

Anatomy and histology of the newly discovered adipose sac structure within the labia majora: international original research

Adam Ostrzenski¹ · Pawel Krajewski² · Kern Davis³

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Abstract

Objectives To determine whether there is any new anatomical structure present within the labia majora.

Study design A case serial study was executed on eleven consecutive fresh human female cadavers. Stratum-by-stratum dissections of the labia majora were performed. Twenty-two anatomic dissections of labia majora were completed. Eosin and Hematoxylin agents were used to stain newly discovered adipose sac's tissues of the labia majora and the cylinder-like structures, which cover condensed adipose tissues. The histology of these two structures was compared.

Results All dissected labia majora demonstrated the presence of the anatomic existence of the adipose sac structure. Just under the dermis of the labia majora, the adipose sac was located, which was filled with lobules containing condensed fatty tissues in the form of cylinders. The histological investigation established that the well-organized fibro-connective-adipose tissues represented the adipose sac. The absence of descriptions of the adipose sac

within the labia majora in traditional anatomic and gynecologic textbooks was noted.

Conclusions In this study group, the newly discovered adipose sac is consistently present within the anatomical structure of the labia majora. The well-organized fibro-connective-adipose tissue represents microscopic characteristic features of the adipose sac.

Keywords Labia majora · Anatomy of labia majora
Labia majora adipose sac · Female genitalia · Vulva

Introduction

It has been documented that the anatomical descriptions of female urogenital anatomy were inaccurate; however, the labia majora has not been studied to determine accurate descriptions of anatomy or histology [1, 2]. Surgical interventions for reconstructions of labia majora are based on and guided by the accurate anatomic quality and validity of available anatomical relevant descriptions. Therefore, understanding anatomical structure and its potential defects are key factors in surgical reconstructions. The senior author of the current study noticed discrepancy between the labium majus surgical anatomy and presented gross anatomy in the standard anatomical textbooks, gynecologic textbooks, anatomic atlases, and surgical gynecologic atlases [4–18]. Electronic and manual scientific-clinical literature searches were conducted from 1960 to 2015 to determine the overview on the labia majora anatomy. These searches failed to identify any article relating to the subject matter. The standard textbooks and atlases were reviewed and analyzed of the labia majora anatomical presentation [4–18].

The hypothesis was advanced that an additional structure must be present within the labia majora; however

Adam Ostrzenski is the Retired Professor and Former Director of Operative Gynecology in Howard University.

✉ Adam Ostrzenski
ao@baymedical.com

¹ The Institute of Gynecology, Inc., 7001 Central Ave.,
St. Petersburg, FL 33710, USA

The Department of Forensic Medicine Warsaw, Medical
University, Warsaw, Poland

³ The Department of Pathology, St. Anthony Hospital,
St. Petersburg, FL, USA

anatomical gross descriptions are missing in the classic textbooks. To test this theory, the gross anatomy study of labia majora was designed and executed on fresh human female cadavers. The objectives were to determine and to document whether any new anatomic structure was consistently present in the labia majora; to identify existing deficiency in gross anatomy descriptions of the human female labia majora; and to define the microscopic characteristic features of any new anatomical structure within the labia majora.

Materials and methods

Eleven consecutive fresh Caucasian female cadavers were included into this study. The subjects' ages ranged between 27 and 83 years, who were admitted to the Department of Forensic Medicine (DFM), Warsaw Medical University (WMU), Poland, for mandatory postmortem autopsy due to sudden death. The Ethics Committee of WMU (AKBE 146/12) approved the study's protocol. Demographic data of suddenly deceased subjects were limited to registration numbers at the DFM, their names, if available, and ages were on hand. No additional demographic or medical history information was available.

Inclusion/exclusion criteria

Fresh Caucasian female cadavers who expired fewer than 48 h prior to performing anatomical macro- and micro-dissections were included. Those cadavers who demonstrated a disseminated process of illness, evidence of prior operation on the vulva, contagious diseases, disfiguration, or pathological increased size of female external genitalia, the presence of a tumor, enlarged inguinal lymphatic nodes, and those who were raped were excluded. Those subjects who were refrigerated for longer than 48 h were also excluded. A "rigor mortis" of the subject did not interfere directly with dissections of labia majora, mons veneris, inguinal areas, and inner thigh surfaces including the fascia lata of the thighs. In this study, anatomical nomenclatures were used in accordance with the *Nomina Anatomica* [19].

Anatomical dissections

Before positioning a subject on the dissection table a "rigor mortis" of the hip and knees were overcome by a gentle flexion and extension. A superficial incision on the epidermis and dermis of the labia majora was performed from the level of the anterior commissure to the posterior commissure. The initial incision was carried out on the edge of the hairline and the interlabial crease. The cutis was

reflected laterally and the hypodermis area of the labia majora was exposed. The subcutaneous tissue was separated sharply from the cutis. The dissection was continued until after the adipose sac was exposed, Figs. 1, and 2. Upon completion of dissections of the labia majora, the cutis incision was extended to the mons veneris. Laterally, the incision was continued towards the inguinal area, and posteriorly, toward the posterior perineum. The isolated adipose sac measurements were performed. The digital photos were taken for documentations from all 22 dissected labia majora. Histological investigations were performed on the specimens of adipose sac and the pouch of lobules of the fatty tissues obtained from all labia majora, Figs. 3 and 4. The adipose sac of the labia majora was striped off for identifying fat distribution within the adipose sac, Fig. 5.

Results

Altogether, the 22 macro- and micro- dissections of the labia majora were performed. The subjects' ages ranged between 27 and 83 years with a mean age of

50 ± 23 years (standard deviation). Six women were in the reproductive age and five were in the postmenopausal age. The adipose sac structure was consistently present within the structure of labia majora. The adipose sac's wall resembles grossly a fibroadipose structure. The geometrical

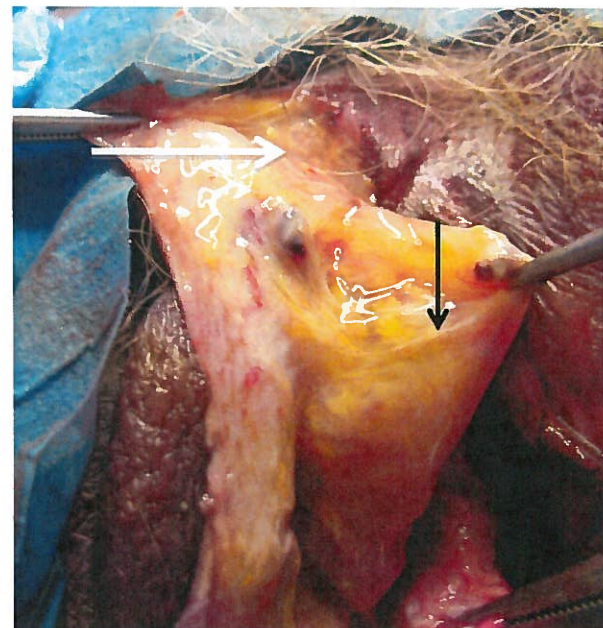


Fig. 1 The labium majus fat tissue is resting within the adipose sac; the *black arrow* depicts the sac edges after being opened; the *white arrow* depicts the superficial fascia of the mons pubis fusing with the adipose sac of the labium majus. The adipose sac distinguishes itself from abdominal fat distributions (see Fig. 8)

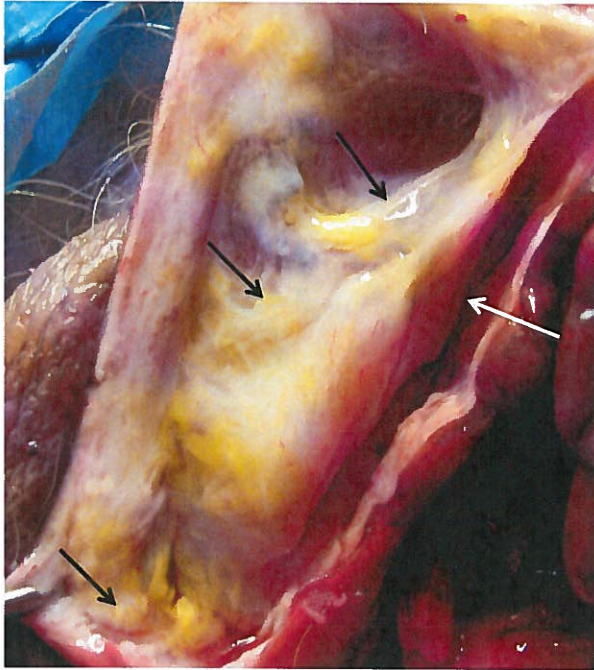


Fig. 2 Labia majora multiple adipose sac defects (*black arrows*); the crease between the labia minora and labia majora presented as a groove (the *white arrow*). The lowest *blue arrow* indicates the presence of adipose sac defect and migrations of the fat tissue to the hypodermis

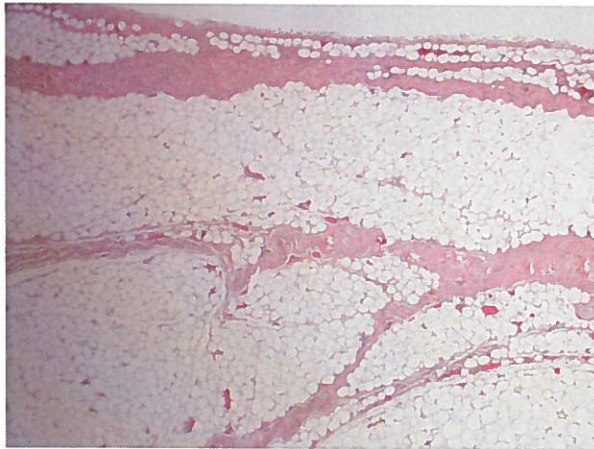


Fig. 3 The adipose sac tissues stained with H&E and presented under 40X magnifications. The newly discovered labium majus adipose sac histology is depicted. The adipose sac contains well-organized bands of collagen rich fibrous connected tissue with mature adipose cells present in-between

shape of the adipose sac of the labia majora appears as an inverted triangle with the apex being at the most inferior point, Figs. 6 and 7. The orientation of the adipose sac is in a longitudinal plane, (Figs. 6, 7) and the size varies among subjects. A mean length was 6 ± 1.5 cm of standard

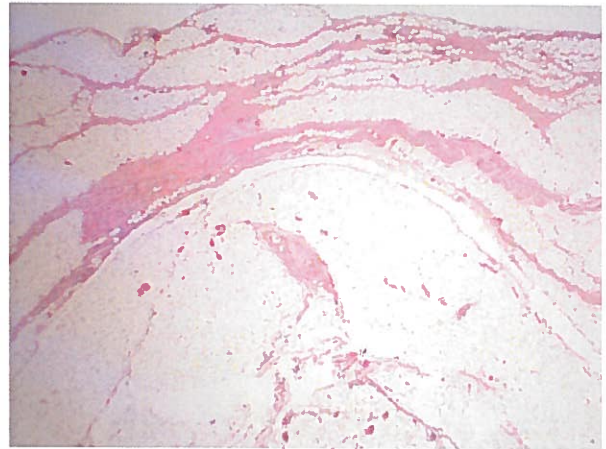


Fig. 4 The pouch tissue surrounded lobules was stained H&E and presented under 40X magnifications. Bands of collagen rich fibroadipose tissues are less organized than in the adipose sac (see Fig. 3)



Fig. 5 The transverse section of the labium majus and the lobes (different sizes) of adipose tissues are presented. The adipose sac has been striped off to demonstrate the fat tissue distributions within the labia majora. A connective tissue of pouch surrounds each individual adipose lobule

deviation, and; the mean width 4.5 ± 0.5 cm of standard deviation; and the mean thickness was $2.1 \text{ cm} \pm 0.3$ of standard deviation. The greatest thickness of the labia majora was half way between the anterior and posterior commissures. The newly discovered adipose sac dimensions (the length, width, and thickness) are presented in Table 1.

The thickest part of the labia majora adipose sac was noted along the intra-labial crease. The adipose sac creates the semi-ballooning shape of the labia majora in the form

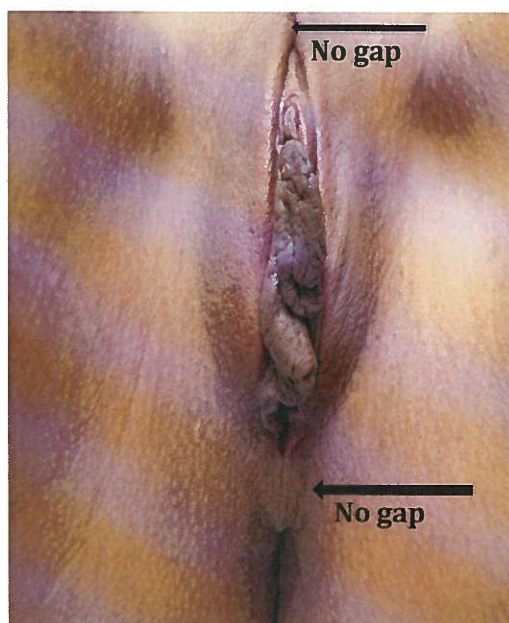


Fig. 6 The general view of the labia with the anterior and posterior commissures adequately developed (*arrows* indicate fusion of commissures without gap)

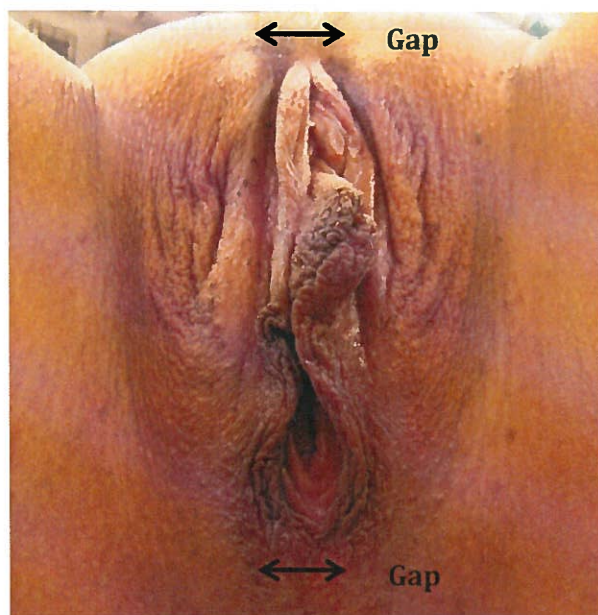


Fig. 7 Incomplete fusions between the left and right labia majora commissures are demonstrated (*arrows*). Labia majora deformities are depicted and presumptively associated with the adipose sac defects

of slope. Anteriorly, the subdermal adipose sac abuts to the labial cutis; laterally, is neighboring with the intra-labial crease and the opposite margins fuses with the fascia lata of

Table 1 Dimensions of the newly discovered adipose sac

Subject	Length (cm)	Width (cm)	Thickness (cm)
No. 1	4.0	4.2	1.8
No. 2	7.2	4.7	2.4
No. 3	7.5	4.5	1.9
No. 4	6.3	4.0	2.1
No. 5	6.8	4.0	2.3
No. 6	6.3	4.1	2.2
No. 7	4.7	4.6	1.9
No. 8	5.3	4.5	1.7
No. 9	5.8	4.2	2.2
No. 10	5.4	4.9	2.3
No. 11	4.8	5.0	1.6

the thigh; cranially, the adipose sac is adjacent to the mons veneris; caudally, it extends down into the proximal part of the posterior peritoneum; and posteriorly, the sac is loosely fused with the superior surface of the Colles' fascia. The adipose sac of the labia majora resists downwards displacement by creating continuity with the superficial fascia of the mons veneris, Fig. 1, medially with the superficial clitoral ligament, laterally with the round ligament in the vicinity of the inguinal ring, and posteriorly the adipose sac fuses with the superior surface of the Colles' fascia. Caudally, the adipose sac gets thinner and smaller, Figs. 6 and 7. The pouches of lobules fill the adipose sac in the cylinder-like structures, which are packed with condensed fat tissues, Fig. 5. A defect(s) of adipose sac wall creates anatomical deformed appearance of the labia majora and clinically manifests as deep skin's wrinkles or indentations, or both, Fig. 7, when compared to the intact of adipose sac, and Fig. 6. Contrary to the existence of the adipose sac within the labia majora structure, the abdominal adipose tissue is defused with the absence of the adipose sac, Fig. 8.

The microscopic characteristic features of the adipose sac of the labia majora is the presence of well-organized bands of layers containing rich fibrous and connective tissues with mature adipose cells present in-between, Fig. 3. Comparing adipose sac histology, Fig. 3, with the histology of the pouch of lobules, Fig. 4, notable differences are present; the pouch of lobules was less organized bands of fibroadipose-collagen tissues than was observed within in the adipose sac, Fig. 3.

An electronic and manual scientific literature search failed to identify any scientific-clinical article related to the anatomic existence of the labium majus adipose sac. The current study established the presence of the adipose sac within the labium majus structure. An inaccurate gross



Fig. 8 Abdominal fat distributions represents the same subject as presented on Fig. 1. There are different forms of adipose tissue distributions in the labia majora (LM) and abdomen. The similarity exists in the subdermal location.; however, the similarity ends, since abdominal adipose tissues are in the defused form of distributions and LM adipose tissue is compacted within individual connective tissue pouch creating cylinder-like lobes (see Fig. 5). The histology of the pouch connective tissue differs from the histology of the labium majus adipose sac (see Figs. 3, 4)

anatomical description of the labium majus within the standard textbooks was documented [4–18].

Discussion

The sample size of the study was sufficient to address objectives and defined the gross anatomy and histology of the adipose sac of the labia majora. The current study determined that the adipose sac has distinct appearance and presents as the light whitish-yellowish-shiny soft tissues. This appearance distinguishes the adipose sac from the surrounding tissues of subcuticular stratum and when compared to the subcutaneous abdominal tissues, it looks different in the gross appearance and distribution.

Our findings also confirmed that the cylinder-like structures of lobules are filled with the compacted adipose tissues. The cylinder-like components within the adipose sac have separate pouches and these pouches histologically look different than the adipose sac. Additionally, the results of the current study determined that the adipose tissue configuration and orientation within the labium majus were

different than within the abdominal wall. The intact subcuticular adipose sac maintains the natural semi-balloon shape of the labia majora. Furthermore, the adipose sac of the labium majus fuses itself with the superficial fascia of the mons veneris, and fuses with the superficial clitoral ligament as well as fuses with the round ligament. These fusions provide stabilization of the labia majora [20]. Moreover, the current study confirmed Ross' et al. findings related to direct connection of the labia majora with the superficial fascia of the mons veneris and the superficial clitoral ligament [20].

The histological investigation established that the adipose sac wall was the well-organized fibro-connective tissue. These findings create an opportunity for a surgeon to repair the defect(s) of the adipose sac to restore a natural contour and shape of the labia majora. Furthermore, the adipose sac wall's defects could be responsible for anatomical deformities of the labia majora.

In general, the gross anatomical descriptions are considered long-standing facts; however, the findings of this current anatomical study determined the presence of the adipose sac with characteristic histological features. It is important to bearing in mind that liposuction or abdominoplasty can disrupt the fusion between the adipose sac and the superficial mons veneris fascia as well as the superficial clitoral ligament. Those procedures can result in undesirable site effect, including a negative impact on the overall appearance of the labia majora. The discovery of the adipose sac of the labia majora was a significant finding, since it may help surgeons in modifying existing procedures or develop new operations. Moreover, the current investigation findings imply that either autologous fat transfers [22] or artificial filler injections into the labia majora should be avoided, until proven otherwise, since such interventions can open the adipose sac and cause fat tissue migrations under the cutis. By injections of artificial or natural material into the adipose sac wall it can be opened and the fat tissue can spontaneously migrate under the cutis, causing permanent anatomical deformities to the labia majora. However, to avoid such speculation on this topic, a study should be designed and conducted to examine whether a natural fat transfer or artificial filler can cause labia majora deformity/injury.

The strength of this current study is the fact of discovery and documentation of the anatomical existence of the adipose sac within the labia majora. These findings create an opportunity for a surgeon to repair the defect(s) of the adipose sac and creating a natural contour of the labia majora. Additionally, the strength of this study rests in significant clinical potentials for practical clinical implementations of this new discovery. Currently, a surgical intervention for reconstructions of the labia majora is based on segmental resections of the skin together with the

underlying adipose sac and lobules of fatty tissue of the labia majora. At the end of the operation, the skin is only approximated [3]. Such a surgical intervention inadvertently causes flattening of a natural semi-balloon counter of the labia majora. To avoid this undesirable surgical outcome of labia majora segmental resection, new surgical techniques of labia majora such as labiopexy and labioplasty were developed by utilizing the new discovery of the adipose sac. These new surgical interventions were published elsewhere [21].

There is no similar finding in the existing literature to compare the current study's results. Dissections through the cutis tissues without stratum-by-stratum dissections inadvertently open the adipose sac's wall. Elsewhere, such anatomical dissection of the labium majus with photo documentation was presented by others [16]. An evaluation and analysis of the abdominal fat distributions established that the abdominal adipose tissue distributions deferred in the gross appearance and structural components from the labia majora.

Limitations of this study were attributed to the individual interpretations of the results, the presence of topographic postmortem changes, and the absence of accepted terms. Additionally, the mechanical strength and ability to stretch of the adipose sac wall's defects could be responsible for anatomical deformities of the labia majora; however, the biomechanical study was out of scope of this study.

The description of the fat tissue being encapsulated in the form of multiple cylinders had been described in the textbook; however, these cylinders within the labium majus are separate anatomical structures from the adipose sac, which houses these cylinders. The gross anatomical and histological characteristics of these two structures, the adipose sac and the pouch of the lobules, differ significantly from each other.

Conclusion

In the current study, the adipose sac is consistently present within the structure of the labia majora. The adipose sac is filled with lobules (cylinder-like) of condensed fatty tissues. The microscopic characteristic features of the adipose sac are regularly present as the well-organized fibro-connective-adipose tissues. In the standard textbooks, the absence of anatomical description of the adipose sac structure was noted.

Compliance with ethical standards

Conflict of interest The authors do not report any conflict of interest.

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Ethics committee Approved the study: WUM-AKBE 146/12, date of approval 06-12-2010.

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