comparable to the Cronbach α coefficient and quantify the error associated with subjective measurements in a sample. Higher values show greater reliability.

Reliability and Validity of the Objective Buttocks Assessment Scale

Interrater reliability was analyzed to assess the reliability of the aesthetic scales.[21]

The scores following a normal distribution obtained by each rater were compared using a paired t test. Reproducibility or test–retest reliability was used to observe whether the intrarater variability could be excluded.[22] All patients were reassessed 1 month later by the same raters to test the score accuracy and possible changes over time. The total scores obtained 1 month later following a normal distribution were compared with the initial scores using a paired t test. The same data were analyzed using the Pearson test. A value of $p < 0.05$ was considered significant. Continuous variable normal distribution was analyzed using the Kolmogorov-Smirnov test. All analyses were performed using PRISM, version 5 (GraphPad, San Diego, Calif.). All the authors had full access to the data and took full responsibility for the integrity of the data.

RESULTS

Descriptive Statistics

The mean patient age was 37.7 ± 16.1 years (range, 18 to 53.8 years). Mean body mass index was 24.8 ± 5.1 kg/m² (range, 19.7 to 29.9 kg/m²). The mean score obtained at the time of the first rating was 18.2 ± 8.3. At the time of the second rating (1 month later), the mean score was 19 ± 2.1.

Rasch Measurement Theory

The matching statistics for the Rasch model are summarized in Table 2 (the observed data matched closely with those expected by the model). The targeting was good and all items in each of the 12 scales had ordered thresholds, which shows that the raters were able to distinguish among the four item options (very good, good, poor, very poor). A nonsignificant chi-square value confirmed that the 12 scales matched the Rasch model. All the scale items had a residual matching within the recommended range of –2.5 to +2.5. The Person Separation Index values for each scale were greater than or equal to 0.8, indicating good reliability. These findings supported the reliability and validity of each of the 12 scales for their respective constructs.

Internal Consistency Reliability: Cronbach α Coefficients

All scales exceeded criteria for acceptability, reliability, and validity. In particular, Cronbach α coefficients (≥0.90) and intraclass correlation coefficients (≥0.78) supported scale reliability and validity (Table 3). These findings indicated that the items of each scale formed a statistically conformable group and that these scores were reliable and valid.

Reliability of the Objective Buttocks Assessment Scale

The Pearson test demonstrated strong correlation between the scores at the first and second evaluation cycles. The second round of assessments confirmed these strong correlations with nearly identical correlation coefficients (with a mean Pearson correlation coefficient value of 0.98). In terms of interrater reliability, no significant difference was observed between the scores obtained by the raters (t test = 1.44; p = 0.15). To examine test–retest reliability (intrarater reliability), all patients were reassessed 1 month later by the same raters. No intrarater variability was observed (t test = 1.44; p = 0.16). These analysis results satisfied the necessary conditions for an objective evaluation tool.

Table 2. Overall Fit to the Rasch Model and Person Separation Index for Each Scale

Scale	Degrees of Freedom	p	χ^2	Person Separation Index
Degree of skin laxity	15	0.16	24.3	0.88
Number of stretch marks per buttock	20	0.56	33.8	0.90
Cellulite (classification scale by Nürnberger and Müller)	20	0.41	15.3	0.89
Number of skin inflections	20	0.15	21.7	0.90
Vertical projection (waist-to-hip ratio)	20	0.12	32.4	0.90
Vertical ratio for lateral prominence	16	0.74	41.7	0.90
Horizontal projection (waist-to-hip ratio)	16	0.23	13.3	0.90
Vertical ratio for posterior prominence	20	0.34	34.9	0.90
Upper third	16	0.15	49.5	0.90
Medium third: maximum projection	20	0.25	55.8	0.90
Lower third (inferior gluteal fold)	20	0.16	14.8	0.90
Lateral gluteal fat deposit (saddlebags)	20	0.60	33.3	0.90

Table 3. Cronbach α and Intraclass Correlation Coefficients

Scale	Cronbach α	Mean Intraclass Correlation Coefficient
Degree of skin laxity	0.90	0.78
Number of stretch marks per buttock	0.96	0.78
Cellulite (classification scale by Nürnberger and Müller)	0.97	0.83
Number of skin inflections	0.92	0.79
Vertical projection (waist-to-hip ratio)	0.94	0.80
Vertical ratio for lateral prominence	0.98	0.88
Horizontal projection (waist-to-hip ratio)	0.94	0.84
Vertical ratio for posterior prominence	0.95	0.84
Upper third	0.93	0.78
Medium third: maximum projection	0.97	0.88
Lower third (inferior gluteal fold)	0.93	0.84
Lateral gluteal fat deposit (saddlebags)	0.95	0.84

DISCUSSION

Sedentary lifestyle, poor nutrition, and advanced age cause changes in the body, affecting the appearance of the buttocks. Multiple medical and surgical procedures can improve the shape, volume, and projection of this area. Several scales for assessing the appearance of buttocks have recently been described in the literature. Klassen et al.[4] developed the BODY-Q assessment scale, which examines the whole body, including the buttocks, in patients undergoing postbariatric surgery. It assesses patients' quality of life and psychosocial improvement. The BODY-Q is useful but difficult to use and subjective. In 2016, Wong et al.[1] presented their effort to establish an objective assessment of the ideal buttocks appearance, analyzing a large number of participants, both men and women, between the ages of 18 and 65 years and of different ethnicities. Similar to Wong et al.,[1] we aimed to assess the posterior projection and lateral projection of the buttocks and insert these criteria in our scale. As the authors point out, their study was limited in that more than 90 percent of the respondents lived in the United States and, by the fact, there were disproportionately high numbers of White respondents. Perception of buttocks aesthetics is influenced by a wide range of factors. Heidekrueger et al.[23] illustrated that intercultural and ethnic differences, in addition to the ethnic and geographic background of surgeons and the general public, play major roles in this regard. Particularly in the field of plastic and reconstructive surgery, globalization suggests more unified surgical goals, and with respect to buttock aesthetics, apparently a waist to hip ratio of 0.7 is rated to be attractive by a wide range of people. However, Heidekrueger et al. urge plastic surgeons to take all compounding factors into consideration when defining surgical goals with their patients, which will ultimately aid in achieving optimal aesthetic outcomes, satisfying both surgeon and patient.[23]

For a more complete and easy buttocks assessment tool, we included four areas in the Objective Buttocks Assessment Scale that we treat systematically when we want to achieve global buttock surgical remodeling (by liposuction and lipofilling and insertion of gluteal prostheses). These areas are represented as "the four areas of the buttocks": a superior gluteal line, a medium third, and well-marked gluteal creases increase the harmony and improve the appearance of the buttocks, whereas excess fat in the lateral region of the buttocks (saddlebags) represents a defect on which surgeons are often asked to intervene surgically. Skin laxity frequently occurs in areas where a large amount of adipose tissue is covered by a relatively thin layer of skin, such as the buttocks, thighs, the region above the knee, and the upper arms. In these areas, the skin is subject to the mechanical action of the weight exerted by adipose tissue and other subcutaneous structures as well as the effects of gravity. The appearance of lax skin on the buttocks can be distressing and is a major cosmetic concern for many people. Treatments to tighten the skin were once restricted to only surgical procedures, but individuals with mild to moderate skin laxity are increasingly seeking noninvasive options that have minimal downtime and no scarring (such as monopolar and bipolar radiofrequency or broadband and laser light sources). Therefore, we added this criterion into the Objective Buttocks Assessment Scale.

A valid and reliable tool to assess the totality of the buttocks objectively has not yet been described in the literature. For this reason, our team has developed a tool based on different scales, which is a simple, complete method that can easily be used in medical practice.[24–27] The only available tools for the surgeon to assess the results of medical or surgical treatment objectively are preoperative and postoperative photographs. However, it would be useful to be able to review photographs with an objective, reproducible photograph evaluation tool. This is the main reason we decided to develop the Objective Buttocks Assessment Scale.

This scale can be used not only in a clinical setting to assess the effectiveness of medical or surgical procedures performed on the buttocks, but also with scientific purposes. Because it is based on statistical analysis, the Objective Buttocks Assessment Scale is an effective, reliable, and reproducible tool. It can be used to give scientific validity to clinical results obtained so that we can present more complete reports and analyses of surgical outcomes. A significant discrepancy between the preoperative and postoperative score is associated with more effective results of the procedures performed.

Our study has some limitations. Our sample only included White participants. Future research could investigate the use of our scales in patients of other races and ethnicities. In addition, a bias could have been introduced during the patient enrollment process. Further studies are needed to confirm our findings and establish the Objective Buttocks Assessment Scale as a useful tool for gluteal aesthetic features assessment.

Simone La Padula, M.D., Ph.D.
50 Rue Saint Sébastien
75011 Paris, France
drsimonelapadula@gmail.com
simonelapadula_prs

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