

Pelvic cavity and its spaces — anatomical overview

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Abstract: Anatomical nomenclature commonly does not follow changes in the clinical language and demands. Therefore we tried to explain the pelvic relationships based on the changes that occur in the pelvis as well as to compare different nomenclatural strategies used in every day language. Courses of fasciae in the male and female pelvis are also considered.

Keywords: pelvic cavity, peritoneum, fascia.

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Introduction

The pelvic cavity is a space that is limited by pelvic walls and communicates upward with the abdominal cavity. The pelvic floor is created by two diaphragms: pelvic and urogenital. It divides the pelvic cavity into supradiaphragmatic and infradiaphragmatic parts. Peritoneum that descends from abdominal cavity into the true pelvis divides the supradiaphragmatic sector into intraperitoneal compartment (which is the highest level of the pelvis) and the subperitoneal space. The space located between the pelvic floor and the skin is defined as subcutaneous space. The latter creates the lowest level of pelvic cavity.



Peritoneum in the males descends from the anterior abdominal wall and runs over the bladder and descending from its posterior surface it migrates toward the anterior rectum forming the rectovesical pouch.

In the females the peritoneum descends from the anterior abdominal wall and creates the vesicouterine pouch and next it covers part of the anterior uterine corpus, the uterine fundus, posterior wall of the uterus, supravaginal portion of the uterine cervix and finally the posterior wall of the upper vaginal segment (which surrounds the posterior vaginal fornix) — Fig. 1. After that it creates rectouterine pouch (pouch of Douglas) [1] and enters anterior rectum. Pouch of Douglas is the lowest peritoneal recess in the female.

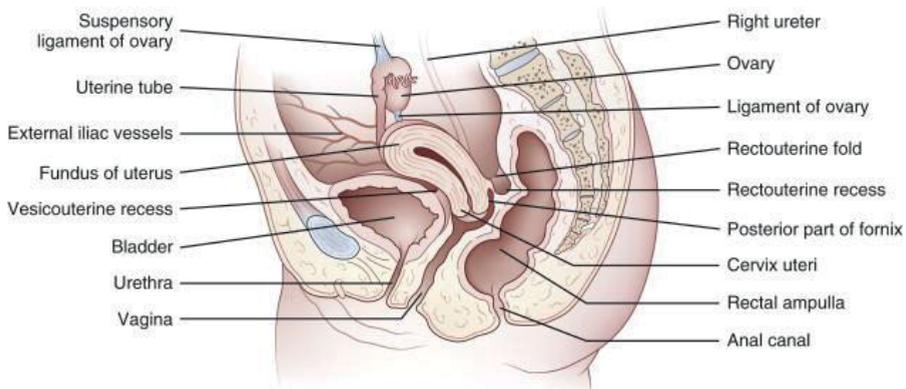


Fig. 1. Sagittal section of the female pelvis.

The male pelvic intraperitoneal space contains bowels, appendix and lower sigmoid colon. In the female pelvis one can additionally find the ovaries and the oviducts. The ovaries are actually within the peritoneal cavity, because they are not covered with the visceral peritoneum.

Subperitoneal space

The subperitoneal space is limited from above by the parietal peritoneum. Its inferior limitation is the pelvic floor. The space connects supero-anteriorly and supero-posteriorly with the preperitoneal and retroperitoneal spaces respectively. The subperitoneal space comprises:

- I. Both in the males and the females
 1. urinary bladder
 2. pelvic portions of ureters
 3. part of the urethra
 4. rectum

5. internal iliac arteries together with their ramifications
6. internal iliac veins with tributaries
7. lymphatic vessels and sacral, internal iliac, and pelvic lymph nodes
8. sacral plexuses with their nerves
9. pelvic portions of sympathetic trunks with their rami [2, 3]
10. hypogastric nerves
11. pelvic splanchnic nerves
12. inferior hypogastric plexuses and their subsidiary rami
13. obturator nerves

II. Besides in the males

1. prostate
2. pelvic portions of ductus deferens
3. seminal vesicles
4. ejaculatory ducts

III. In the females

1. uterus with entire suspensory apparatus
2. upper vagina

Posteriorly and laterally the pelvic cavity communicates with the subgluteal space through greater and lesser sciatic foramina. The greater sciatic foramen is divided into two compartments by the piriformis muscle: the super- and the infrapiriform foramina.

The suprapiriform foramen is traversed by:

- Superior gluteal nerve
- Superior gluteal artery with comitant veins and lymphatics

The infrapiriform foramen communicates pelvis with the subluteal space. It is traversed by the following:

- Inferior gluteal nerve, inferior gluteal vessels and lymphatics
- Pudendal nerve
- Internal pudendal artery with comitant veins
- Sciatic nerve
- Posterior cutaneous nerve of thigh

The lesser sciatic foramen communicates the subgluteal space with the pelvic cavity and contains the following:

- Obturator internus muscle
- Pudendal nerve
- Internal pudendal artery with comitant veins and lymphatics

Subcutaneous space

The subcutaneous space is place under the pelvic floor and is the inferior, infradaphragmatic part of the pelvic cavity. It is limited laterally by the pelvic walls covered with muscles, and inferiorly by the perineal skin. Localization of this space is adjacent to the perineal region; posterior perineal region is adjacent to the anal area and the anterior — urogenital area. The subcutaneous space can be divided into:

- Anterior perineal area — divided by the perineal membrane into:
 - Deep perineal space (is located above the perineal membrane)
 - Superficial perineal space (is located below the perineal membrane) below the latter one can find only the sbcutaneous perineal tissue, so superficial perineal fascia and perineal skin
- Posterior perineal area — right and left ischioanal fossae

Deep perineal space

Deep perineal space is a potential space limited:

- From above: by superior fascia of the urogenital diaphragm
- From below: by the inferior fascia of the urogenital diaphragm (or perineal membrane)
- Bilaterally: inferior fragment of the obturator fascia, ischial ramus and inferior pundental ramus

The content of the deep perineal space differs between the males and females.

In the females:

- urethra
- vagina
- deep transverse perineal muscle (according to some authors this muscle does not exist in the females)
- urethrovaginal sphincter
- major vestibular glands
- rami of internal pudental vessels
- deep artery of clitoris
- dorsal artery of clitoris
- artery of the bulb of vestibule
- urethral artery
- rami of the pudental nerve (dorsal nerve of clitoris, perineal nerves)

In the males:

- mambranous urethra
- deep transverse perineal muscle
- external urethral sphincter

- bulbourethral glands (of Cowper)
- rami of internal pudendal vessels
- branches of pudendal nerve (dorsal nerve of penis, perineal nerves)

Superficial perineal space

Superficial perineal space (or interfascial space) is a potential space located between the perineal membrane (earlier known as inferior fascia of the urogenital diaphragm) and superficial perineal fascia [4]. It is included into urogenital triangle.

This space contains: superficial perineal muscles, perineal rami of the internal pudendal vessels together with the lymphatics, pudendal nerve (or rather its ending branches — perineal nerves, and among them posterior scrotal / posterior labial nerves, and muscular rami supplying transverse perineal muscles, bulbospongiosus muscle, ischiocavernosus muscle, levator ani and external anal sphincter). Besides, in the males we can find the spongy and cavernous bodies of penis, ischiocavernosus and bulbospongiosus muscles, and the beginning portion of spongy urethra. In the females we can find the clitoris with accompanying ischiocavernosus muscles, bulbs of the vestibule with bulbospongiosus muscles and greater vestibular glands [5].

The bulbospongiosus muscle in the males is unpaired muscle, neighbors from above with the urogenital diaphragm, and laterally with the ischiocavernosus muscles. It begins in the central tendon of perineum and is also a partial extension of the external anal sphincter. It reaches the spongy body of penis (ending in the deep penile fascia on the dorsal side). In the females it is paired muscle, embraces the vagina and urethra, adhering to the vestibular bulb and the greater vestibular glands. It also begins in the central tendon of perineum, running similar as in the males as extension of the external anal sphincter ending in the cavernous bodies of the clitoris [6].

The ischiocavernosus muscle arises in the males from the medial surface of sciatic tuberosity and sacrotuberous ligament, reaching the dorsum of the penis and its limbs (crura). In the females it is placed on the crus of clitoris pushing the blood forward (erection of clitoris).

Perineal fascia consists of two layers: superficial and deep.

Deep perineal fascia, known as fascia of Gallaudet [2], is a layer that covers muscles located within the superficial perineal space (ischiocavernosus, bulbospongiosus, transverse perineal muscles) — Fig. 2. The fascia is attached laterally to ischio-pubic ramus and joins the suspensory ligament of penis or clitoris from anterior. It joins the deep abdominal fascia from anterior, and in the males it joins also Buck's fascia [7].

Superficial perineal fascia (or subcutaneous perineal layer) is a tissue which is placed in the perineal area. The space occupied by the superficial perineal fascia is sometimes named the subcutaneous perineal space. This fascia is composed of two layers: superficial fatty layer and deep membranous layer.

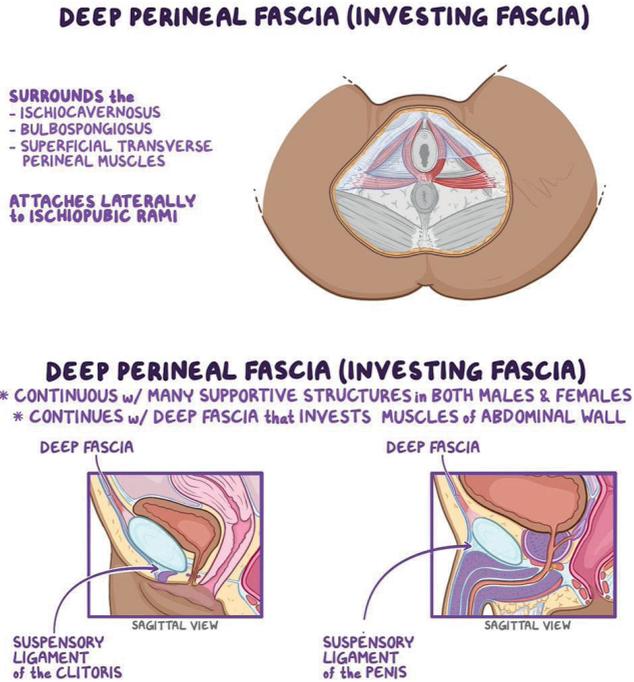


Fig. 2. Course of deep perineal fascia in the females and the males.

The superficial is thick and loose, contains lots of fat in its compartments, although amount of fat may differ individually.

The superficial fatty layer differs between the males and the females. In the females it forms a background for major pudendal labia and mons pubis. In the males it extends until the penis and the scrotum. In the scrotum it is replaced by thin layer of smooth muscles, named muscle of tunica dartos. Both in the males and the females fatty layer continues in the inferior part of the anterior abdominal wall as fatty layer of the superficial abdominal fascia (Camper's fascia) [8] — Fig. 3. To the back it connects with the fatty tissue surrounding the anal canal, known as ischioanal fat pad.

The deep layer of the superficial perineal fascia, known also as membranous fascia (Colles fascia) is thin and strong and resistant. It separates the skin and subcutaneous fat from the superficial perineal space. This layer attaches to posterior margin of the perineal membrane and central perineal tendon and continues laterally as fascia lata of the thigh. Anterior attachment differs between males and females. In the females the deep membranous and superficial fatty reach the major pudendal labia. In the males both layer are connected to join the connective tissue of the penis and scrotum (tunica dartos). Both in males and females the deep membranous layer connects with membranous layer of superficial abdominal fascia (Scarpa's fascia) [9] — Fig. 4–7.

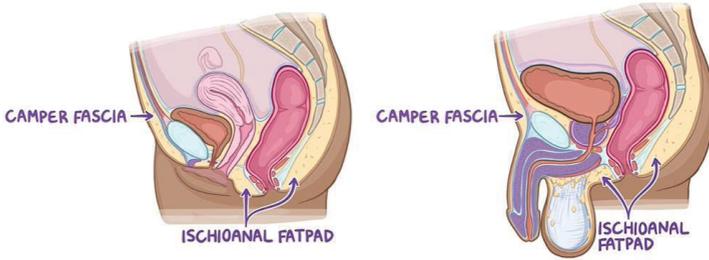


Fig. 3. Camper fascia in the females and the males.

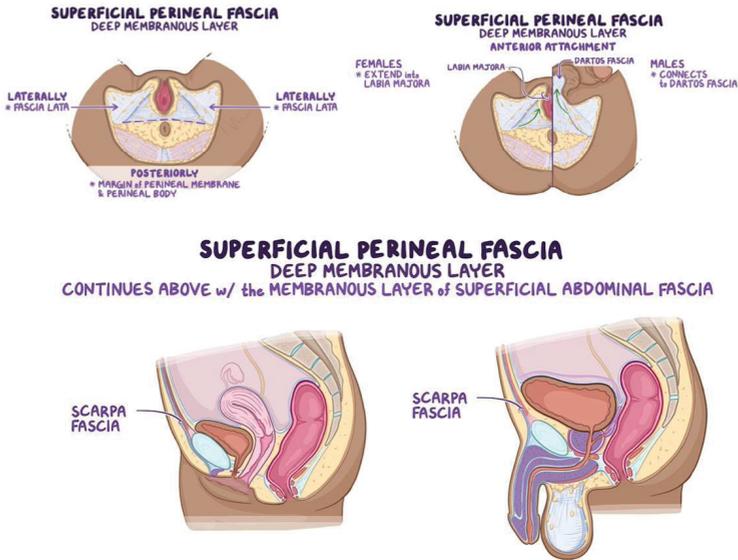


Fig. 4. Superficial perineal fascia in the female and the male.

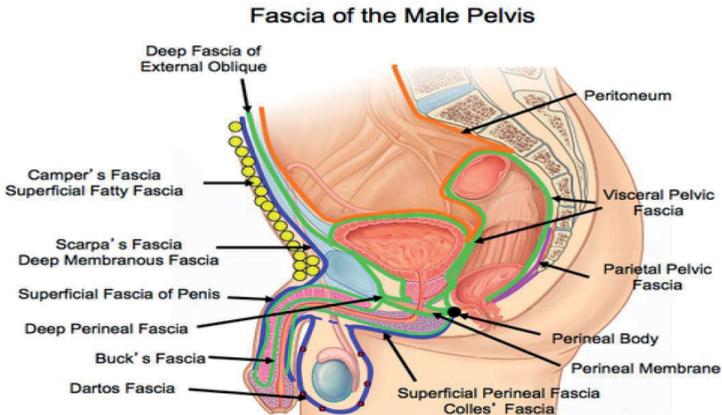


Fig. 5. Fasciae of the male pelvis — general arrangement.

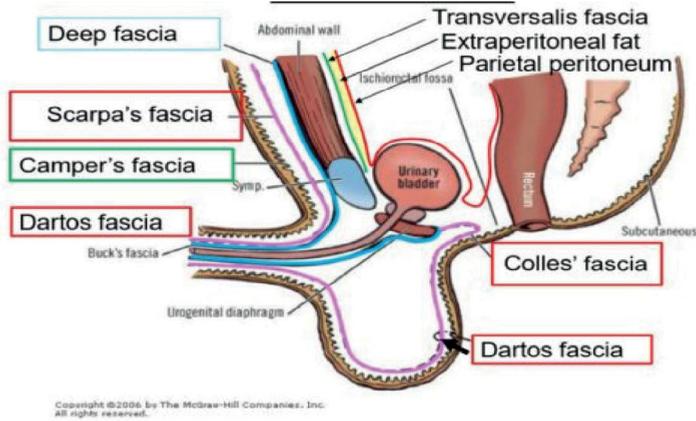


Fig. 6. Fasciae in the male pelvis — their relationship.

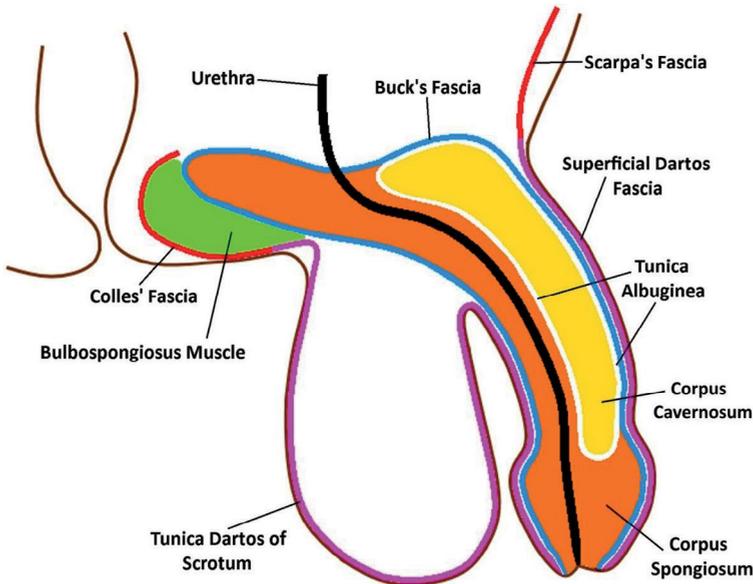


Fig. 7. Relationship of the dartos, Buck's and Colles' fasciae in the male pelvis.

Ischioanal fossa

Nowadays much of the textbooks use the term ischioanal fossa [10], formerly known as ischioanal fossa. The region is however firmly associated with the anal canal not the rectum so a proper descriptive term is the ischioanal fossa.

The fossa is a wedge-shaped space with the base facing the inferior direction. From above and medially it is limited by levator ani muscle (actually the inferior fascia of the pelvic diaphragm, medially it neighbors with the external anal sphincter, laterally with

the sciatic tuberosity, ischial ramus and obturator fascia. Anteriorly it extends as far as the superficial transverse perineal muscle and forms a pudendal recess which courses between the pelvic and urogenital diaphragms toward the pubic symphysis. Posteriorly the fossa extends until the sacrotuberous ligament and lower fragment of gluteus maximus muscle. It connects through the lesser sciatic foramen with the subgluteal space. The inferior limitation is the perineal skin and deep layer of the superficial perineal fascia. Two ischioanal fossae are not connected; they are separated by ano-coccygeal ligament — Fig. 8. Due to this communication infections from one side may spread contralaterally.

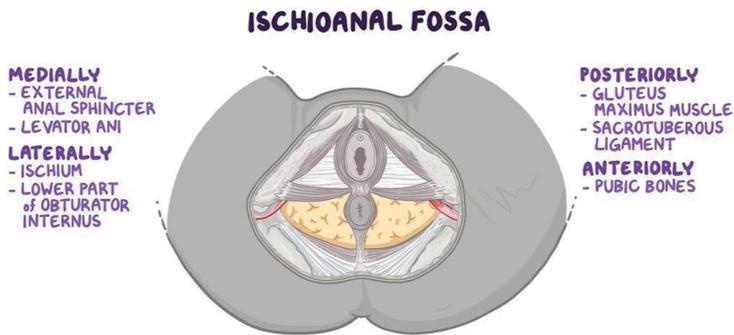


Fig. 8. Ischioanal fossa — general view.

The fossa is filled with connective tissue, mostly fat, and on its lateral wall in so called pudendal canal of Alcock one can find the internal pudendal vessels and pudendal nerve — Fig. 9–10. The canal is limited inferiorly by the falciform proces of the sacrotuberous ligament, laterally by ischial tuberosity and the ischial ramus, and superiorly by the obturator fascia.

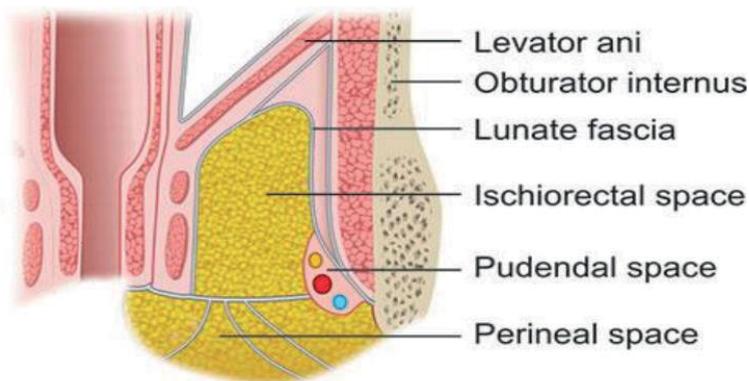


Fig. 9. Ischioanal fossa — coronal section.

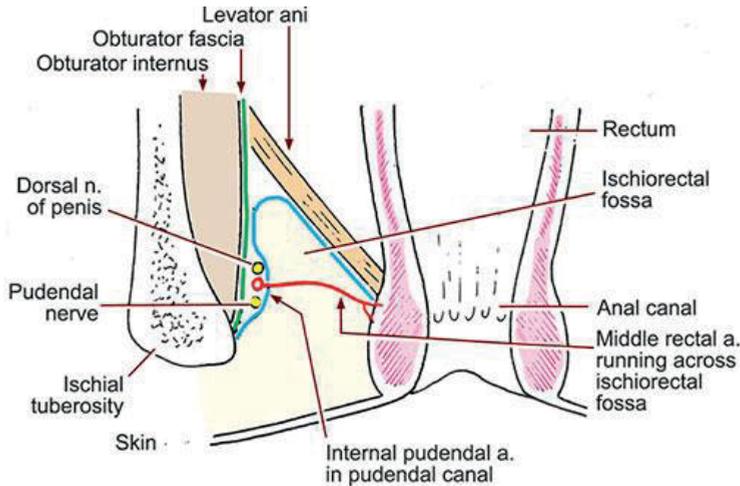


Fig. 10. Ischioanal fossa — general view.

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