

# The vaginal outlet: Anatomy and histology discoveries

Adam Ostrzenski (✉ [ostrzen@fiu.edu](mailto:ostrzen@fiu.edu))

Padua University <https://orcid.org/0000-0003-0132-1626>

---

## Research Article

**Keywords:** Vaginal outlet, Vaginal outlet anatomy, Vaginal outlet histology, Vaginal outletctomy, Vaginal introitus, Vaginal Orifice

**Posted Date:** April 25th, 2022

**DOI:** <https://doi.org/10.21203/rs.3.rs-1471146/v1>

**License:**  This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

---

# Abstract

## Purpose

The vaginal outlet (VO) anatomy and histology have not been described in scientific-clinical literature or traditional anatomy textbooks. The question of the present study is whether the VO has a different anatomical structure(s) and histology than the vaginal wall? The objectives are to describe VO's gross and topographic anatomy, histology stained with hematoxylin and eosin, and document findings by digital photograms.

## Methods

Ten fresh human adult female corpses were subjected to stratum-by-stratum anatomical, macro, and micro dissections in sagittal, transverse, and coronal planes. The multiple excisional biopsies were obtained from VO at 12, 3, 6, and 9 o'clock locations and submitted to histological examination.

## Results

VO consisted of specific anatomical structures in vertical orientation and fused with horizontally located the vaginal wall at the hymeneal plate level. VO had three identifiable anatomical-histological layers a) the hymeneal membrane, b) the hymeneal ring, c) the hymeneal plate, and had specific histological characteristics features that distinguish VO from the vaginal wall. In addition, the vaginal wall was connected to the vaginal outlet at the level of the hymeneal plate, the deepest layer of the vaginal outlet.

## Conclusions

The vaginal outlet is an anatomical structure consisting of the hymeneal membrane, hymeneal ring, hymeneal plate, and it is in vertical topographic orientation. Anatomically and histologically, it differs from the vaginal walls, and the vaginal wall fuses with the hymeneal plate.

## Introduction

The vaginal outlet is a new anatomical terminology representing a newly discovered structure that differs from the vaginal walls. It comprises three layers documented by the gross and topographic anatomy and confirmed by the histology: a) hymeneal membrane; b) hymeneal ring; c) and hymeneal plate, and they are not the part of the posterior perineum.

The vaginal outlet and its resistance force play an essential role during vaginal delivery of a fetal head, participate in the vaginal orifice closure mechanism, and plays a role in sexual vaginal intercourse. Therefore, it is vital to understand the gross and topographic anatomy of the vaginal outlet by

anatomists, clinical teachers, obstetricians, and midwives. The vaginal outlet anatomy can assist them in avoiding severe complications associated with a traditional episiotomy. However, reviewing conventional anatomy textbooks that were published since 1859 showed that vaginal orifice is also called the vaginal introitus, vaginal vestibule, or the vaginal orifice and did not include a description of the vaginal outlet [1–5]. Additionally, the electronic and manual searches of the medical literature failed to identify any scientific-clinical article in which the vaginal outlet is described. Therefore, the present study is the first anatomical and histological description of the vaginal outlet.

The question of the present study is whether the vaginal outlet has different anatomical compositions and histology of the vaginal wall? Consequently, the study question allows defining the research hypothesis of whether the vaginal outlet extends the posterior-distal vaginal wall but consists of autonomic and different anatomy structures than the posterior-distal vaginal wall. Therefore, the objectives of this study are to describe the vaginal outlet gross and topographic anatomy, present histology, and document findings by digital photograms.

The reason to describe the vaginal outlet gross, topographic anatomy, and histology is vitally important for anatomists, obstetricians, gynecologic surgeons, and clinical teachers. Additionally, establishing the vaginal outlet anatomy and histology will put to rest the anecdotal notion that the vaginal outlet is an extension of vaginal walls.

## **Materials And Methods**

The present study included twelve fresh human adult female cadavers. No medical records were available due to services that the Department of Forensic Medicine provides, and it does not have access to medical records of the deceased, and only initials were available. The University Bioethical Committee approved this exploratory, experimental research (WUM-AKBE 146/12).

## **Inclusion/exclusion criteria**

Women who expired within twenty-four hours and did not undergo the preservation process were incorporated into the current research. Additionally, subjects who were victims of incest or rape were excluded from the investigation for legal reasons. Also, those corps presented with anatomical deformity due to surgery on or trauma to the vagina or external genitalia, anatomical disfigurement of urogenital structure, the vulvar skin, or transitional vulvar skin lesions, identifiable tumor, enlarged lymphatic nodes, and those who grossly demonstrated contiguous disease were excluded.

## **Anatomical dissection**

Every corpse was placed on the anatomical table in the supine position with lower extremities separated laterally and a band in the knee joint; to stabilize in this position, a wide bandage was used, and the ankle and wrist were held together, preventing legs from moving; the under the knee bandage is attached to an IV pole to stabilize the legs laterally. The author of this study executed all macro and micro dissections

(3.5-4.0x magnification loupe was used). The labium minus on both sides was separated in the midline, and traction 2 – 0 size sutures were used to secure labia to the vulvar skin—this maneuver allowed access to the vaginal outlet. The vaginal outlet was marked with a dermo-marker at 12, 6, 3, 9 o'clock for the future orientation of taking biopsies for histological examinations.

The labia minora frenulum was incised, extended through the fossa navicularis, and stopped at the hymen. Next, the superficial incision was made within the crease between the hymen and the labia minora. The Bartholin's duct orifice and urethral membranous sphincter were outside the incision. The subsequent step was to make on the hymeneal membrane the vertical incision with no. 15-blade of the surgical scalpel, and it was dissected off from the hymeneal ring. This structure shows as well-defined and in the white color structure that fuses with the hymeneal dissection until the entire hymeneal plate is visualized. Consequently, the three layers of the vaginal outlet can be identified, and the perpendicular orientation to the vaginal wall is visible. Additionally, biopsies from the vaginal outlet were taken from predetermined sides.

## Literature search

The medical literature was searched electronically and manually for the gross and topographic anatomy of the vaginal introitus, vaginal vestibule, vaginal orifice, and vaginal outlet. In addition, anatomy articles, conference proceedings, and specializing websites were also included. The Medical Subject Headings (MeSH) were applied. The following keywords or phrases were used: the human vagina, vaginal outlet gross human vaginal outlet topographic anatomy, human vaginal introitus gross anatomy, human vaginal topographic anatomy, human vaginal orifice gross anatomy, human vaginal orifice topographic anatomy, perineal body location, vaginal posterior-distal laceration, vaginal outlet (vaginal introitus, and vaginal orifice) histology, posterior vaginal colporrhaphy.

## Results

The vaginal outlet was a separate anatomical structure and not an extension of the posterior-distal vaginal wall or the posterior perineum. It consisted of three anatomical strata: the hymeneal membrane, hymeneal ring, and hymeneal plate supported by the perineal fascia, Fig. 1, 2. Those three layers formed one conglomerate that grossly resembled “a belt,” Fig. 2. The white color structure of the hymeneal ring emerged upon dissecting the hymeneal membrane. The hymeneal ring and hymeneal plate protuberance created the crease that was a demarcation line between these structures, Fig. 1B. The vaginal outlet was identified as a “belt” and was presented in Fig. 1B and Figure. 3. The vaginal outlet was in a vertical orientation, Fig. 1A, 1B, Fig. 3, connected perpendicularly with the vaginal walls were in a horizontal orientation, Fig. 1A. Those two anatomical structures were joined at the level of the hymeneal plate.

Multiple cadaveric vaginal outlet biopsies were submitted for hematoxylin and eosin staining and histological evaluation. Microscopic characteristic features showed three layers of the vaginal outlet – superficial, intermediate, and deep, Fig. 2. The superficial layer of the vaginal outlet structure was the

hymeneal membrane, Fig. 1B, Fig. 2, which consists of striated squamous cells arranged on average in five roses (from 4 to 10 roses) of the epithelial cells. The subepithelial stratum was well-organized and composed of 10 roses of epithelial cells. The elastic lamina propria was a dense connective fibers layer projecting papillae into the overlying epithelium with the capillary blood vessel network and nerve endings. Beneath the lamina propria was a strip of the columnar epithelial cells. In addition, the parabasal, basal cells, and basal lamina were identifiable. In the Intermediate layer, the hymeneal ring rested between the upper part of the hymeneal membrane and the lower layer of the hymeneal plate, Fig. 1B and Fig. 2. It was composed of dense connective fibers with a network of arterial blood vessels, veins, nerve endings, and muscle fibers, Fig. 2. Finally, the deep layer – the hymeneal plate – was the stratum of the vaginal outlet composed of dense elastic fibers, connective fibers, and smooth muscles (Fig. 2). This stratum was connected to the vaginal wall.

## Discussion

### Principal findings

The current anatomical research showed that the vaginal outlet was not the extension of the vaginal walls, but it is an anatomical structure with characteristic histological features, Fig. 1, B, 2. The anatomy of the vaginal outlet consists of three layers, Fig. 1a) hymeneal membrane, b) hymeneal ring, c) hymeneal plate. Furthermore, moving from the posterior to the anterior part of the vaginal outlet, it was observed that the vaginal outlet gets thinner, and the anterior or suburethral fragment was the thinnest among them. It is essential findings in reference to where to place an incision when an obstetrical procedure of episiotomy is performed or how to reconstruct the defective vaginal outlet. Additionally, the vaginal outlet is the narrowest part of the vaginal canal. This finding may play a significant role during the fetal head vaginal delivery because it creates tissue resistance on passing through a fetal head.

### Comparison

The vaginal outlet anatomy is not described in the medical literature, and it is the ill-anatomical concept that the vaginal introitus or vaginal vestibule is the vaginal outlet; it is not. The present anatomical and histological investigation shows that the vaginal outlet structure is a distinct gross anatomical and histological structure. On the contrary, the vaginal introitus, or vaginal vestibule terminologies, more reflects space rather than anatomical structures since there is no description of the anatomy.

The clinical-scientific medical literature does not report on the vaginal outlet. Although, there is a clinical situation where the “vulvar outlet stenosis” is recognized, causing superficial dyspareunia [6–8]. They postulated that the vulvar outlet should be evaluated when a relaxed vaginal outlet is present. However, they did not present the anatomy or surgical intervention.

## Documentation

The digital photographic documentation of the anatomy and histology of the vaginal outlet convincingly proves that this structure is fused with the vaginal walls; however, it is not an identical anatomical extension of the vaginal walls. Moreover, the present study's findings can assist obstetricians, general practitioners, midwives, and surgeons in better understanding this vital anatomical structure. Finally, this study confirmed the accuracy of the existing clinical classification of vaginal introitus.<sup>9</sup>

## **Strength and limitations**

The most significant strength of the present study is the anatomical discovery of the vaginal outlet, its histological documentation that the vaginal outlet has different microscopic features than the vaginal walls. Moreover, the current study shows that the vaginal walls are horizontal and fuse with the hymeneal plate that is in the vertical orientation. Therefore, the hymeneal membrane and ring are not directly linked to vaginal walls, Fig. 1B.

The limitation of this study is that postmortem anatomical structure diameters do not reflect the actual size in live women due to tissue shrinking. Additionally, the research on the cadavers can not establish the functional anatomy of the vaginal outlet; however, it can be used as a tool for functional understanding of these anatomical structures. Additionally, clinical research indicates that the vaginal outlet can play a role in vaginal wall prolapse and vaginal parturition, Fig. 3. Furthermore, a single researcher's interpretation of the anatomical findings can also be considered a limitation.

## **Future research**

The present study findings showed that the vaginal outlet could have played a potentially significant role in developing a new episiotomy procedure (vaginal outlectomy) and, by doing so, eliminating the incisions of the posterior perineal musculature and eliminating postpartum posterior perineal pain. However, additional clinical-scientific research is needed to assess vaginal outlectomy on alive subjects since the current study on female corpses cannot evaluate it. Future studies on a new episiotomy can revolutionize our current obstetrical practice.

## **Conclusion**

The vaginal outlet is an anatomical structure consisting of the hymeneal membrane, hymeneal ring, hymeneal plate, and it lays in vertical topographic orientation. Anatomically and histologically, the vaginal outlet differs from the vaginal walls, which fuse with the hymeneal plate.

## **Declarations**

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. The study was approved by the Bioethics Committee of the Warsaw Medical University (WUM-AKBE 146/12).

This study was performed in line with the principles of the Declaration of Helsinki. Approval was granted by the Bioethics Committee of Warsaw Medical University B ((WUM-AKBE 146/12).

**Funding:**

The authors declare that no funds, grants, or other support were received during the preparation of this manuscript.

**Competing Interests:**

The authors have no relevant financial or non-financial interests to disclose.

**Author's contribution:**

The author develops the study's hypothesis, designs the research protocol, collects data, analyzes and interprets findings, provides documentation, and drafts the manuscript.

**Ethics approval:**

This study was performed in line with the principles of the Declaration of Helsinki. Approval was granted by the Bioethics Committee of Warsaw Medical University (WUM-AKBE 146/12).

**Consent to participate:**

Written informed consent was obtained from the parents.

**Consent to publish:**

The author affirms that human research participants provided informed consent for the publication of the images in Figures 1-3.

**Acknowledgments:**

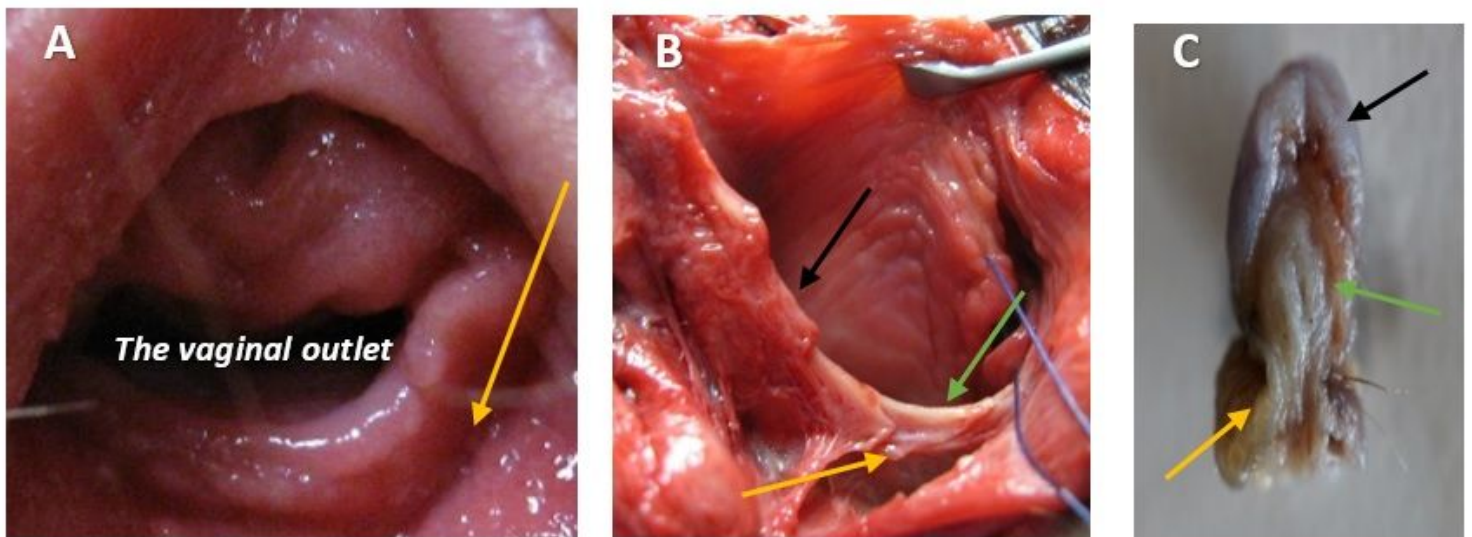
The author would like to thank Prof. Dr. Pawel Krajewski, chairman of the Department of Forensic Medicine, Warsaw Medical University, for providing access to fresh human female cadavers and obtaining the study protocol approval from the local Bioethics Committee. The author also wishes to express gratitude to Zbigniew Antosz, M. D. from Diagnostics Consilatione, Poland, who assisted in histologic staining and interpretations of the microscopic features. Finally, the author wishes to thank those families who donated their bodies to science for performing anatomical research.

**References**

1. Dunlison RJ (1859) Gray's Anatomy. Anatomy of the Human Body. First American Edition. Blanchard and Lea, Philadelphia, PA, USA

2. Netter FH (1984, 1989) The Ciba Collection of Medical Illustrations. Reproductive System. Vol. 2. Ciba-Geigy Corporation, West Caldwell NJ, USA
3. Clemente CD (1985, 1987) Gray's Anatomy. 30<sup>th</sup> edition. Lea & Febiger, Philadelphia, PA, USA.
4. Williams PL et al. (1995) Gray's Anatomy. 38<sup>th</sup> edition. Churchill Livingstone, New York, NY, USA.
5. Standing S (2008) Gray's Anatomy. The Anatomical Basis of Clinical Practice. 40<sup>th</sup> edition. Churchill Livingstone-Elsevier, New York, NY, USA
6. Paniel BJ, Haddad B, el Medjadji M (1995) Orifice dyspareunia: the surgeons point of view. Contracept Fertil Sex Apr;23(4):271-274.
7. Cundiff GW & Fenner D, 2004 Evaluation and treatment of women with rectocele: focus on associated defecatory and sexual dysfunction. Obstet Gynecol;104(6):1403-1421.
8. Cespedes RD (2011) The treatment of posterior compartment vaginal defects. Urol Clin North Am. Feb;38(1):17-23, v. doi: 10.1016/j.ucl.2010.12.003. PMID: 21353075.
9. Ostrzenski A (2011) The first clinical classification of vaginal introital defects. Eur J Obstet Gynecol Reprod Biol;159(2):449-452.

## Figures



**Figure 1**

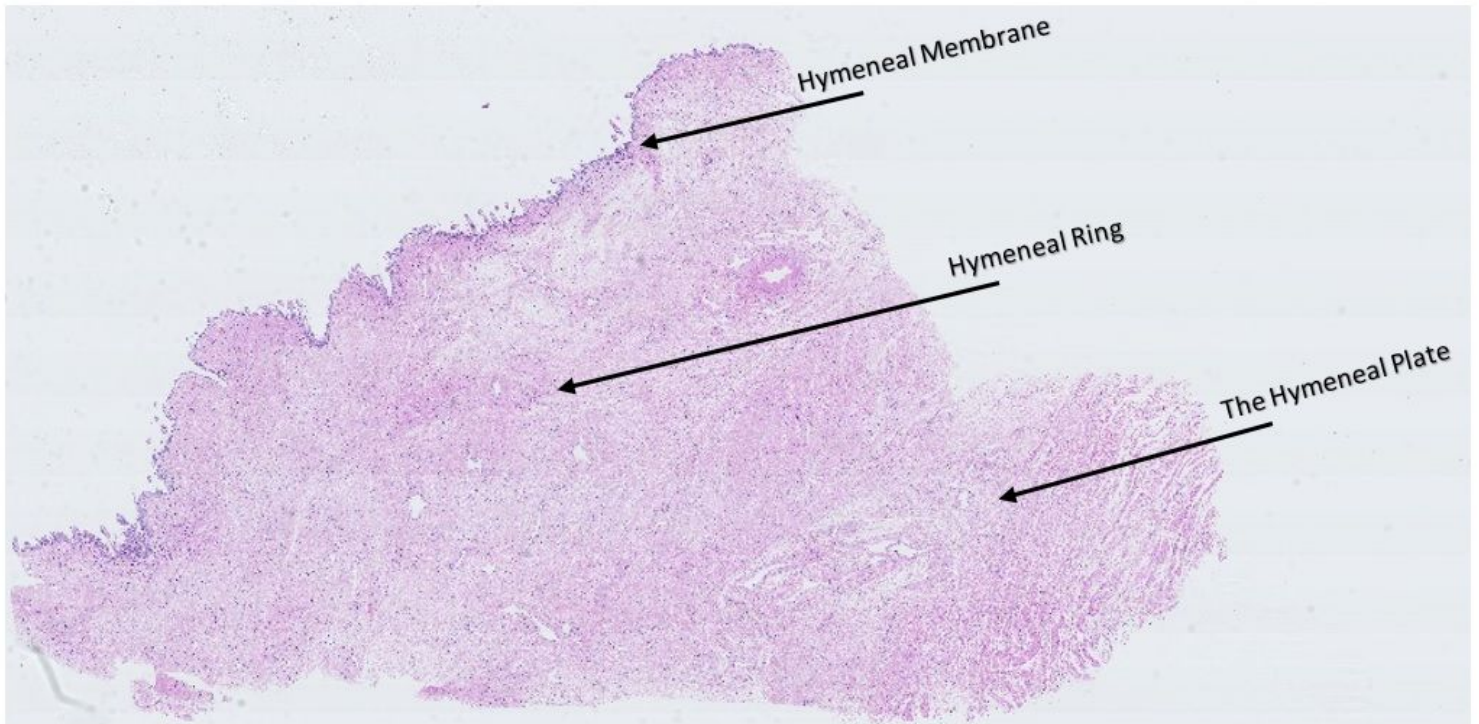
The gross and topographic anatomy of the vaginal outlet

**A.** General, an external view of the vaginal outlet is depicted. The yellow arrow points to the hymeneal crease that separates the horizontal location of the vaginal outlet plane. The hymeneal crease as a demarcation line connects the vaginal outlet anatomical structures with the vertical plane of the labia minora - laterally, the fossa navicularis – posteriorly, and the urethral membranous sphincter -anteriorly.



**B.** Three anatomical structures of the vaginal outlet are presented: a) the hymeneal membrane is the superficial layer (the black arrow); b) the green arrow shows the hymeneal ring; c) the yellow arrow indicates the protrusion of the hymeneal plate, and there is also the visible groove between the hymeneal ring and the hymeneal plate structures.

**C.** The V-shape excised fragment of the vaginal outlet anatomical structures. The black arrow indicates the superficial layer (the hymeneal membrane) of the vaginal outlet; the green arrow represents the middle layer (the hymeneal ring); the yellow arrow depicts the deep layer (the hymeneal plate).



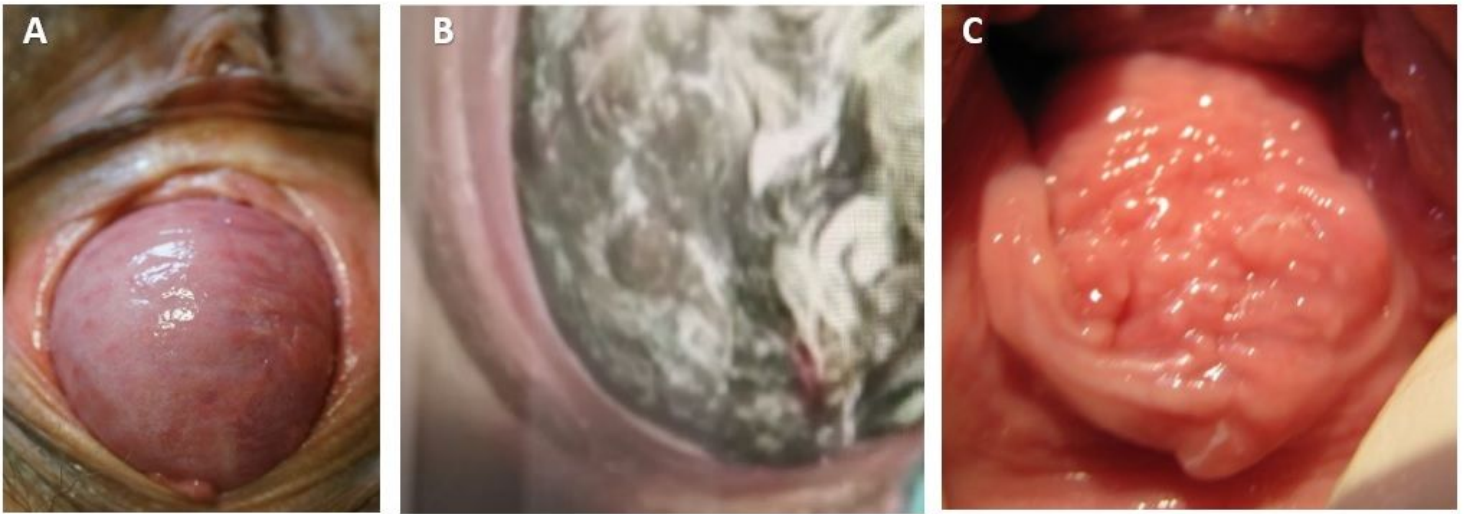
**Figure 2**

Microscopic characteristic features of the vaginal outlet and its histologic layers of the vaginal outlet.

The superficial layer of the vaginal outlet structure is the hymeneal membrane that consists of striated squamous cells arranged on average in five roses (from 4 to 10 roses) of the epithelial cells. The subepithelial stratum is well-organized and composed of 10 roses of epithelial cells. The elastic lamina propria is a dense connective tissue layer projecting papillae into the overlying epithelium with the capillary blood vessel network and nerve endings. Beneath the lamina propria is the strip of the columnar epithelial cells. In addition, the parabasal, basal cells, and basal lamina are identifiable.

The hymeneal ring is the middle part between the upper part of the hymeneal membrane and the lower layer of the hymeneal plate (intermediate layer); it is composed of dense connective tissue with a network of arterial blood vessels, veins, numerous nerve endings, and the muscle fibers.

The hymeneal plate is the deep layer of the vaginal outlet. It is composed of dense connective, elastic fibers and smooth muscles that connect with the longitudinal layer of the vaginal smooth muscles.



**Figure 3**

The clinical function of the vaginal outlet

- A.** Resistance force of the hymeneal outlet structure on the anterior vaginal wall prolapse cystocele),
- B.** The belt-like of vaginal outlet structure resists the fetal head passing during vaginal delivery,
- C.** The defective vaginal outlet structure causes the posterior-distal vaginal wall prolapsing.

## Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [GraphicalAbstract.jpg](#)