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# Musculoaponeurotic Area of the Hip and Clinicophotographic Scaling System

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**Background:** With the evolution of body contouring, few innovative alternatives have been developed for cosmetic treatment in the hip area.
**Methods:** A multicenter controlled study was conducted, including a prior review of the literature regarding the hip area. Dissections were performed on 4 male cadavers, outlining the "musculoaponeurotic area of the hip." The area was subdivided into anterior and posterior surfaces. A clinical study was conducted in 79 patients, obtaining a scale by using the most prominent points on the sides of both thighs as the main reference. With the lines marked on photographs and the measurements, a "clinicophotographic scaling system" was designed.
**Results:** The anterior surface corresponds to the tensor fasciae latae and its tendon as well as to the aponeurosis of the gluteus medius. The posterior surface corresponds with the iliotibial tract and the tendon insertions of the gluteus maximus. The average dimensions of the cadaver "musculoaponeurotic area of the hip" are as follows: length, 17.5 cm, and width, 11.5 cm. Using the "clinicophotographic scaling system," the dimensions are as follows: length, 14.9 cm, and width, 10.3 cm.
**Conclusions:** The "musculoaponeurotic area of the hip" was defined involving muscles, tendons, aponeurosis, fascia, subcutaneous cellular tissue, and skin. The borders were established using important anatomical points that determine the length and width of the area. The "clinicophotographic scaling system" was used to clinically calculate the length and width of the area. By examination and palpation, the borders and dimensions of this area could be determined. *(Plast Reconstr Surg Glob Open 2015;3:e423; doi: 10.1097/GOX.0000000000000401; Published online 17 June 2015.)*

Body contouring surgery has evolved over the years. The waist, buttocks, and hip are areas of great interest. From the outset, gluteoplasty has evolved so that adjacent areas have been involved. The last 5 decades have contributed anatomical and surgical expertise to body contouring. Methods using buttocks implants and autologous fat infiltration as well as techniques using combinations of these methods have been described. However, few innovative alternatives have been reported for adjacent areas. During the 1960s, Bartels et al[1]

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performed the first reconstructive gluteoplasty in a patient with idiopathic gluteal atrophy. In the following decade, Cocke and Ricketson[2] placed the first subcutaneous gluteal implant, for aesthetic reasons, in a patient with deficient hip development. The well-known indications and complications of subcutaneous and submuscular gluteal implants, alone[3–8] or in combination with autologous fat infiltration, were described.[9,10] Babuccu et al[11] studied the morphological changes of the buttocks and hip areas in women concluding that this region is very dynamic and its dimensions vary throughout life. Cuenca-Guerra and Quezada[12] analyzed many pictures at different angles and projections to find the harmonic balance of the best gluteal projection. Centeno and Young[13] described 8 aesthetic units as criteria on which to base surgical decisions involving the flanks of the back, sacral region, and buttocks as well as the triangle of light diamond area and thighs. Universal aesthetic ideals vary. Frequently, prominent buttocks and a narrow waist in combination with wide hips are preferred, predominantly in Hispanic, African American, and African Caribbean populations. This preference for buttock size and shape is influenced by culture and the appearance of public figures.[14] This phenomenon is seen through consultations and Internet forums: Female patients with narrow pelvises are known as "boy's hips." Constantino and Mendieta[15] contributed significantly to the surgical approach by describing points A, B, and C and the following buttock shapes: A-shape, V-shape, Square, and Round. This contribution is useful in the selection of hip shapes. Two publications described aesthetic improvement of the hip area using hip implants. Benito-Ruiz et al[16] combine the Vergara and Marcos gluteoplasty technique and smooth oval implants placed at the greater trochanter below the fascia lata and report the possibility of communication between the 2 pockets, with consequent migration of the implants. Another reconstructive option corrects contour deformities of the hip region with a pedicled deep inferior epigastric perforator flap.[17] Cárdenas-Camarena[18] recently described a technique similar to that of Benito-Ruiz et al[16] and achieved more natural results on the hip contour.

The following research is bibliographically supported by 46 hip area references. From these references, we selected 19 studies that most completely and helpfully support this research. However, the retrievable information that is helpful for improving aesthetic contouring of the hip area is very limited.

This research was conducted to describe and delimit an area that in the future might be used more easily and predictably for surgical procedures. We sought an innovative approach that would enable new techniques for aesthetically modifying the hip contour and facilitating reconstructive purposes, including providing for precise placement of implants.

## PATIENTS AND METHODS

An analysis of the scientific literature was performed, in addition to a multicenter, controlled study. In March 2011, 2 anatomy textbooks, 2 plastic surgery textbooks, and 46 indexed articles in plastic surgery journals were consulted. The authors studied the importance of the soft tissues of the pelvis and thigh, including the skin, subcutaneous tissue, fascias, aponeurosis, and muscles. Specific attention was given to structures such as the fascia lata, tensor fasciae latae, and the blood supply,[18,19] as well as to other important structures adjoining this region, including the lateral cutaneous nerve of the thigh and Scarpa's triangle.[20,21]

During July and December 2011, dissections of the hip, thigh, and buttocks were conducted in 4 fresh cadavers. All of the cadavers were male, and the ages varied between 30 and 50 years. We chose male cadavers because most of the patients seeking cosmetic improvement of the hip area are women with anatomical characteristics very similar to those of men. The cadavers were anatomically intact in the pelvic and thigh regions. Measurements, photographs, and videos were obtained. The primary objective was to analyze and evaluate the anatomical constants specific to this region. The important structures adjoining the tensor fasciae latae that could be involved in surgical approaches were identified and analyzed. Based on the observations made during the dissections, the authors described and defined a "musculoaponeurotic area of the hip," which encompasses soft tissues such as skin, subcutaneous cellular tissue, fascia, and musculoaponeurotic structures.

During the cadaver dissections, the "musculoaponeurotic area of the hip" boundaries were established and measured with the following lines:

- Line A (Anterior) is the line that extends from the anterosuperior iliac spine to the external tuberosity of the tibia.
- Line P (Posterior) is the line that begins where the middle one-third joins the posterior one-third of the superior edge of the iliac crest and ends at the external tuberosity of the tibia.
- Line S (Superior) is the horizontal line level in the anterosuperior iliac spine. This line corresponds to the level of point A mentioned by Babuccu et al.[11]

Line I (Inferior) is the line parallel to line S in the most prominent points of the superior and lateral area of the thigh. This line corresponds with the level of point B mentioned by Constantino and Mendieta.[15]

The distance between S and I determines the length of the area. The distance between lines A and P determines the width.

The area enclosed within these 4 lines was divided and measured as the anterior surface (as) and the posterior surface (ps) (Figs. 1, 2).

The center of the "musculoaponeurotic area of the hip" is closely related to the lateral depression of the buttock, point C (described by Constantino and Mendieta[15]), and to the greater trochanter of the femur.

The findings of the dissections, as well as the lines and their anatomical points of reference, were applied clinically and photographically for an anthropometric study, using 4 wooden meticulously constructing "modified vernier calipers" (Fig. 3). These calipers were calibrated in millimeters, with the capacity to measure widths of up to 60 cm. A caliper was provided to each of the 4 photography studios.

A total of 79 patients (77 female and 2 male) were studied, photographed, and measured at the following clinical photography studios: 22 patients at the Instituto Jalisciense de Cirugía Reconstructiva, "Dr. José Guerrerosantos"; 43 patients at the Estudio de Fotografía Clínica Bejart; 9 patients at the Hospital Clínica Ángeles Chapalita; and 5 patients at the Hospital Innova Médica.

The patients attended for abdominoplasty, liposuction, and augmentation gluteoplasty were included for the clinical and photographic evaluation. The patients were interviewed, measured, weighed, and photographed, with clinical photographs taken from the front and side being submitted for the analysis. The ethics committee of the Jalisco Institute of Reconstructive Surgery approved the study, and all the patients received written information regarding the purpose and the methods of the study; all of the patients gave consent to participate in the study.

Holding the "modified vernier caliper" level with line I, we measured the width of the patient's hips. We referred to this distance as the Trochanter-Trochanter or "TT" (expressed in centimeters). With a ruler, we measured this width on a photograph of the same patient and termed this distance "tt" (expressed in centimeters). We used these measurements to create the "clinicophotographic scaling system," which consisted of the following: we divided TT by tt to obtain the "scale," expressed in centimeters (Fig. 4). We then marked on the photographs the lines, A, P, S, and I, in accordance with the identical anatomical references on the cadaver. The distance between S and I was measured on the photograph and multiplied by the scale to obtain the length of the area (LA), expressed in centimeters. The distance between A and P (at the midpoint between S and I) was multiplied by the scale to obtain the width of the area (AN), expressed in centimeters (Fig. 5).

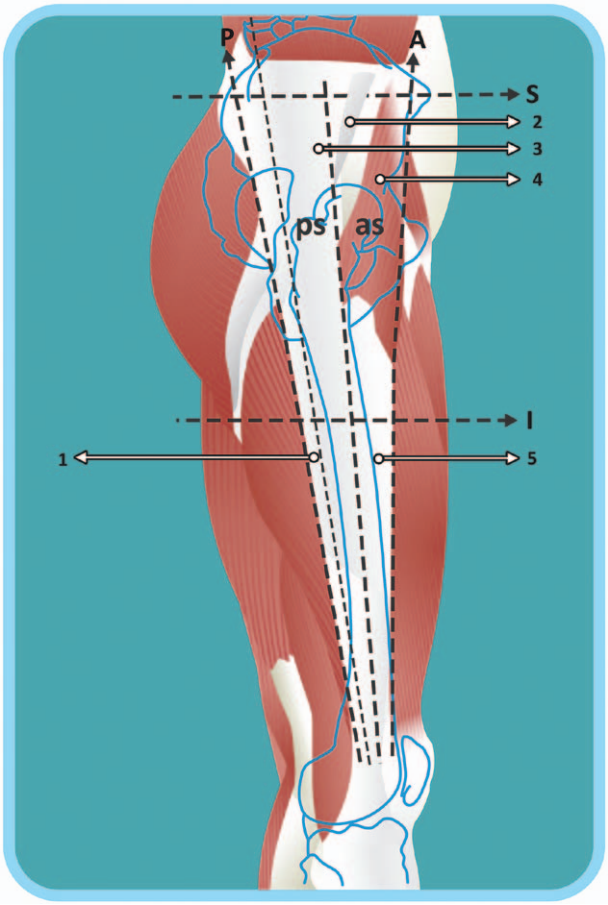


**Fig. 1.** 1, Tendon fibers of the gluteus maximus. 2, Aponeurosis of the gluteus medius. 3, Iliotibial tract. 4, Tensor fasciae latae. 5, Tendon fibers of the tensor fasciae latae. as, The anterior surface of the musculoaponeurotic area of the hip. ps, The posterior surface of the musculoaponeurotic area of the hip. A, The anterior line of the musculoaponeurotic area of the hip. P, The posterior line of the musculoaponeurotic area of the hip. S, The superior line of the musculoaponeurotic area of the hip. I, The inferior line of the musculoaponeurotic area of the hip.

The distance at which the photographs were taken in our studio varied between 1.5 and 2 m. After the scale between TT and tt was calculated, it became the constant that determined the actual dimensions of the "musculoaponeurotic area of the hip," regardless of the distance at which the photographs were taken.

The measurement calculation and data summary sheet were completed, and the following data were

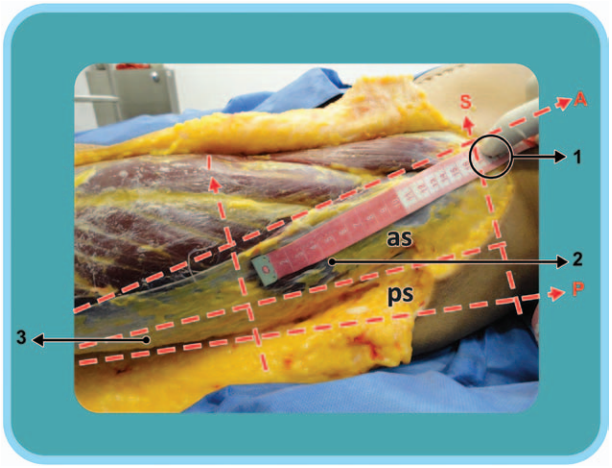


**Fig. 2.** A, The anterior line of the musculoaponeurotic area of the hip. P, The posterior line of the musculoaponeurotic area of the hip. S, The superior line of the musculoaponeurotic area of the hip. I, The inferior line of the musculoaponeurotic area of the hip. as, The anterior surface of the musculoaponeurotic area of the hip. ps, The posterior surface of the musculoaponeurotic area of the hip. 1, Anterosuperior iliac spine. 2, Tensor fasciae latae. 3, Tendon fibers of the gluteus maximus.

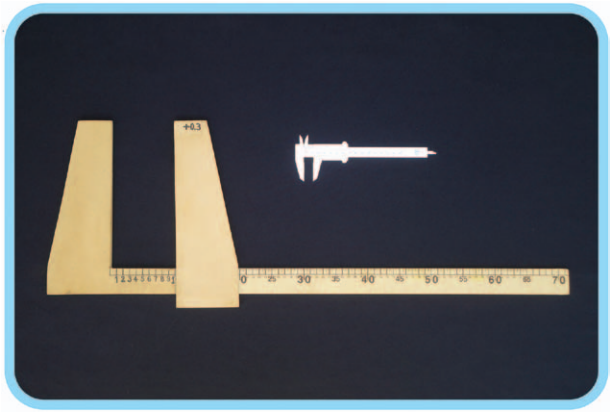

**Fig. 3.** The modified wooden vernier caliper calibrated in millimeters and capable of measuring widths of up to 60 cm.

recorded: the age, gender, weight, height, body mass index, TT, tt, scale, LA, and AN (Fig. 6).

These measurements and calculations were performed to ascertain the relationship between the dimensions obtained using the "clinicophotographic scaling system" and those found during the cadaver dissections.

## RESULTS

### Literature Reviews

Of the 46 plastic surgery indexed journal articles and books on that we reviewed, 19[1–19] articles and 1 anatomy textbook were relevant to the hip area.[20–22] These publications were fundamental to our

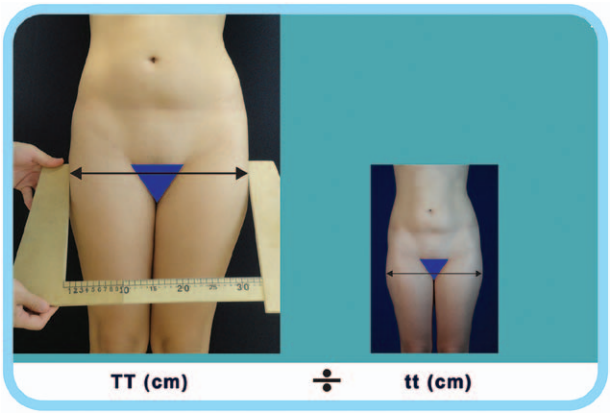


**Fig. 4.** Calculating the scale with the "modified vernier caliper" using the "clinicophotographic scaling system."

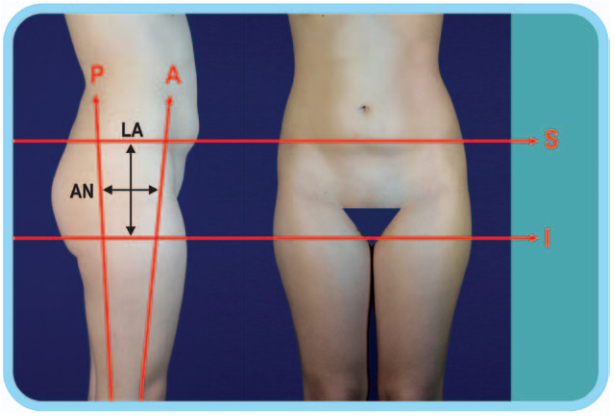


**Fig. 5.** Determining the length (LA) and width (AN) using the "clinicophotographic scaling system."

investigation, and of particular interest were points A and B, mentioned by Babuccu et al[11] and Constantino and Mendieta.[15] Babuccu et al[11] describe point A as the anterosuperior iliac spine and point B as the most prominent point of the greater trochanter. Constantino and Mendieta[15] describe point A as the most prominent point on the superiolateral area of the hip and point B as the most prominent point on the lateral area of the thigh.

### Cadaver Dissections

In the "musculoaponeurotic area of the hip," line A (Anterior) corresponds with the anterior edge of the tensor fasciae latae and its tendon. Line P (Posterior) corresponds with the posterior edge of the insertions of the gluteus maximus and the posterior edge of the iliotibial tract. Line S (Superior) corresponds to the level of the anterior superior iliac spine. Line I (Inferior) corresponds to the level of the most prominent points of the superior and lateral areas of the thigh.

The mean length (LA) of the "musculoaponeurotic area of the hip" in cadavers was 17.5 cm. The mean

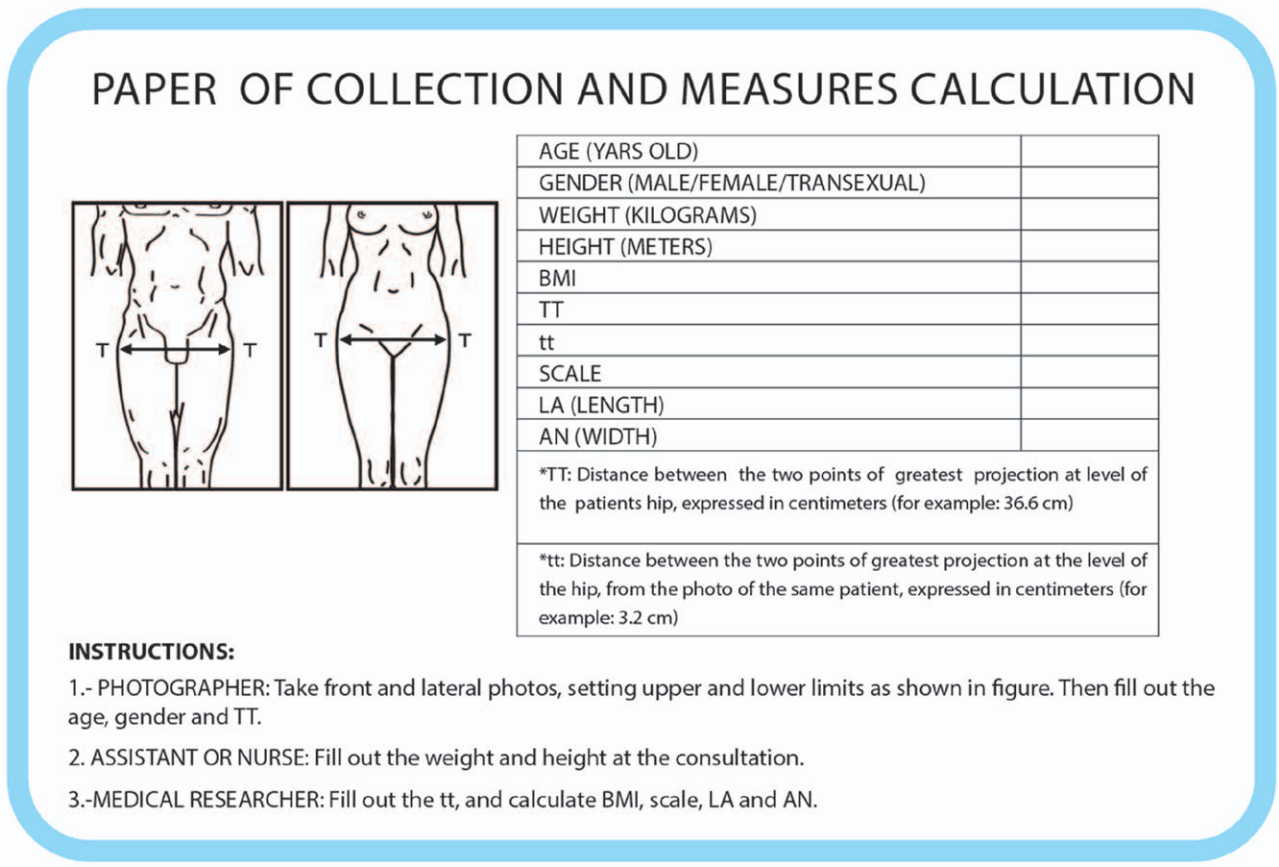


**Fig. 6.** Measurement calculation and data summary sheet.

width (AN) was 11.5 cm. The mean of the anterior surface (as) was 6 cm, and the mean of the posterior surface (ps) was 5.5 cm. These measurements, as well as the minimum and maximum values, are shown in Table 1.

**Anthropometric and Photographic Study**

A total of 79 patients (77 female and 2 male) were studied, photographed, and measured at 4 clinical photography studios as follows: 22 patients (27.8%) at the Instituto Jalisciense de Cirugía Reconstructiva "Dr. José Guerrerosantos"; 43 patients (54.4%) at the Estudio de Fotografía Clínica Bejart; 9 patients (11.4%) at the Hospital Clínica Ángeles Chapalita; and 5 patients (6.3%) at the Hospital Innova Médica. The mean values for the following variables were as follows: age, 34.32 years; weight, 61.41 kg; height, 1.6 m (160 cm); body mass index, 23.98; TT, 35.15 cm; tt, 9.16 cm; scale, 3.97 cm; length (LA), 14.99 cm; and width (AN), 10.3 cm. These measurements, as well as the minimum and maximum values, were derived from our "clinicophotographic scaling system" (Table 2).

**Table 1. Dimensions of the "Musculoaponeurotic Area of the Hip": Results in Cadavers**

| | Minimum (cm) | Maximum (cm) | Mean (cm) |
|---|---|---|---|
| Width (AN) | | | |
| as | 5 | 7 | 6.0 |
| ps | 5 | 6 | 5.5 |
| as + ps = AN | 10 | 13 | 11.5 |
| Length (LA) | | | |
| S → I | 17 | 18 | 17.5 |

## DISCUSSION

Numerous surgeons have focused on and described methods of agreeable contouring in different parts of the human body. Many of these studies concentrate on areas such as the breasts and buttocks, and very precise anatomical and anthropometric descriptions, classifications, and surgical techniques exist for these areas.[2–19]

Regarding these studies, we aimed to identify the research concerning the hip area. Few anatomical, surgical, and anthropometric innovations have been reported regarding surgery in the hip area.[15–19] The hip area is generally an overlooked region that merits further study because present-day patients seek more aesthetic and reconstructive alternatives.

A range of social and cultural factors result in preferences regarding hip size and shape. A strong

**Table 2. Numerical Results of the Variables according to Our "Clinicophotographic Scaling System"**

| Continuous Variables | *N* | Minimum | Maximum | Mean | SD |
|---|---|---|---|---|---|
| Age | 79 | 18 | 59 | 34.32 | 8.81 |
| Weight, kg | 77 | 43.0 | 81.5 | 61.41 | 7.23 |
| Height, m | 77 | 1.48 | 1.83 | 1.6 | 0.06 |
| BMI | 77 | 18.79 | 36.03 | 23.98 | 2.58 |
| TT | 79 | 28.4 | 41.3 | 35.15 | 2.2 |
| Tt | 75 | 5.0 | 13.0 | 9.16 | 1.55 |
| Scale | 75 | 2.9 | 6.96 | 3.97 | 0.93 |
| Length (LA), cm | 72 | 12.73 (cadaver 17.0) | 17.82 (cadaver 18.0) | 14.99 (cadaver 17.5) | 1.25 |
| Width (AN), cm | 72 | 8.26 (cadaver 10.0) | 12.6 (cadaver 13.0) | 10.3 (cadaver 11.5) | 0.77 |

It can be observed that the dimensions derived using our scales are smaller than those obtained from the dissections.
BMI, body mass index.

interest or preference exists for a rounded hip contour with Hispanic, Afro-American, Caribbean, and African characteristics. This interest results from the strong influence exerted by very attractive Latin American public figures, as described by Roberts et al[14] in their article. In our investigation, we retrieved 2 studies that specifically aimed to correct hip deformities from a reconstructive point of view. Benito-Ruiz et al[16] described the use of gluteal implants to provide volume to the hips of female HIV patients who had lost volume in this area as an effect of antiretroviral therapy. Schoeller et al[17] describe the use of a deep inferior epigastric perforator flap in a series of cases that involved sequelae or deformities in the hip area. Both articles primarily had reconstructive aims. We hypothesize that the first option has merit and could offer a good aesthetic alternative. In a recent study, Cárdenas-Camarena[18] used a combination of gluteal implants in the buttocks and hip for purely aesthetic reasons, and improved aesthetic hip contour results were reported.[18] These studies do not rely on an anatomical and topographical study that could be applied clinically to achieve an optimal outcome.

The investigations and reports by Babuccu et al[11] and Constantino and Mendieta[15] provided detailed knowledge of the "musculoaponeurotic area of the hip." Our line, specified as S, corresponds to the height of point A mentioned by Babuccu et al,[11] and the two have the anterosuperior iliac spine in common. This line does not correspond to point A, as mentioned by Constantino and Mendieta.[15] In our study, line I corresponds to Constantino and Mendieta's[15] point B, and the two have in common the most prominent point of the lateral area of the thigh. However, in our study, line I does not correspond to the most prominent point of the greater trochanter reported by Babuccu et al.[11] In accordance with the length (LA), the lateral depression of the buttock, Constantino and Mendieta's[15] point C, and the greater trochanter correspond to the height of the middle third of the "musculoaponeurotic area of the hip." For this reason, we disagree with the descriptions of point B suggested by Babuccu et al[11] because they describe the greater trochanter as being the point of greatest prominence, whereas, in our study, we found that the greater trochanter is more closely linked to the height of the lateral depression of the buttock and Constantino and Mendieta's[15] point C.

In anatomical, topographical, and clinical terms, the anterosuperior iliac spine, the iliac crest, the most prominent point of the hip, and the external tuberosity of the tibia are the most important anatomical references when determining the dimensions of the "musculoaponeurotic area of the hip." Benito-Ruiz et al[16] and Cárdenas-Camarena[18] did not define the dimensions of the pocket that holds the implants in the hip area. Neither its dimensions nor borders, based on established anatomical references, are specified. We suggest that the description of the "musculoaponeurotic area of the hip" and the "clinicophotographic scaling system" are clinically useful for making a surgical decision pertaining to the hip. Our aim was not to define anatomical structures that have already been perfectly understood and described. The objective was to create a system of clinical and photographic evaluation using anatomical structures as references to define, as simply as possible, an area that could be modified. Determining the dimensions of the musculoaponeurotic hip area would be useful in selecting the suitable dimensions, undermining, and pocket size of an implant. Even without implant placement, defining this area could be useful for preoperative marking before modifying treatment in this area. The objective with these types of surgical procedures in this area is to increase the volume by the insertion of an implant or with autologous fat infiltration. These dimensions allow for proper planning.

We included the results from the dissections in the table of measurements obtained by our "clinicophotographic scaling system" to demonstrate that the measurements obtained with our method do

not exceed those obtained in the dissections. The mean length was 14.99 cm, and the mean width was 10.3 cm. These dimensions are very similar to those at the base of a gluteal implant. We hypothesize that our study will be useful in future investigations similar to those described by Benito-Ruiz et al[16] and Cárdenas-Camarena.[18]

Some doubts and controversial questions could result from the characteristics of our study because most of our photographed patients are female, whereas the cadavers are male. The difference is justified because most female hip deficiencies result in a hip appearance that resembles male hip appearance, and the term "boy's hips" was created by some women. We aimed to develop a technique to transform hips with a masculine appearance into more feminine hips.

## CONCLUSIONS

This study defines the "musculoaponeurotic area of the hip," which includes muscles, tendons, aponeurosis, fascia, subcutaneous tissue, and skin. Using the "clinicophotographic scaling system," the length and width of the area could be calculated. The scaling system is easy, reproducible, and inexpensive. With inspection and palpation using anatomical points of reference, the borders and dimensions of the area could be clinically defined before surgery. This area is very important for the modifications of hip contouring and could be useful for the design of specific implants in the future.

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