Contents

2 Anatomical Aspects

Dawid Serafin

The object of this chapter is a detailed description of the practical anatomy of the female reproductive system in the context of Aesthetic Gynecology therapy and reconstruction. This knowledge is crucial to choosing the proper treatment while taking into consideration the patient's safety.

The female reproductive organs can be divided into internal and external organs. The internal organs consist of the uterus, ovaries, fallopian tubes, and vagina. The external organs, comprising the vulva (Latin *pudendum femininum*), consist of:

- Mons pubis
- Labia majora
- Clitoris
- Labia minora
- Vaginal opening

VAGINA

Part of the female birthing canal, the vagina is a myomembranous canal, extremely elastic and flexible, from 5 to 14 cm long (usually 6 to 8 cm), which connects the uterus to the vestibule of the vagina, which is part of the vulva. The narrowest inferior part widens gradually. Its central part is 2 to 3 cm wide. The bladder is located anteriorly to the vagina, and both ureters run between the bladder and the vagina. The urethra connected to the anterior vaginal wall with the urethrovaginal septum, which fills the urethrovaginal space (spatium urethrovaginale), is located inferiorly to the vagina. This area is often treated with energy transmission methods, such as laser, high-intensity focused ultrasound (HIFU), or radiofrequency, due to stress urinary incontinence [1–3].

Posteriorly, the superior part of the vagina (1 to 2 cm) is covered with the peritoneum, which extends onto the rectal ampulla, forming the fundus of the rectouterine pouch, which is usually a crevicular space. This area is treated in cases of vaginal dryness, also using the aforementioned methods. Indications for this treatment are vaginal atrophy or the necessity to narrow the lumen of the vagina due to loosening of the vaginal introitus, and rectocele [4].

The superior part of the vagina includes the vaginal part of the cervix. In virgins, this inferior end is closed off by the hymen, which is torn during the first sexual intercourse or spontaneously due to the use of tampons, which results in the presence of hymenal carunculae (carunculae hymenales). This area is often subject to post-partum plastic surgery [5].

The vaginal wall has three layers, which consists of an external membrane consisting of continuous tissue; a muscularis layer consisting of smooth muscle and continuous tissue; and a mucous membrane, which smoothly transforms from muscularis and includes two layers (the lamina propria and epithelium).

In some women, the anterior wall contains a sensitive sensory area with richer innervation. This area was described in 1950 by Grafenberg, who called it the G-spot [6], and in 2012 it received a histopathological description by Ostrzeński [7]. This area is often treated with platelet-rich plasma or hyaluronic acid to increase sensitivity or accessibility for the partner during intercourse [8].

Vascularization

- The vaginal artery – the descending branch of the uterine artery (or the direct branch of the internal iliac artery reaching the lateral margin of the vagina)
- Branches of the inferior vesical artery
- Branches of the middle rectal artery
- Branches of the internal pudendal artery

An azygos artery of the vagina can form on its posterior wall (arteria azygos vaginae).

Innervation

Fibres transmitting sensation as well as anatomical fibres emerge from the pelvic plexus. From there, nerves go out to the muscularis and mucous membrane. The anterior portion of the vagina where the G spot is located is innervated with branches of the pudendal nerve.

MONS PUBIS

The mons pubis is a cutaneous mound covered with pubic hair, whose shape depends on the presence of adipose tissue located above the pubic symphysis. Inferiorly it borders with the upper ridge of the labia majora. In the case of excessive adipose tissue, reduction procedures, like injection lipolysis or liposuction, can be performed. In the

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case of deficiencies, a common procedure is autologous fat transfer or hyaluronic acid injections [9].

LABIA MAJORA

The labia majora is a paired organ. These structures border superiorly with the mons pubis. The upper part of both labia descends centrally into the anterior commissure of the labia majora. Clitoral hood (prepuce) hypertrophy is often accompanied by the separation of this commissure, which should also be corrected in the case of clitoral hood reduction. The lower part of the labia forms the posterior commissure of the labia majora. Both labia are medially separated from the central structures by the pudendal cleft, and the lateral margin of the labium is also the margin of the vulva. The skin of the labia can be divided into the pilose outer part and the hairless inner part, which adheres to the labia minora and the clitoral prepuce. The labium majora resembles the anterior abdominal wall.

The volume, shape, and size of the labia are defined by the presence of the adipose sac with variable adipose tissue content. The adipose tissue has a rich venous plexus. During pregnancy these veins often become distended, causing labia majora varices due to the increased venous pressure generated by the expanding uterus. The subcutaneous layer of the mons pubis and labia majora consists of a superficial adipose layer described by Ostrański [7], which is similar to the Camper fascia and is connected to it, and of a deeper membranous layer, called the Colles fascia, which corresponds to the Scarpa fascia in the abdominal wall. The Colles fascia is attached to the ischiotibial branch inferiorly and the urogenital diaphragm posteriorly; it does not have an anterior insertion. This can be of clinical significance, since hematomas and infections cannot expand into the thigh area, but they can reach the anterior abdominal wall. The adipose sac is used in a procedure called the Martius labial fat pad graft. In the case of fat atrophy or lack of adipose tissue in slim patients, procedures with autologous fatty tissue or hyaluronic acid are often performed [10]. In cases of increased labia majora volume, a commonly performed procedure is labia majora reduction using a simple incision or the presented Double Hockey Stick Technique (Figs. 2.1 and 2.2) [11].

CLITORIS

The clitoris is homologous with the male penis; similarly to the penis it consists of the glans and corpus cavernosum. The paired corpora cavernosa (*corpora cavernosa clitoridis*), which begin as the crura of the clitoris (*crura clitoridis*), are attached to the inferior rami of the pubic bones. They merge forming the body of the clitoris (*corpus clitoridis*) in the centre, which consists of the ascending and descending part, the latter ending with the glans, which is covered with the clitoral prepuce. Superiorly, the prepuce is separated from the mons pubic by the anterior labial commissure and laterally by the labia majora. The

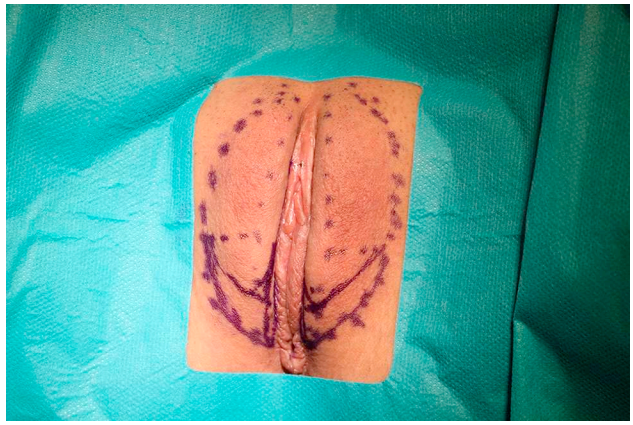

FIGURE 2.1 Labia majora plasty (Double Hockey Stick Technique) – marking lines.

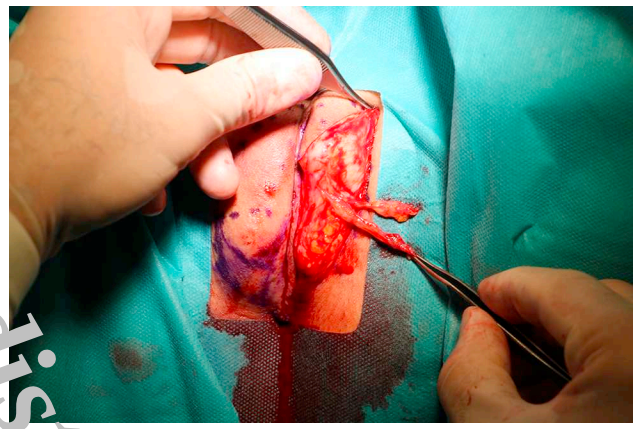

FIGURE 2.2 Labia majora plasty (Double Hockey Stick Technique) – tissue reduction.

clitoral glans changes into the frenulum of the clitoris, which then branches out forming the initial part of the right and left labium.

The prepuce is often involved in labia minora hypertrophy, which requires a complex approach to labia minora reduction procedures (Fig. 2.3). A common problem is significant prepuce elongation, which is often accompanied by hypertrophy.

As a result, the prepuce covers the whole glans, which in turn can lead to weakened sexual stimulation during clitoral excitement. In this case the reduction is performed by decreasing the width and length, and changing the shape of the clitoral prepuce, while remembering to correct the anterior labial commissure if it separated. A common result of improperly planned labiominorrhaphy with omission of clitoral foreskin hypertrophy reduction is the penile effect (Fig. 2.4).

In the case of severe clitoral foreskin hypertrophy, the lateral folds can result in incorrect assessment of the anatomy, particularly identification of the proper margins of the labia minora.

(a) (b)

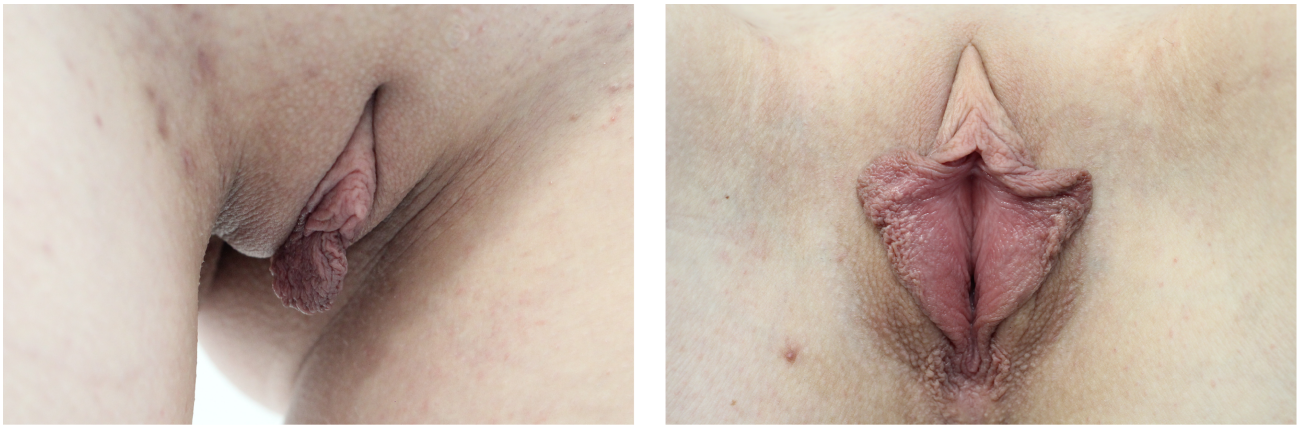

FIGURE 2.3 Clitoral prepuce hypertrophy: (a) Vulva in standing position – side view, (b) Vulva in lying position – front view.

(a) (b)

FIGURE 2.4 Penile effect after labiaplasty (Trim technique): (a) Vulva in standing position – front view, (b) Vulva in lying position – side view.

LABIA MINORA

The labia minora is a paired organ, located bilaterally between the labia majora. In the centre, they close off the area called the vestibule of the vagina. Superiorly, the ridges of both labia come down across the middle line forming the frenulum of the clitoris. The lower part of the labia minora extends downward forming the frenulum of the labia minora. The labia minora are covered by hairless skin, both externally and internally, divided by tissue homologous to the structure of the corpus spongiosum. The labia minora are very often afflicted with congenital shape, size, and thickness deformations. Labia minora hypertrophy can cause the skin structure to change, which is often associated with darkening of the labia (Fig. 2.5). This kind of hypertrophy is often an indication for labia reduction. This procedure has been performed for many years, and there are many techniques depending on the shape, size and type of hypertrophy. The types of labia hypertrophy have not been classified such as to mandate choosing a specific surgical technique. The current classification takes into consideration the size and characteristics of the hypertrophy, but the choice of the

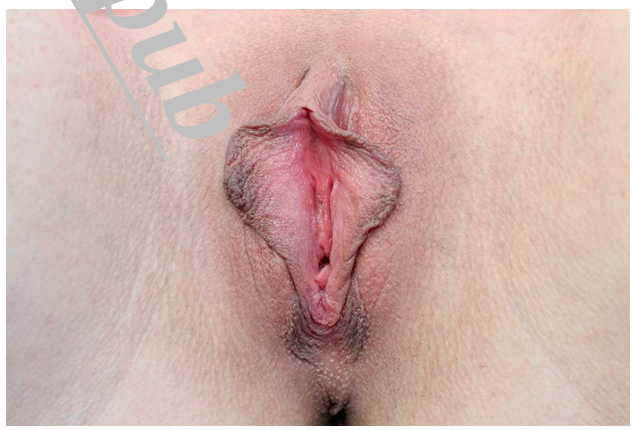

FIGURE 2.5 Labia minora hypertrophy.

surgical technique depends on the skills and experience of the surgeon.

Vaginal Opening (Introitus, Vestibule)

This central orifice is partially closed off by the hymen. Anatomically, this area is limited superiorly at the frenulum of the clitoris, laterally by the labia majora, and inferiorly by the frenulum of the labia minora. From the top, it consists of the urethra and the vaginal introitus beneath located in the midline. The vestibule of the vagina is also an essential area for minimally invasive procedures, since it may require e.g., platelet-rich plasma injections used in treating dysfunctions consisting in a weakened ability to experience sexual satisfaction during intercourse or masturbation [12].

Vascularization

Blood to the external genitalia is supplied by arteries forming many anastomoses. The internal pudendal artery, which is the main branch supplying blood to the external genitalia, is a branch of the internal iliac artery and branches out into:

- The inferior rectal artery descending into the rectal canal
- The perineal artery supplying the superficial transverse muscles of the perineum
- The posterior arterial branches supplying the labia
- The artery supplying the bulb of the vaginal vestibule
- The dorsal artery of the clitoris
- The deep artery of the clitoris supplying the corpora cavernosa of the clitoris

The external iliac artery extending into the external pudendal artery branches out into:

- The anterior labial artery

The femoral artery is an extension of the external iliac artery, which branches out into:

- The external pudendal artery additionally supplying the labia majora

Innervation

The innervation of the vaginal vestibule stems mostly from the pudendal nerve. It is a mixed nerve, which extends from the abdominal branches of the S2, S3, S4 spinal nerves and the intermediomedial nucleus.

The muscle branches innervating the muscles in the pelvis, the cutaneous nerves innervating the skin of the vulva, except for the mons pubis and the anterior part of the labia majora, which is additionally innervated with the anterior labial nerves extending from the ilioinguinal nerve, the perineal branches of the posterior cutaneous femoral nerve, and the genital branch of the genitofemoral nerve (*ramus genitalis nervi genitofemoralis*) extending from the lumbar plexus.

Labia Minora Classification

Until now, the sole classification of external female genitalia abnormalities included only hypertrophy of the labia minora.

The first attempt to create a classification system was made by Felicio in 1992 [13]. This classification included four size variations, where the width of the labia was assessed from 2 to 6 cm:

1. Up to 2 cm
2. 2–4 cm
3. 4–6 cm
4. Over 6 cm

This did not exhaust all the possibilities in the case of labia reduction.

In 2011, Cuhna presented a classification that assessed the characteristics of the hypertrophy instead of its size [14], which consisted of three grades of excess skin:

1. In the posterior/inferior region adjacent to the vaginal introitus
2. Extending laterosuperiorly to the clitoris
3. In the entire region, including the clitoral prepuce

This was the first classification to include the clitoral prepuce.

The widest classification, presented by Gonzalez in 2015, describes both the length of the labium from the base, the presence of clitoral prepuce hypertrophy, and symmetry [15]. This classification allows the clinician to organize medical documentation in a systemic way and is also helpful at the initial stage of reduction procedures, since it helps select which technique should be used for the specific type of hypertrophy based on its classification.

Grade of hypertrophy		*By location*	*By symmetry*
1	Up to 2 cm	A: Anterior	Symmetrical
2	2–4 cm	B: Central	Asymmetrical
3	4–6 cm	C: Generalized	
4	Over 6 cm		

Type-based hypertrophy classification is certainly a helpful tool in planning surgical procedures and preparing proper documentation, both pre-operatively and post-operatively. At the same time, it is this author's opinion that the extent of the procedure and the selected surgical technique should not be based solely on a classification system. The decision should be made after consulting with