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The Superficial Fascia System: Anatomical Guideline for Zoning in Liposuction-Assisted Back Contouring

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Background: Dorsal contour deformity presents with different manifestations in each part of the back, such as back rolls, iliac crest deposit, and buffalo hump. However, scant current literature exists on the anatomical basis of dorsal contour deformity. The aim of this study was to better understand the anatomical characteristics of the back, and to propose evidence-based zoning principles for liposuction-assisted back contouring.

Methods: A total of 12 fresh cadavers were dissected for observation of each hierarchy in the vertical order (skin to deep fascia) and transverse comparison of the superficial fascial system (SFS) in the scapular-infrascapular-lumbar triangle region. Full-dorsum vectorial sections were used for the study of supra-scapular fat deposits.

Results: The SFS acts as a bridge connecting all levels of the dorsal subcutaneous tissue. Macroscopically, it is denser in the scapular and lumbar triangle regions and looser in the infrascapular region; microscopically, the ultrastructure of the retinaculum cutis consists of loose interlobular fascia and stiff functional fascia.

Conclusions: The regional variation pattern of the SFS in the back was consistent with observed back contour deformities in Asian female patients. A better understanding of the topographic anatomy of the back applied to evidenced zoning is the basis for improving surgical precision and avoiding dorsal contour deformity. (*Plast. Reconstr. Surg.* 151: 989, 2023.)

It has been reported in the literature that the sagging of facial fat compartments is not synchronized in the process of aging.¹⁻³ Interestingly, we have observed that there are also

great differences in the manifestations of contour deformities that occur during the development of obesity, such as thickened fat pads, cellulite, and drooping rolls in specific regions, which cannot be simply explained by the description of previous studies.⁴⁻⁶

At present, the main approaches for contour deformity are lipectomy and liposuction. Lipectomy is widely used in patients after massive weight loss.⁷⁻¹¹ However, the disadvantages are obvious scarring, trauma, and long recovery time. Thus, lipectomy is less advantageous for patients with smaller amounts of excessive skin. Liposuction is a surgical procedure with stealth

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Received for publication February 6, 2021; accepted May 11, 2022.

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DOI: [10.1097/PRS.00000000000010077](https://doi.org/10.1097/PRS.00000000000010077)

Disclosure statements are at the end of this article, following the correspondence information.

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incisions, quick recovery, and broader indications than lipectomy. However, in back applications, this procedure is less commonly used because of its high suction resistance, bleeding, and association with complications such as hematoma and ecchymosis.^{12,13}

Lockwood⁵ proposed that the superficial fascial system (SFS) is an important structure affecting subcutaneous fat morphology, and modern imaging techniques have shown the SFS connects all layers as a bridge, allowing the skin/subcutaneous complex (SSC) to present homogeneous mechanical properties when its volume changes.¹⁴ The SFS, composed of many elastic and collagen fibers, is the major contributor to SSC biomechanics.^{15,16} We hypothesized that differences in deformity manifestations may be related to SFS structure and that understanding its anatomical characteristics may provide a better solution to the problems related to liposuction of the back.

The back is a flat and broad area exhibiting different forms of contour deformities. The subcutaneous tissue is less affected by glands, the lymphatic system, and important blood vessels and nerves, which can directly reflect the changes in subcutaneous adipose tissue. Therefore, the back is more suitable as an entry point for studying SSC morphologic change models. The purpose of this study was to understand the SFS structural characteristics of the back and to propose a minimally invasive approach to back liposuction based on the SFS system.

MATERIALS AND METHODS

Twelve full-dorsum female cadaver dissections were performed in the anatomy laboratory.

Table 1. Descriptive Statistics of Demographics

Characteristic	Value
Mean age ± SD, yr	52.83 ± 14.33
Mean weight ± SD, kg	56 ± 7.59
Mean height ± SD, m	1.57 ± 0.06
Mean BMI ± SD, kg/m ²	22.6 ± 2.59
Sex	
Female	12
Male	0
PMH	
Diabetes	3
Smoking	1
Alcohol	0
Cushing	0
HIV-positive	0

BMI, body mass index; PMH, previous medical history; HIV human immunodeficiency virus.

The age range of specimens was 39 to 83 years. Descriptive statistics of demographics are summarized in Table 1. All cadavers were fresh cadavers (with no formaldehyde preservative used) that were less than 24 hours old. Those who had trauma, surgery, or radiation therapy in the back were excluded. This study was conducted according to the guidelines proposed in the Declaration of Helsinki.

Gross dissection was performed in a vertical order from skin to deep fasciae to expose the superficial adipose tissue (SAT), superficial fascia (SF), and deep adipose tissue (DAT) sequentially (Figs. 1 and 2). In the meticulous dissection procedures for the SFS, incisions were directly made from the skin to the deep fascia to form strips of SSC. Four incisions oriented perpendicular to the spine were designed at equal intervals from the cephalic to the caudal end across the dorsum. In the same way, a long incision oriented parallel to the spine is made on the other half of the back at a distance of 6 cm from the spine. To further explore the fine structure and biochemical characteristics, adipose tissue was removed while the fascial tissue was carefully protected.

To verify whether there are regional differences in the biomechanics of the SFS and whether such differences are consistent with the degree of subcutaneous tissue attachment, we proposed the concept of deformation rate to quantify the strength of the SFS and performed the following steps to measure it. Six points are taken at equal intervals on the long incision across the dorsum. A tensile stretch of 5 N was applied to each point through two pulleys fixed above the dissection table. (See Figure, Supplemental Digital Content 1, which shows a schematic demonstrating the measurement approach for determining the deformation rate, <http://links.lww.com/PRS/F756>.) The deformation distance (L) of the retinaculum cutis was measured and the deformation rate at each point was obtained using the following formula:

$$D \text{ (mm/N)} = L \text{ (mm)} / 5 \cos \alpha \text{ (N)}.$$

Statistical analyses were performed with SPSS version 25 (IBM Corp.). Continuous variables were recorded as means and standard errors. The Shapiro-Wilk test was used to determine whether the data followed a normal distribution. An analysis of variance test was performed to test

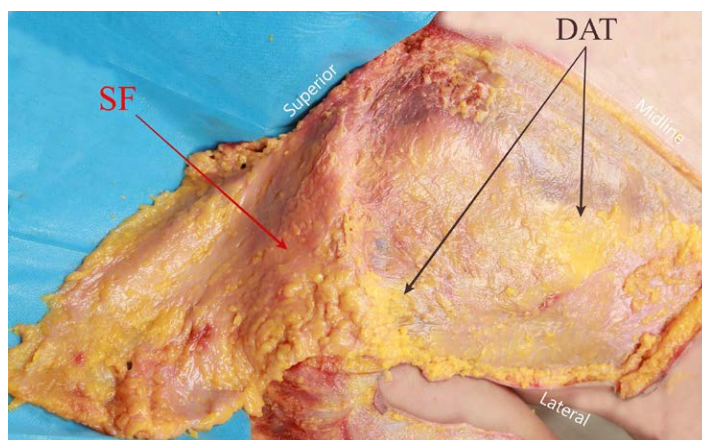


Fig. 1. SF sharply separated and folded upward in a 45-year-old female specimen reveals unevenly distributed DAT in the upper back.

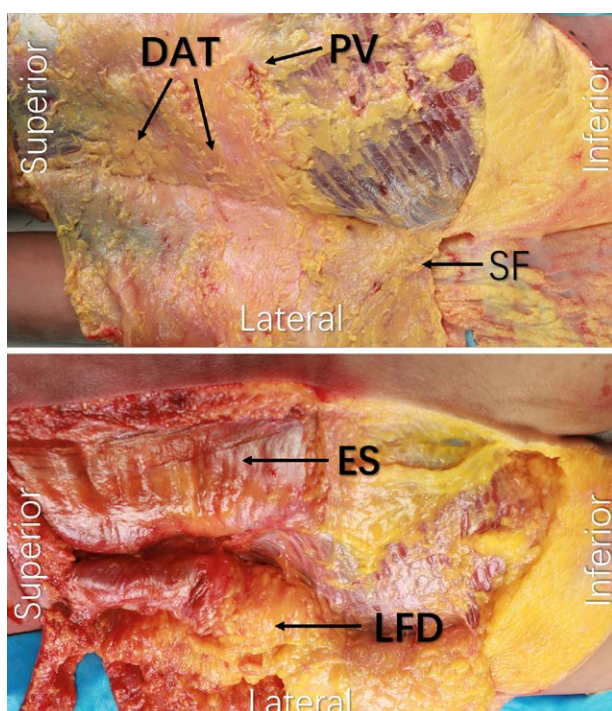


Fig. 2. (Above) With the SF reflected in a 47-year-old female specimen, the lumbar triangle fat deposit (LFD) superior to the gluteus maximus and perforator vessel is visible. The perforator vessel (PV) represents the inferior boundary of the dorsum. (Below) DAT elevated in a 55-year-old female specimen reveals that the thickness of DAT reaches its peak lateral to the erector spinae (ES) and superior to the posterior superior iliac spine and gradually thins inward, upward, and downward.

for differences in deformation rate among the groups. If a statistically significant difference was found with the analysis of variance, the Tamhane test was used as a post hoc multiple comparison

test when the variances were not homogeneous. Data were visualized using GraphPad Prism version 8 (GraphPad Software, Inc.).

RESULTS

Dorsal Anatomical Layers and Fat Distribution

The SAT in the back was thick and evenly distributed, with few regional changes (Fig. 1). Further comparison of superficial fat thickness on the back and buttocks also showed no regional changes (Fig. 2). Vertically oriented retinacula cutis superficialis (RCS) were discovered between the skin and the superficial fascia (SF). The RCS are dense and concentrated in the back, dividing the SAT into cube-shaped units.

The SAT and DAT are separated by the SF. The SF between the thoracic vertebrae and the scapula, the dorsal thoracic fascia, is dense and possesses abundant vascularity. The SF and deep fascia are connected at the spinous processes and form zones of adherence, thus separating the SSC on both sides of the back, which allows the SSC on each side to function independently. The same connection of SF and deep fascia is observed at the medial border of the scapula and along the iliac crest.

DAT is distributed unevenly. In the upper back, it is thickened laterally in the scapular region close to the posterior axillary line (Fig. 1). In the lumbar triangle region, the thickness varies significantly (Fig. 2, above). The thickest area, located lateral to the erector spinae and superficial to the gluteus medius, is known as the iliac crest deposit, where the DAT is considerably thickened compared with the SAT. A perforator vessel running through the deep fat was observed at the junction of the lumbar triangle region and buttock (Fig. 2, above). In the upper back, the retinaculum cutis profundus

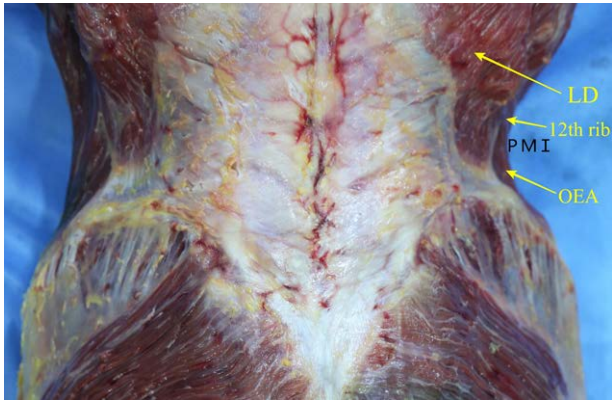


Fig. 3. All the subcutaneous tissue removed from the trunk of a 42-year-old female specimen, revealing the point of maximum indentation (PMI) at the junction of the anterior edge of the latissimus dorsi (LD) and the lateral edge of the musculus obliquus externus abdominis (OEA) along the inferior edge of the twelfth rib.

(RCP) was closely connected with the supraspinatus ligament and formed a fibrous septum directed obliquely upward to the cranial side. In the lumbar triangle region, the RCP has a horizontal oblique laminar structure and is tightly bound to the thoracolumbar fascia. After removal of all

subcutaneous tissue, the point of maximum indentation¹⁷ can be seen at the junction of the anterior edge of latissimus dorsi and the lateral edge of musculus obliquus externus abdominis along the inferior edge of the twelfth rib (Fig. 3). The vectorial cross-sections suggested that fat deformity in the suprascapular region, the buffalo hump, results from the thickening of the DAT (Fig. 4).

Regional Variations and Fine Structure of the SFS

In the transverse incisions in each region, the SSC in the scapular and subscapular regions was lifted to expose the deep fascia (Fig. 5). Microscopically, the retinaculum cutis consists of loose interlobular fascia and stiff functional fascia. Macroscopically, the RCP of the scapular region gradually lengthens from medial to lateral, and its combination with the deep fascia gradually changes from compact to lax. In the infrascapular region, the RCP binds more loosely to the deep fascia than in the scapular region. Differences were quantified along the craniocaudal incision excepting the suprascapular region, where the SSC was too compact to be lifted to a processable level and therefore was excluded from the analysis (Fig. 6). The SFS in the infrascapular region

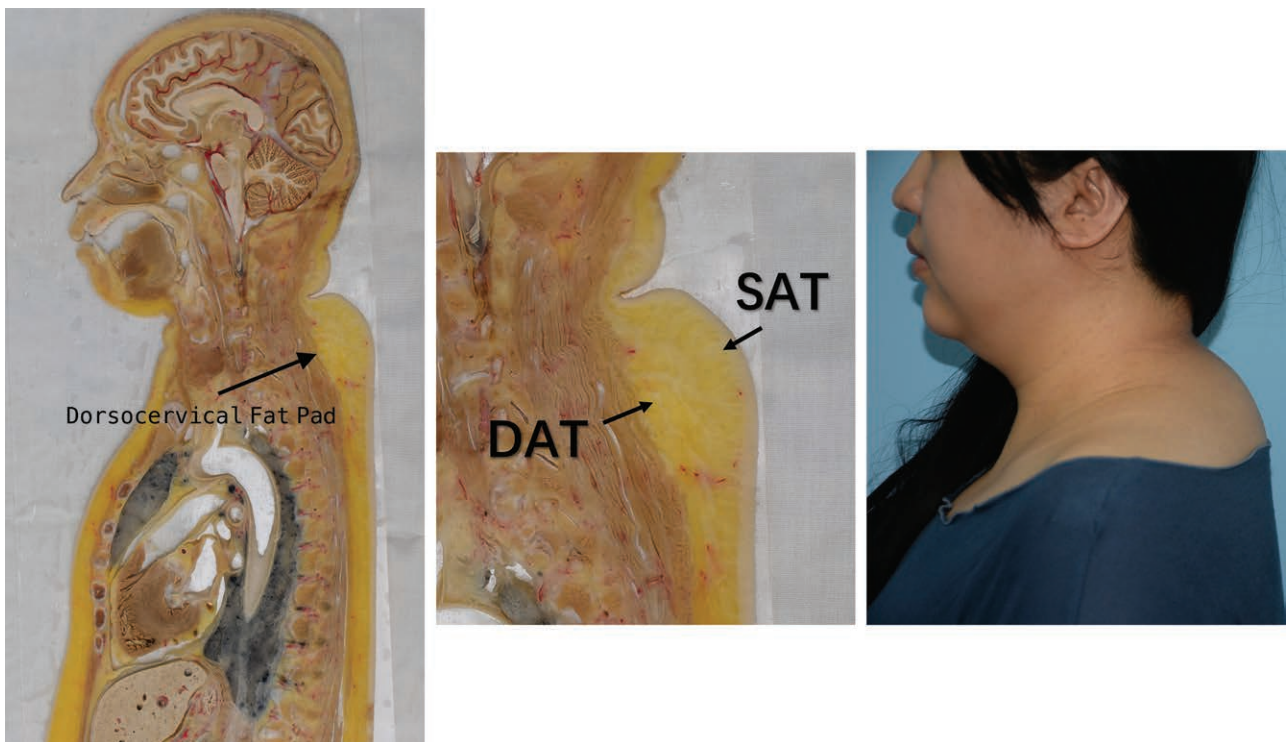


Fig. 4. (Left) A vectorial cross-section of a cadaver mount suggests DAT thickening and compact SFS structure in the suprascapular area. (Center) Close-up view of the vectorial section shows the ultrastructure of the dorsocervical fat pad. (Right) Lateral view of a 41-year-old female patient with the buffalo hump deformity.

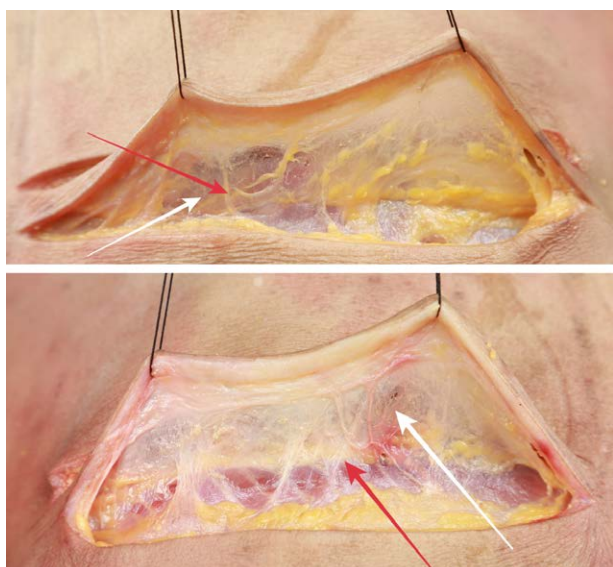


Fig. 5. Bottom view of lifted strips of the SFS in the scapular (*above*) and infrascapular (*below*) region of a 39-year-old woman reveals the ultrastructure of the retinaculum cutis. The retinaculum cutis, a heterogeneous three-dimensional network, is composed of loose interlobular fascia (*white arrow*) and condensed functional fascia (*red arrow*).

was loose with a transparent appearance, and the SFS in the scapular and lumbar triangle regions was denser with an opaque or white appearance. Under a tensile force of 5 N, the deformation rates of the RCS and RCP in the above regions were measured ([Table 1](#)). The deformation rate of the RCS ([Fig. 7](#)) was 5.31 ± 0.43 mm/N in the scapular region, 5.75 ± 0.70 mm/N in the infrascapular region, and 5.38 ± 0.96 mm/N in the lumbar triangle, with no significant difference ($P = 0.308$). The deformation rate of the RCP ([Fig. 8](#)) in the infrascapular region (19.33 ± 4.40 mm/N) was significantly higher than that in the scapular region (7.49 ± 2.76 mm/N) and lumbar triangle (9.33 ± 5.38 mm/N), and there was no significant

difference in the deformation rate between the scapular region and lumbar triangle ([Table 2](#)).

DISCUSSION

Illouz⁶ observed and described the existence of some “fixed points” on the human body. Lockwood⁵ defined these points as “zones of adhesion” and states adhesion is greatest in creases and folds and less so over bulges of deep fat deposits. However, Taylor¹⁸ reported that the zones of adhesion above the iliac crest are independent of the overlying deep fat collections and mapped the strength of the adhesion by observing the cadaver muscle fascia. In this study, we further investigated the anatomical explanation of the adhesion strength and quantified this property. Specifically, the subcutaneous laxity/density/adhesion strength is a macroscopic representation of the denseness of the distribution of functional fascia. In our meticulous dissection, we observed regional differences in this density, which is consistent with previous reports of microscopic observations.^{14,15,19} However, because the fascia is three-dimensional and cannot be accurately described by density in any single vectorial direction, we defined deformation rates to facilitate further comparison. Differences in deformation rates across the dorsal SFS were verified by statistical methods, and this topography of differences did not coincide with maps of fat thickness variation, which contributed to the diversity of dorsal contour deformities. That is, the appearance of the SSC is determined by the combination of variable fat thickness and different SFS deformation rates. If fat accumulation is combined with low-deformation-rate SFS, the SSC is less likely to be lax, forming a fat pad-like deformity. If the fat thickening is at a site with high deformation rate, it potentially produces expansion, excursions, and sagging. The results of this study revealed macroscopic patterns and microscopic structures

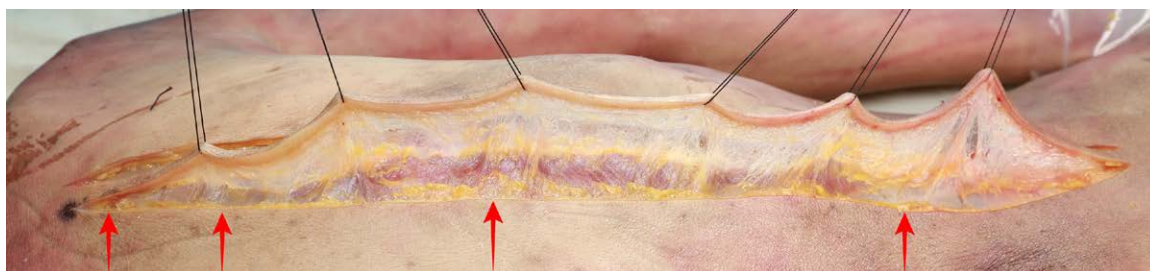


Fig. 6. Lateral view of lifted strip of SFS in the longitudinal axis reveals the different levels of compactness in each region. Elevation of the suprascapular region is difficult. The scapular region and lumbar triangle show dense connections.

Reticula cutis superficialis

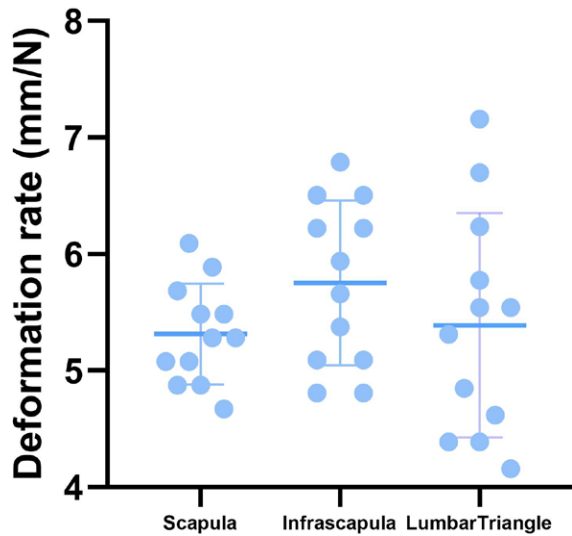


Fig. 7. Deformation rate of retinacula cutis superficialis. Scatter dot plot with line at mean.

Reticula cutis profundus

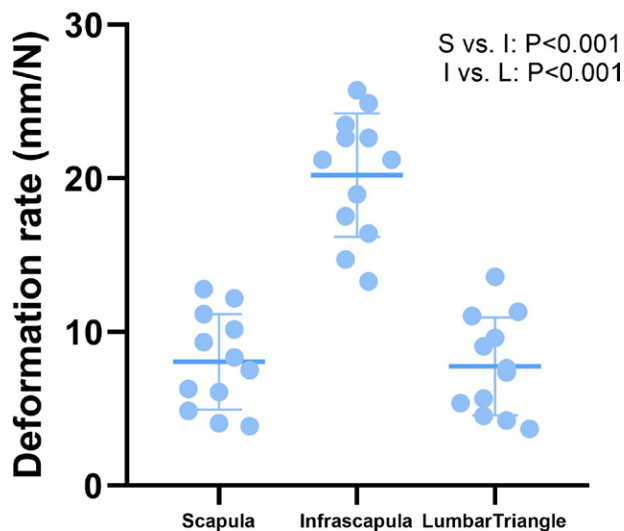


Fig. 8. Deformation rate of RCP. Scatter dot plot with line at mean.

of dorsal SFS, which explain the diversity of dorsal contour deformities and why dorsal liposuction is considered laborious.

Macroscopic Patterns of SFS Variation Align with Clinical Observations

The SFS was dense and had a low deformation rate in the scapular and lumbar triangle regions, whereas the subscapular region was relatively

Table 2. Deformation Rate

	RCS Deformation Rate		RCP Deformation Rate ^a	
	Mean	SD	Mean	SD
Scapula	5.31	0.43	7.49	2.76
Infrascapula	5.75	0.70	19.33	4.40
Lumbar triangle	5.38	0.96	9.33	5.38
ANOVA test ^b	$P = 0.308$		$P < 0.001$	

RCS, retinaculum cutis superficialis; ANOVA, analysis of variance.

^aTamhane for RCP.

^bS (scapula) versus I (infrascapula) < 0.001 ; S versus lumbar triangle (L) = 0.669; I versus L < 0.001 .

loose and had a high deformation rate, which matched the regional differences observed in back contour deformity (Fig. 9). An increase in fat volume results in distinctive regional outcomes. The suprascapular region and lumbar triangle region expand in thickness to form a fat pad. The lateral scapular region and infrascapular region expand both vertically and horizontally, and the direction of fat roll deformity depends on the positional relationship between the zones of adherence and the vector of gravitational effect. Furthermore, the deformation rate algorithm is also applicable to the zones of adherence/adhesion, which can be considered as densification/condensation of the retinacula cutis^{2,14} and therefore features the minimum deformation rate. As observed clinically, the zones of adherence along the spinous process and the medial scapula do not expand (Table 2).

Clinical Implications from the Microstructure of the SFS

The anatomical results demonstrate the close interaction between dorsal SFS and adipose lobules. To facilitate the understanding of the dynamic anatomy of the SSC at different deformation rates and the interaction of the components, a simplified illustration is shown in Figure 10. Obesity and contour deformity may be considered a disease state and are more than just hypertrophy of adipose. Correcting the “sick” SSC involves two aspects: first, removal of the expanding fat; and second, retraction of the cutaneous envelope after removal of that which expanded it. The elastic SFS network provides a dynamic anchor, permitting an adaptation to stress in all directions that enable tissues to spring back to their original state when the tensile force disappears.

The importance of protecting the SFS during liposuction has been widely recognized, and surgical complications (eg, irregularities, hematoma, and pain) are considered to be related to SFS injury.^{4,20,21} With the further findings of the SFS



Fig. 9. (Above) The infrascapular region shows the highest laxity. Posterior view of a 39-year-old woman with back rolls, presenting as SSC ptosis at both sides of the infrascapular region, corresponding to the laxest section of the superficial fascia in the figure. (Below) Posterior view of a 56-year-old woman with iliac crest deposits, presenting as fat pads over the area of the iliac crest, corresponding to the relatively denser lumbar triangle section in the figure above.

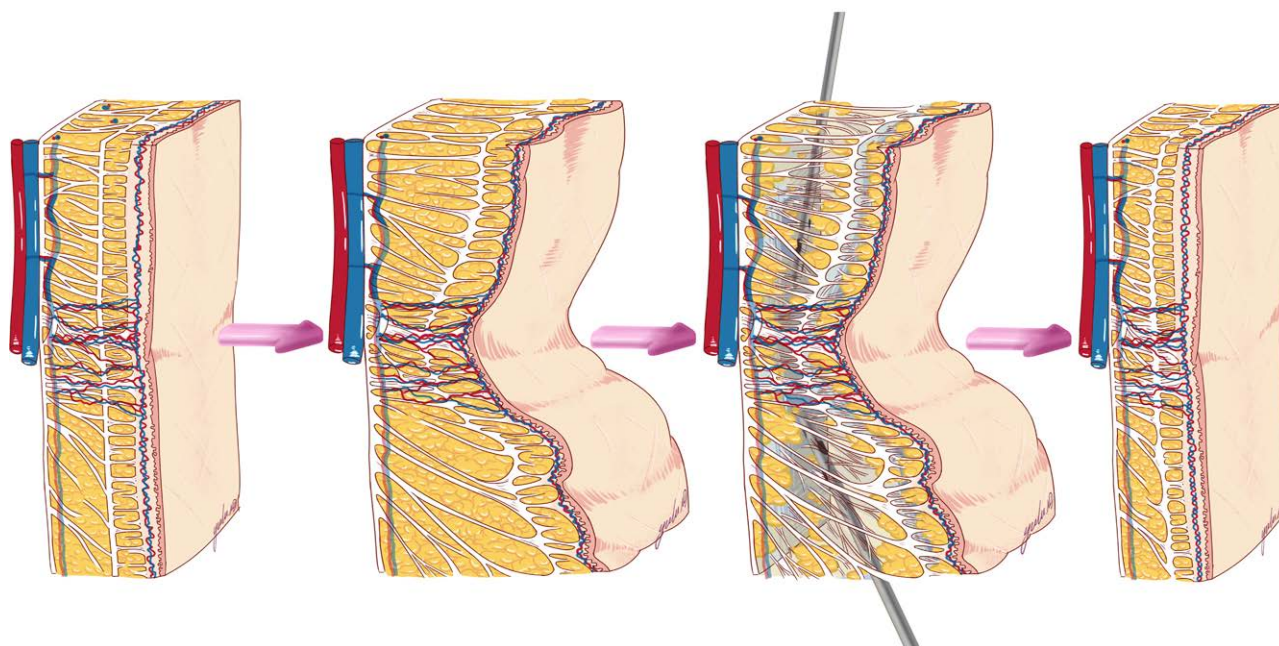


Fig. 10. Generic model of the variations in the SSC. Depending on the region, the density of the SFS is different and is simply divided into three scales in this model. The interlobular fascia are not shown for improved visualization: low-deformation-rate region, zone of adherence, and high-deformation-rate region. The diagram shows the changes in the SSC during the obesity process and liposuction-assisted contouring in (left) healthy SSC with smooth skin, and (second from left) "sick" SSC with excess adipose tissue. The region with a lower deformation rate provides stronger restraint ability, resulting in the different outcomes of the SSC. Zone of adherence remains stable. The region with a low deformation rate thickens but remains stiff enough to stay in place, forming a fat pad. The region with a high deformation rate is too weak to control the expansion and ptosis influenced by gravity. (Second from right) Liposuction removes excess fat from the SFS network, and (right) this allows the elastic fibers to spring back gradually.

substructures in this study, it is necessary to discuss which substructure needs preservation precisely, as this has potential significance for surgical design and may be generalizable to other regions.

On the basis of the results of this article and review of the literature including immunofluorescence studies,¹⁶ histologic studies,¹⁵ in vivo computed tomographic images, and 3T magnetic resonance imaging scanning,¹⁴ we believe that functional fascia is the key to SSC retraction after liposuction and preventing vascular and nerve damage, and this is why we have named it functional fascia.

Morphologic Function

The richness and organization of the elastic component of the functional fascia suggests that it plays a major role in the mechanical behavior.¹⁵

Neurovascular Scaffold

It is reported that the subcutaneous vascular and nervous elements are surrounded and protected by the functional fascia.¹⁴ In the back, fat lobules are separated by more densely distributed functional fascia, and the liposuction cannula that can move easily in other areas (eg, abdomen) is blocked by functional fascia with smaller gaps. The surgeon has to apply stronger force to move the cannula, which possibly causes avulsion injuries to the functional fascia. How to target non-functional fat removal and preserve functional fascia in this special area deserves further discussion. Rohrich et al.⁴ proposed that the zones of adherence should be avoided in liposuction to prevent complications, and only small cannulas (<3.0 mm) could be used in case of necessity. From a microstructural point of view, the zones of adherence feature the lowest deformation rate and the densest functional fascia. Choosing a thinner cannula to match the narrower gap may also work in preventing functional fascia and its accompanying vascular nerve avulsions in the low-deformation-rate dorsal region. We hypothesize that thinner cannulas and reduced forces provide the opportunity for the cannula tip to slide over the elastic net and complete breakthrough



Fig. 11. Points for incisions and trajectory of the cannula direction are illustrated on the *left half*. Clinical zones of the female dorsum are shown on the *right*. Zone 1, suprascapular zone; zone 2, scapular zone; zone 3, infrascapular zone; zone 4, lumbar triangle zone.

in the relatively weak interlobular septa. However, a thin cannula increased the possibility of deflection against fibrotic tissue in back areas, leading to difficulty in tracking the cannula tip with palpation. We use a conical tip to avoid resistance that impedes the path of a cannula and alters its direction, keeping the tip in a controllable trajectory. The cannula should be positioned tangential to the back to minimize the risk of pneumothorax.

Based on the SFS topography, the functional protection concept, and the characteristics of Asian women, we summarized the following simplified zones for the back region (Fig. 11). First, the suprascapular zone belongs to the low-deformation-rate model. It was considered to be composed of fat tissue that is too

Table 3. Clinical Zones

	Suprascapular	Scapular (Midline→Lateral)	Infrascapular	Lumbar Triangle
Retinacula cutis density	Dense	Dense→sparse	Sparse	Dense
Adherence degree	Strong	Strong→lax	Lax	Strong
Deformation rate	Low	Low→high	High	Low
Common deformity	Fat pad	Periaxillary rolls	Rolls	Fat pad
Cannula diameter, mm	2.5	3.0	3.0	2.0
Incision	Bra-strap line	Axillary fold	Axillary fold (plus bra-strap line)	Intergluteal crease

hard for liposuction, and excisional lipectomy has been the traditional approach for this zone.¹² Anatomical results demonstrated that the reason lies in its dense and developed SFS, and the authors have offered less invasive recommendations for this situation (Table 3). For patients with a dorsocervical fat pad, adequate liposuction of the DAT is very important. In addition, areas with a well-developed SFS have better retraction abilities, contributing to good postoperative outcomes. Second, the scapular zone is characterized by a gradual increase in the deformation rate from the midline to the axillary region. The fat in the axillary region is often ignored in liposuction. The anatomical results demonstrated that the region around the axilla features loose RCP with thick DAT, making the SSC more mobile during surgery. It is reported that liposuction of the axillary region increased the incidence of pneumothorax; thus, extra care should be taken in this area.²⁹ In the authors' clinical practice, a 3-mm cannula is used for tumescent infiltration and liposuction in the DAT layer, and a 2.5-mm cannula is used in the SAT with incision at the intersection of the posterior axillary line and the axillary fold.¹⁷ Pinch the SSC up off the chest wall and maintain constant awareness of the cannula tip to minimize the risk of chest penetration. Ideal aesthetic outcome includes defining the contour of the scapula, smoothing the lateral dorsal line, and extending the

distance from the acromion to the posterior border of the axillary fold crease. Third, the subscapular zone belongs to the high-deformation-rate model and requires adequate release of the fat lobule to obtain the maximum retraction. Criss-crossing technique is important to make an obvious contraction effect. For patients bothered by back roll deformity without extreme skin redundancy, liposuction can make good correction with a minimal stealth scar (Fig. 12). Fourth, the lumbar triangle zone belongs to the low-deformation-rate model. Anatomical results demonstrate the considerable DAT accumulation in this zone. Adequate assessment of the fat thickness in this area helps the surgeon to have a clearer prognosis of the endpoint of the procedure, avoiding a conservative level and volume of liposuction that may result in more fat residue and failure to achieve optimal contouring results. Preoperative localization of the penetrating vessels (eg, using ultrasound) and placing the marked area at the very end of the operation helps to avoid the vessel traumatized early in the operation that then remains bleeding throughout the operation.

Some shortcomings of this study should be noted. First, this study included only women, mandating further research in men. Second, only Asian specimens are included in present dissections, as cadaver freshness is important and long-term transport can affect the accuracy of the results. Several studies have indicated racial differences in skeletal

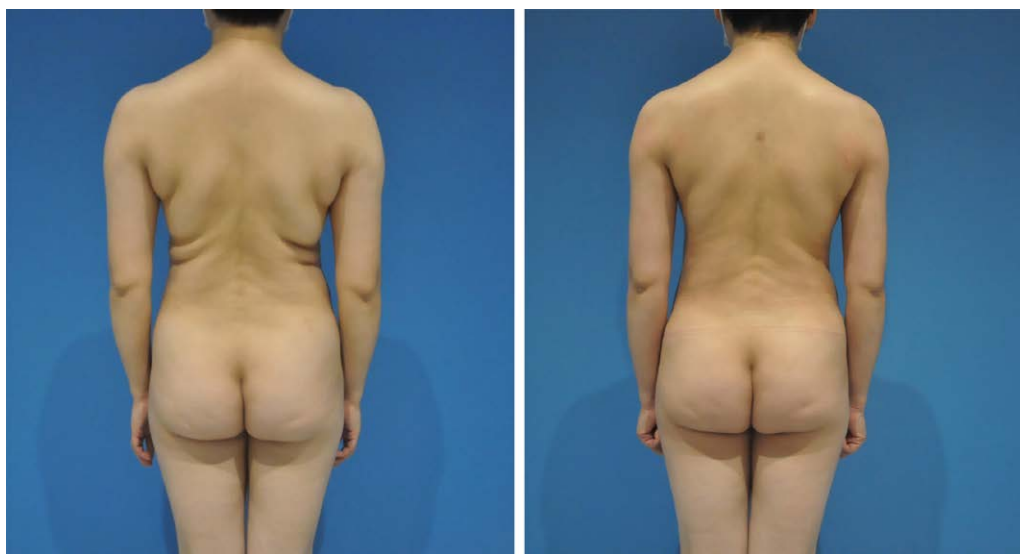


Fig. 12. A 36-year-old woman who is relatively slim (body mass index of 19.2 kg/m²) but with a severe deformity of back rolls. The patient underwent liposuction in the infrascapular zone. Preoperative (*left*) and 6-month postoperative (*right*) images are shown.

framework and fat topography,^{23–26} and whether the anatomical pattern of the dorsal SSC differs between races remains to be further investigated. Third, emerging technologies such as ultrasound-assisted liposuction, laser-assisted liposuction, and radiofrequency-assisted liposuction are not covered. Further research is needed to explore the underlying SFS responses to different energy settings (eg, pulsed or continuous delivery mode). Furthermore, our data collection may be biased by several factors, including relative freshness, preservation mode of cadavers, and environment temperature. The degree of bias and the direction in which this biases the results is unknown. This article could be regarded as a preliminary work for later research on soft-tissue modeling.

CONCLUSIONS

Regional changes in the SFS of the back explain the observed contour deformities in Asian women. An understanding of the SSC provides the basis for zoning and improves surgical precision of liposuction. A less invasive treatment plan with broader indications can be achieved with removal of the expanding fat and protection of SFS functionality. The mechanical behavior of the SSC can be better understood and predicted by mastering the characteristics of the SFS.

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DISCLOSURE

The authors have no financial interest or conflict of interest to declare in relation to the content of this article.

ACKNOWLEDGMENT

This work was supported by National Natural Science Foundation of China grant 81801926.

REFERENCES

1. Stuzin JM, Rohrich RJ, Dayan E. The facial fat compartments revisited: clinical relevance to subcutaneous dissection and facial deflation in face lifting. *Plast Reconstr Surg*. 2019;144:1070–1078.
2. Rohrich RJ, Pessa JE. The retaining system of the face: histologic evaluation of the septal boundaries of the subcutaneous fat compartments. *Plast Reconstr Surg*. 2008;121:1804–1809.
3. Rohrich RJ, Pessa JE. The fat compartments of the face: anatomy and clinical implications for cosmetic surgery. *Plast Reconstr Surg*. 2007;119:2219–2227.
4. Rohrich RJ, Smith PD, Marcantonio DR, Kenkel JM. The zones of adherence: role in minimizing and preventing contour deformities in liposuction. *Plast Reconstr Surg*. 2001;107:1562–1569.
5. Lockwood TE. Superficial fascial system (SFS) of the trunk and extremities: a new concept. *Plast Reconstr Surg*. 1991;87:1009–1018.
6. Illouz YG. Surgical implications of “fixed points”: a new concept in plastic surgery. *Aesthetic Plast Surg*. 1989;13:137–144.
7. Lalonde DH, Handley A, Sullivan D, Rohrich RJ. Bra-line back lift. *Plast Reconstr Surg*. 2008;122:1275–1278.
8. Shermak MA. Management of back rolls. *Aesthet Surg J*. 2008;28:348–356.
9. Soliman S, Rotemberg SC, Pace D, et al. Upper body lift. *Clin Plast Surg*. 2008;35:107–114.
10. Chen S, Gui X-E, Cao Q, Routy J-P. Clinical outcome after lipectomy in the management of patients with human immunodeficiency virus-associated dorsocervical fat accumulation: an observational cohort study. *Medicine*. 2019;98:e16112.
11. Hunstad J, Chen C, Abbed T. Bra-line back lift. *Clin Plast Surg*. 2019;46:77–84.
12. Gervasoni C, Ridolfo AL, Vaccarezza M, et al. Long-term efficacy of the surgical treatment of buffalo hump in patients continuing antiretroviral therapy. *AIDS*. 2004;18:574–576.
13. Hunstad JP. Addressing difficult areas in body contouring with emphasis on combined tumescent and syringe techniques. *Clin Plast Surg*. 1996;23:57–80.
14. Herlin C, Chica-Rosa A, Subsol G, et al. Three-dimensional study of the skin/subcutaneous complex using in vivo whole body 3T MRI: review of the literature and confirmation of a generic pattern of organization. *Surg Radiol Anatomy*. 2015;37:731–741.
15. Lancerotto L, Stecco C, Macchi V, Porzionato A, Stecco A, de Caro R. Layers of the abdominal wall: anatomical investigation of subcutaneous tissue and superficial fascia. *Surgic Radiol Anat*. 2011;33:835–842.
16. Song AY, Askari M, Azemi E, et al. Biomechanical properties of the superficial fascial system. *Aesthet Surg J*. 2006;26:395–403.
17. Hoyos AE, Prendergast PM. High definition body sculpting. In: *Art and Advanced Lipoplasty Techniques*. 1st ed. Berlin : Springer; 2014:44–45.
18. Taylor DA. Zones of adhesion of the abdomen: implications for abdominoplasty. *Aesthet Surg J*. 2017;37:190–199.
19. Guidry RF, McCarthy ME, Straughan DM, et al. Ultrasound imaging of the superficial fascial system can predict the subcutaneous strength of abdominal tissue using mean gray value quantification. *Plast Reconstr Surg*. 2020;145:1173–1181.
20. Markman B, Barton FE. Anatomy of the subcutaneous tissue of the trunk and lower extremity. *Plast Reconstr Surg*. 1987;80:248–254.
21. Gorney M. Sucking fat: an 18-year statistical and personal retrospective. *Plast Reconstr Surg*. 2001;107:608–614.
22. Mentz JA, Mentz HA, Nemir S. Pneumothorax as a complication of liposuction. *Aesthet Surg J*. 2020;40:753–758.
23. Yim J-E, Heshka S, Albu JB, Heymsfield S, Gallagher D. Femoral-gluteal subcutaneous and intermuscular adipose tissues have independent and opposing relationships with CVD risk. *J Appl Physiol*. 2008;104:700–707.
24. Deurenberg P, Deurenberg-Yap M, Guricci S. Asians are different from Caucasians and from each other in their body mass index/body fat per cent relationship. *Obes Rev*. 2002;3:141–146.
25. Park YW, Allison DB, Heymsfield SB, Gallagher D. Larger amounts of visceral adipose tissue in Asian Americans. *Obes Res*. 2001;9:381–387.
26. Wang J, Thornton JC, Russell M, Burastero S, Heymsfield S, Pierson RN. Asians have lower body mass index (BMI) but higher percent body fat than do whites: comparisons of anthropometric measurements. *Am J Clin Nutr*. 1994;60:23–28.