

Anatomy of the sigmoid colon

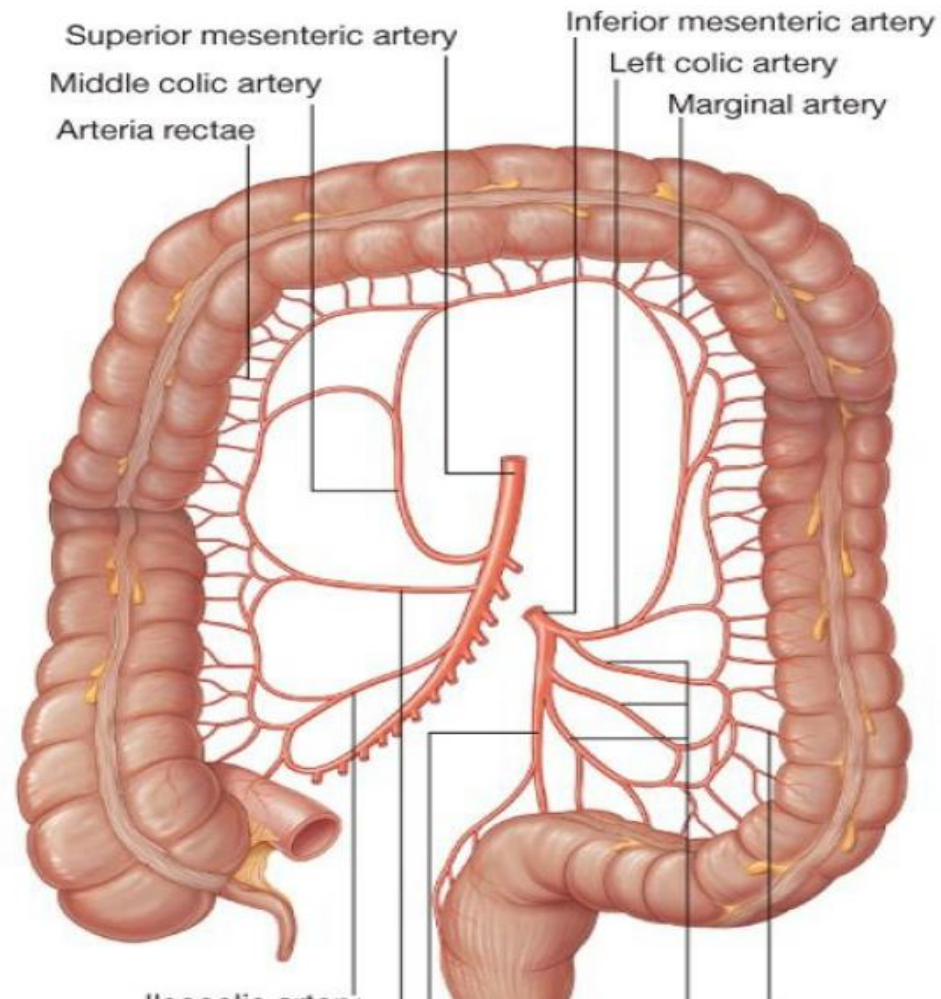
General properties of the colon

- large internal diameter compared to that of the small intestine
- peritoneal-covered accumulations of fat (the omental appendices) (appendices epiploicae)
- longitudinal muscle in its walls form three narrow bands (the taeniae coli) beginning in the cecum and ending in the rectum
- the sacculations of the colon (the haustra of colon).

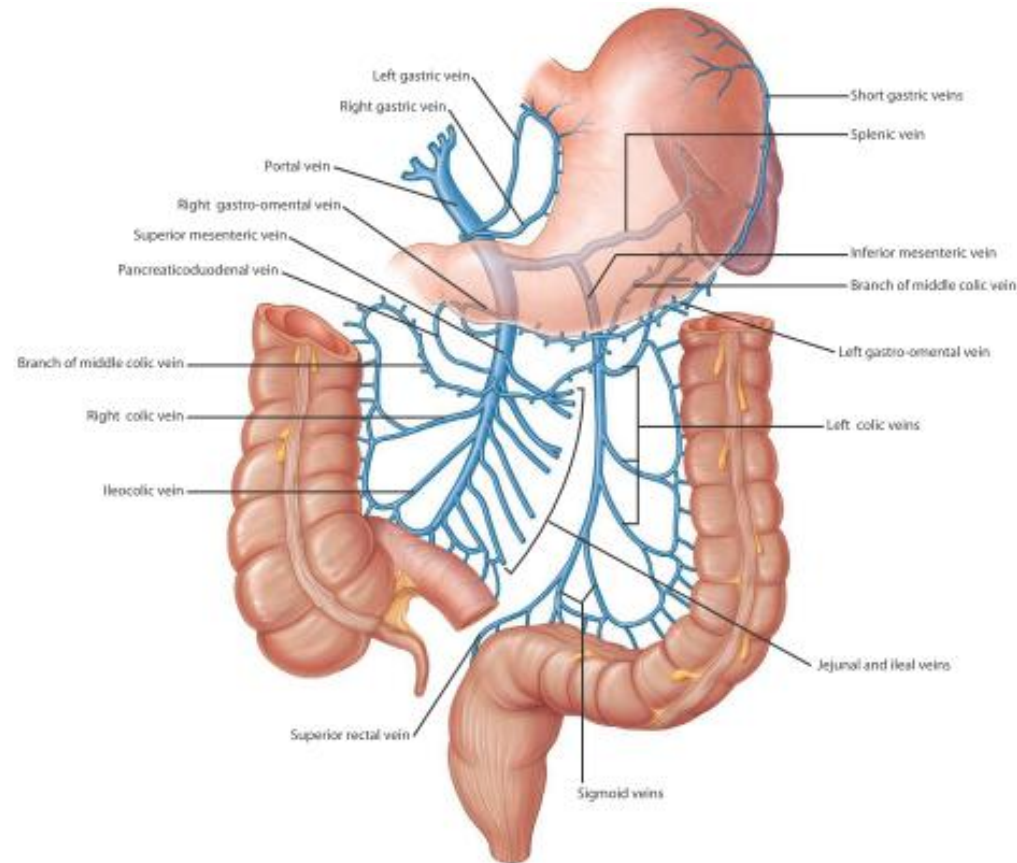
sigmoid colon

- The final segment of the colon begins above the pelvic inlet
- Its length varies dramatically from 15 to 50 cm
- extends to the level of vertebra SIII
- it is continuous with the rectum
- S-shaped and is quite mobile
- it is suspended by the sigmoid mesocolon.

Arterial supply

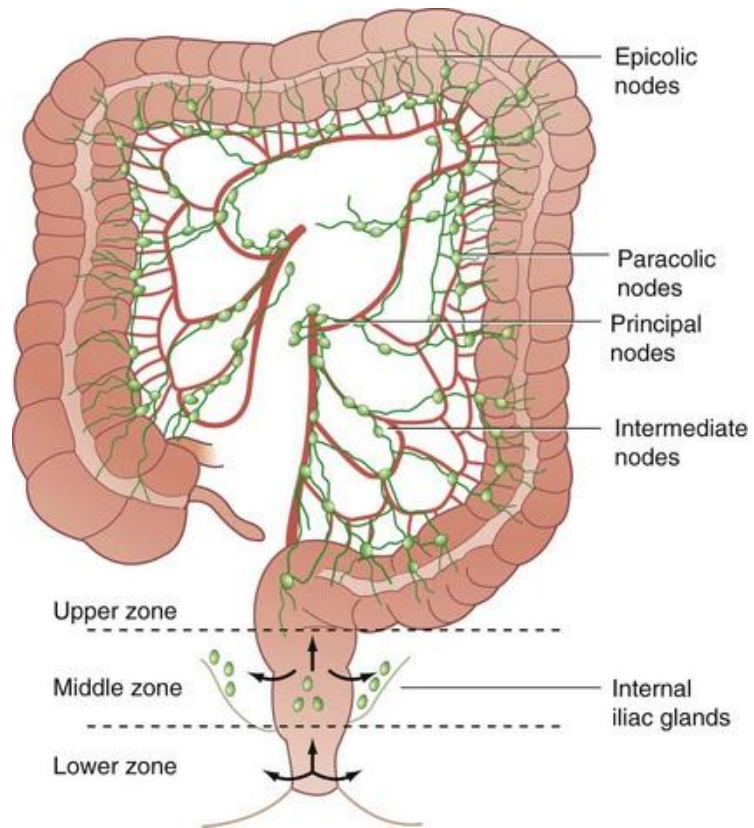


Venous drainage

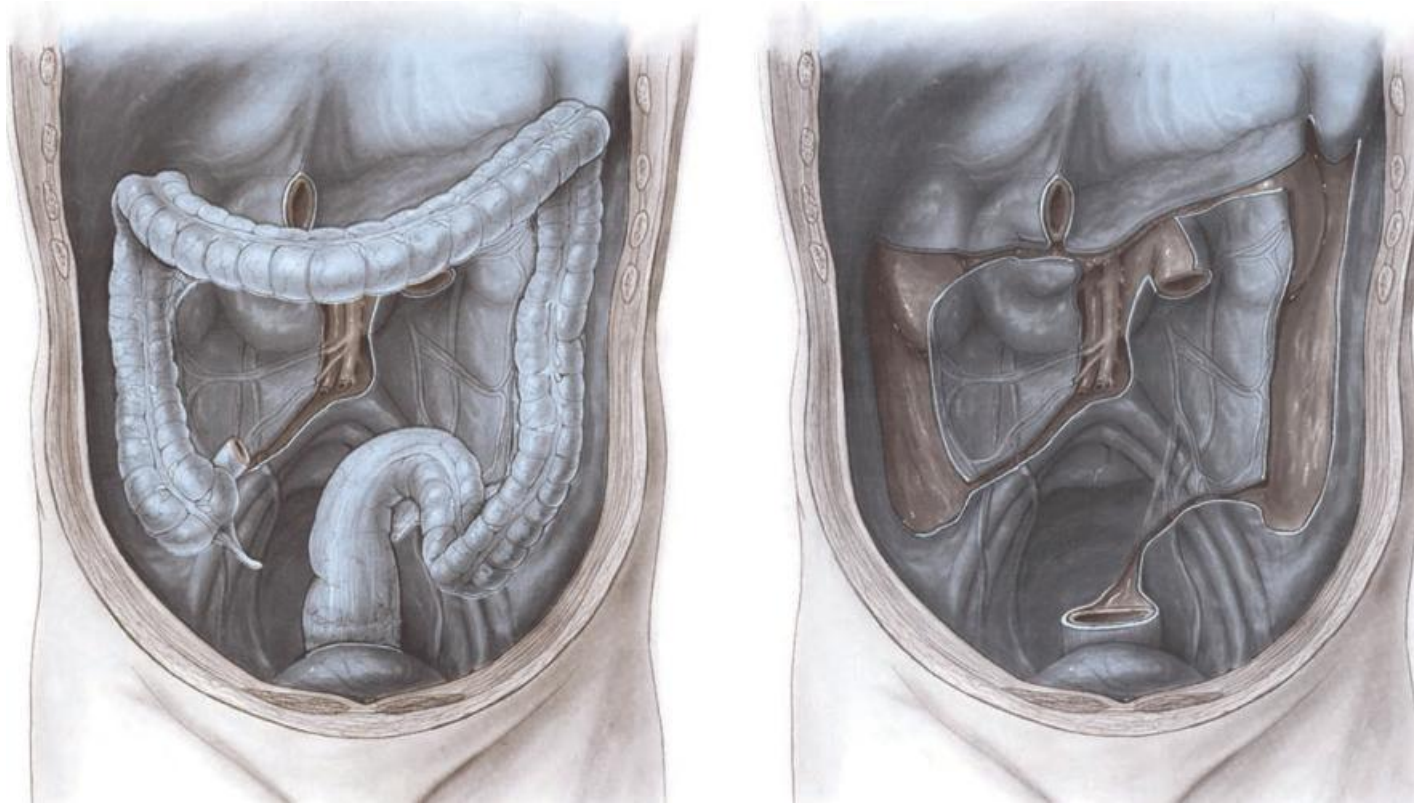


Venous drainage of the abdominal portion of the gastrointestinal tract

Lymphatic drainage

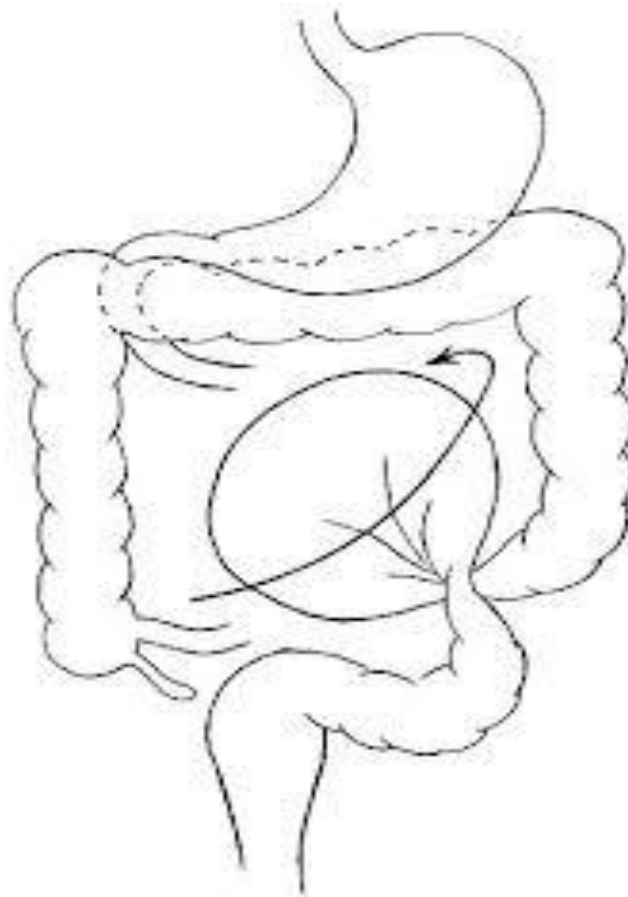


Mesenteric attachment



- The base of the mesocolon extends from the iliac fossa, along the pelvic brim, and across the sacroiliac joint to the second or third sacral segment; in so doing, it forms an inverted V.

Volvulus (sigmoid)



Volvulus (sigmoid)

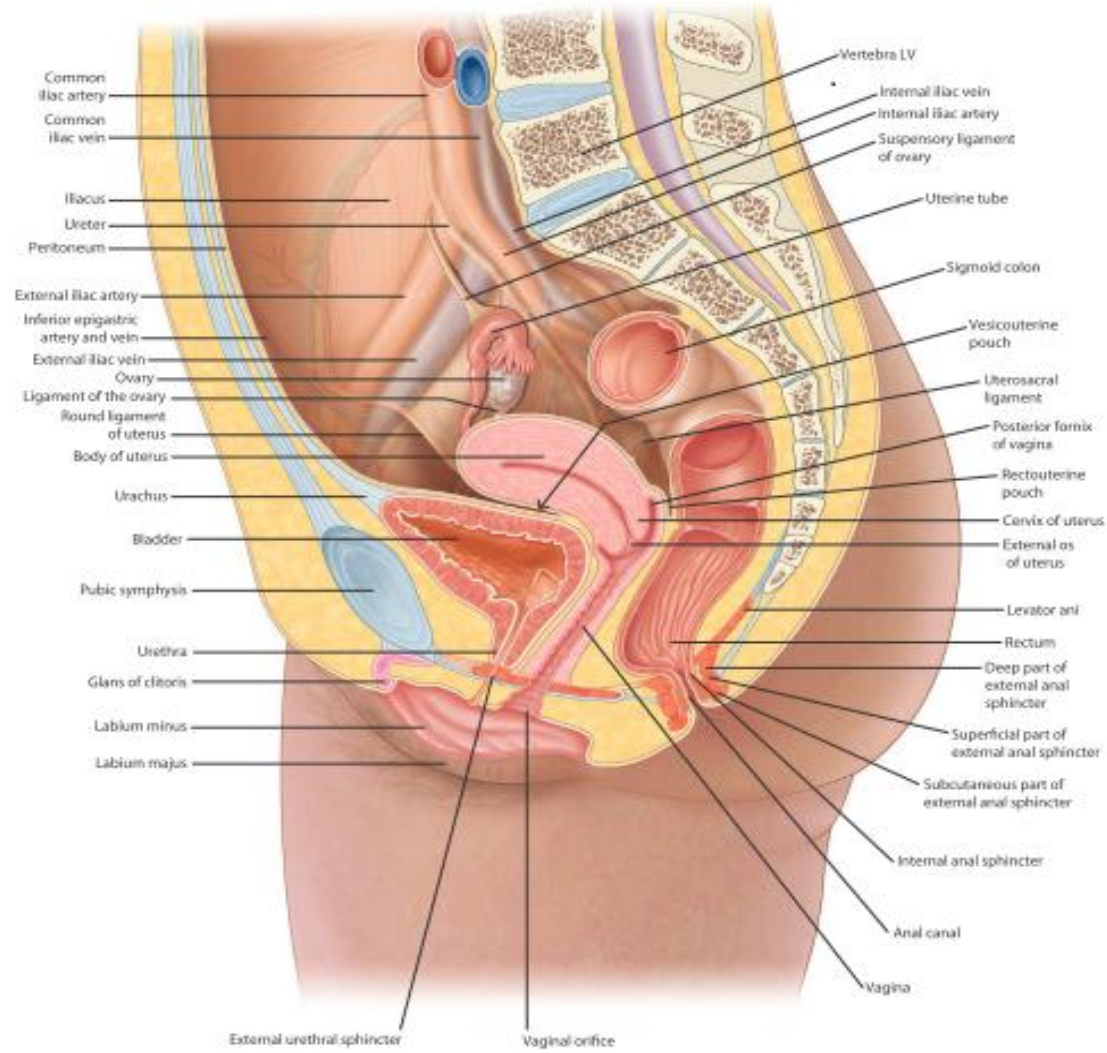


Anatomy of the rectum and anus

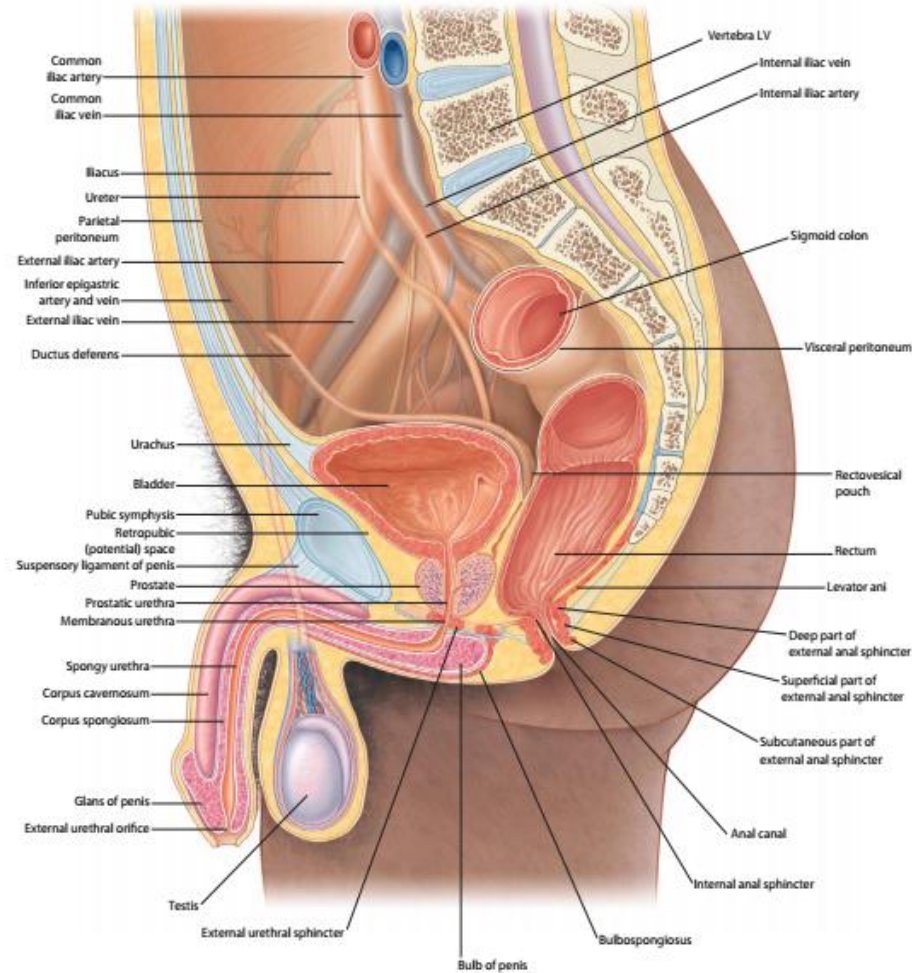
The rectum

- Continuation of the sigmoid colon at sacral segment III
- Lies anterior to and in the concavity of the sacrum
- Ends by passing through the pelvic floor (levator ani) continuing as the anal canal
- Although anatomists traditionally assign the origin of the rectum to the level of the third sacral vertebra, surgeons generally consider the rectum to begin at the level of the *sacral promontory*

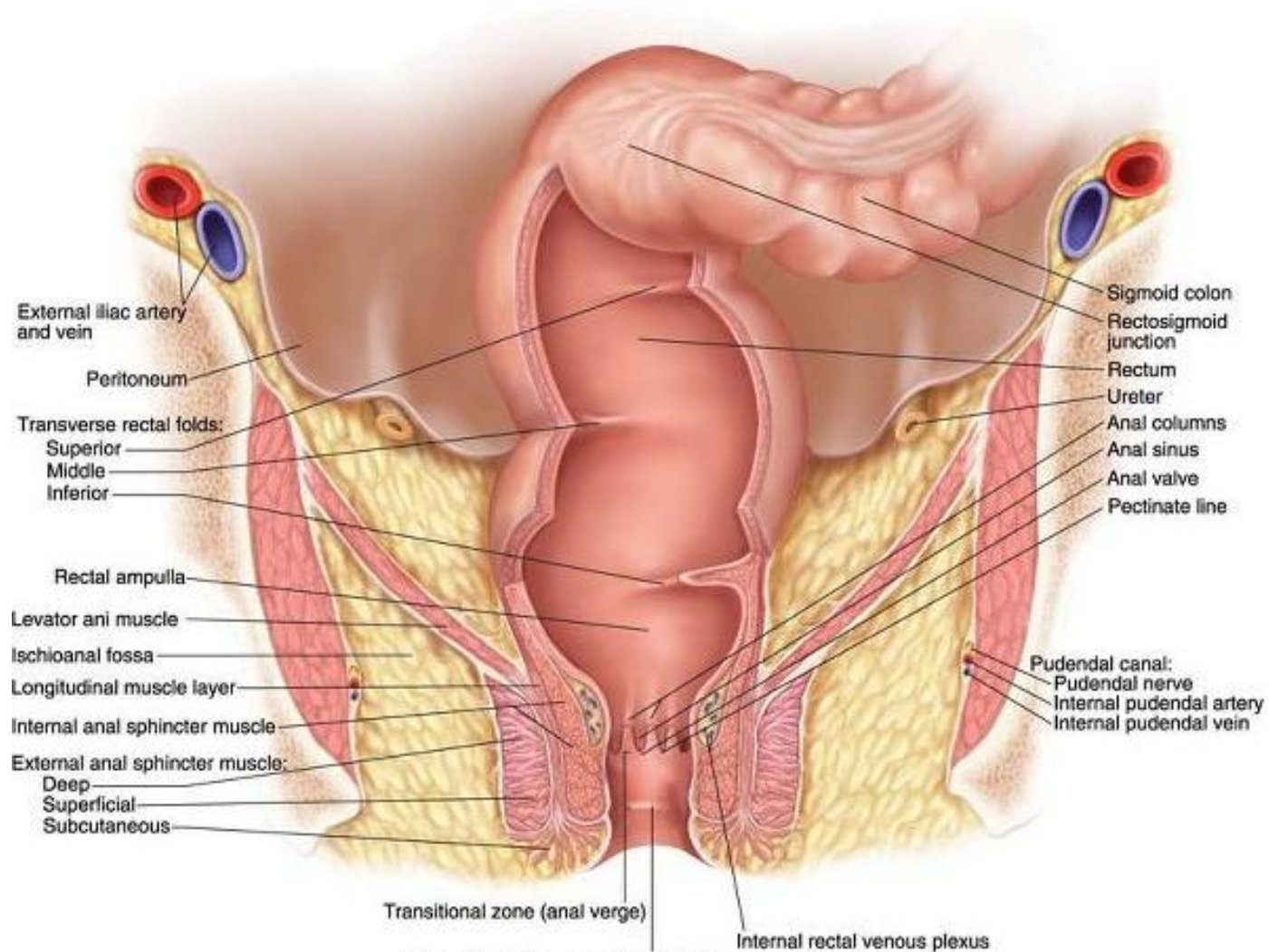
The rectum female



The rectum male



The rectum



The rectum

- The rectum describes three lateral curves: the upper and lower curves are convex to the right, and the middle is convex to the left.
- On their inner aspect these infoldings into the lumen are known as transverse rectal folds (**valves of Houston**)
- The middle fold is the internal landmark corresponding to the anterior peritoneal reflection

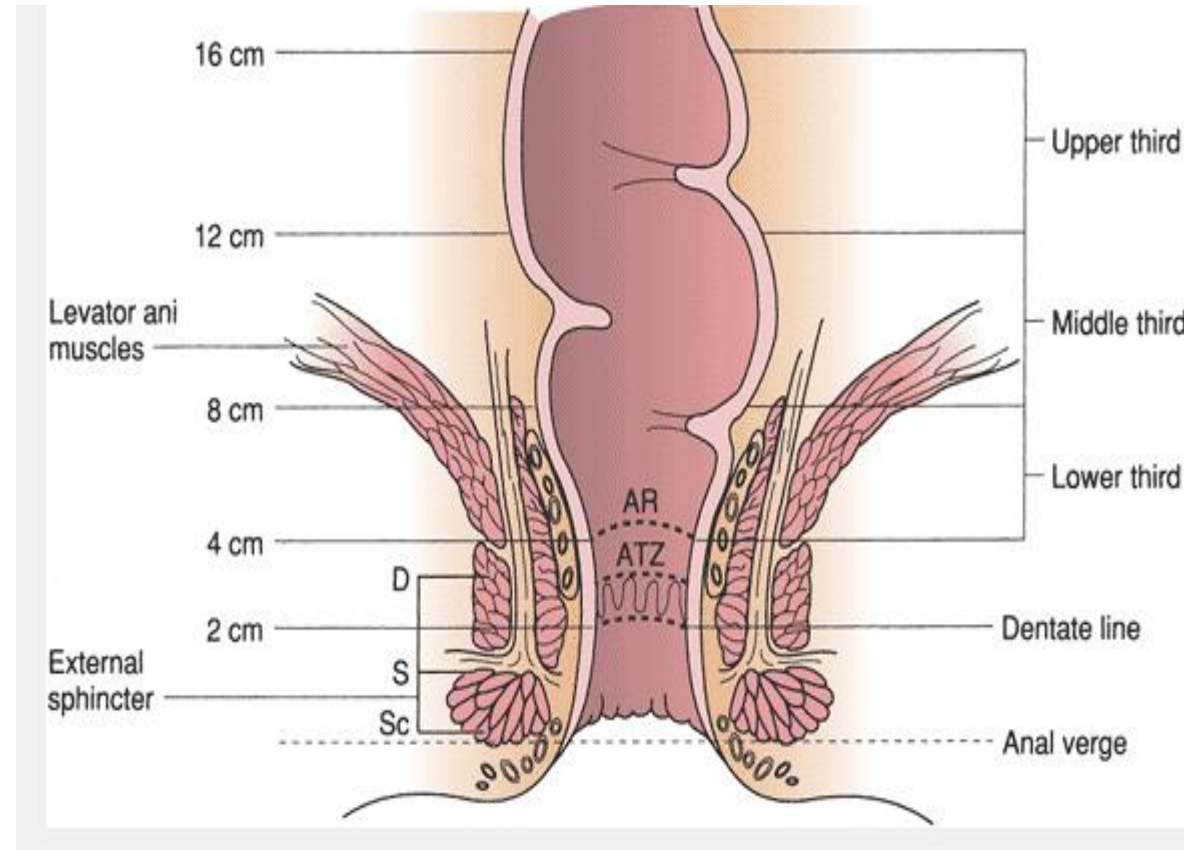
The rectum

- Different from colon
 1. no taeniae coli muscles
 2. no omental appendices (appendices epiploicae)
 3. no sacculations (haustra of the colon)
 4. no mesentery
- Rectal ampulla

The rectum

- 1/3 division
- Peritoneal coverage
- Valves of Houston
- Anorectal angle
- Fascial attachments; lateral ligament, Denonvillier fascia, rectosacral ligament

Anorectum Measurements



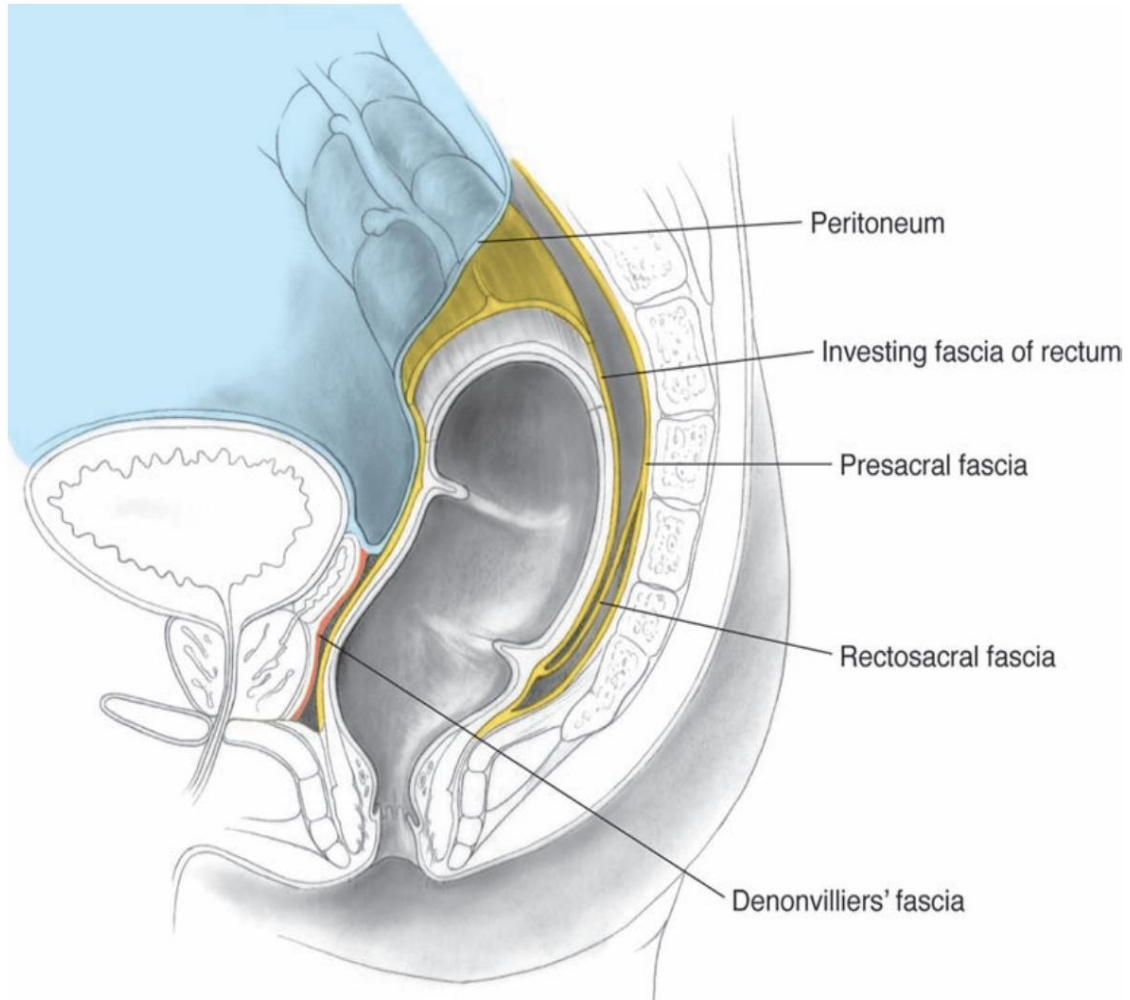
The rectum

Peritoneal coverage

For descriptive purposes the rectum is divided into upper, middle, and lower thirds.

- The upper third is covered by peritoneum anteriorly and laterally
- middle third is covered only anteriorly
- lower third is devoid of peritoneum (extraperitoneal)

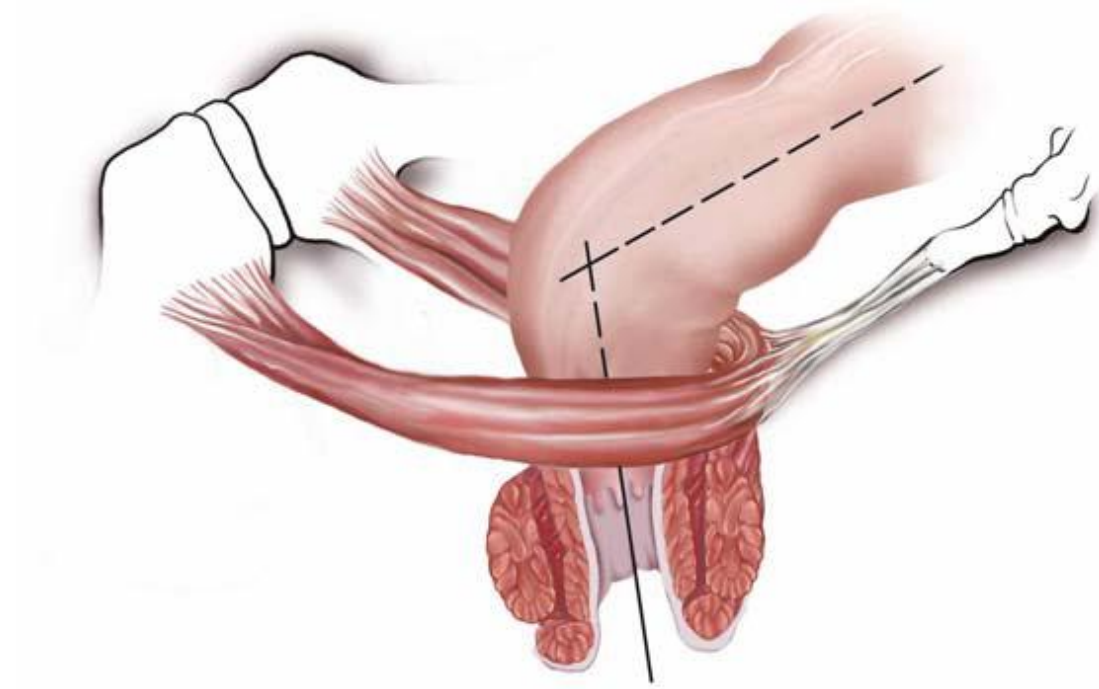
The rectum fascia



The rectum related fascia

- Fascia Propria (Investing Fascia)
- Waldeyer's Fascia; presacral fascia and rectosacral fascia
- Denonvilliers' Fascia
- Lateral Ligament

Anorectal angle



Anal canal

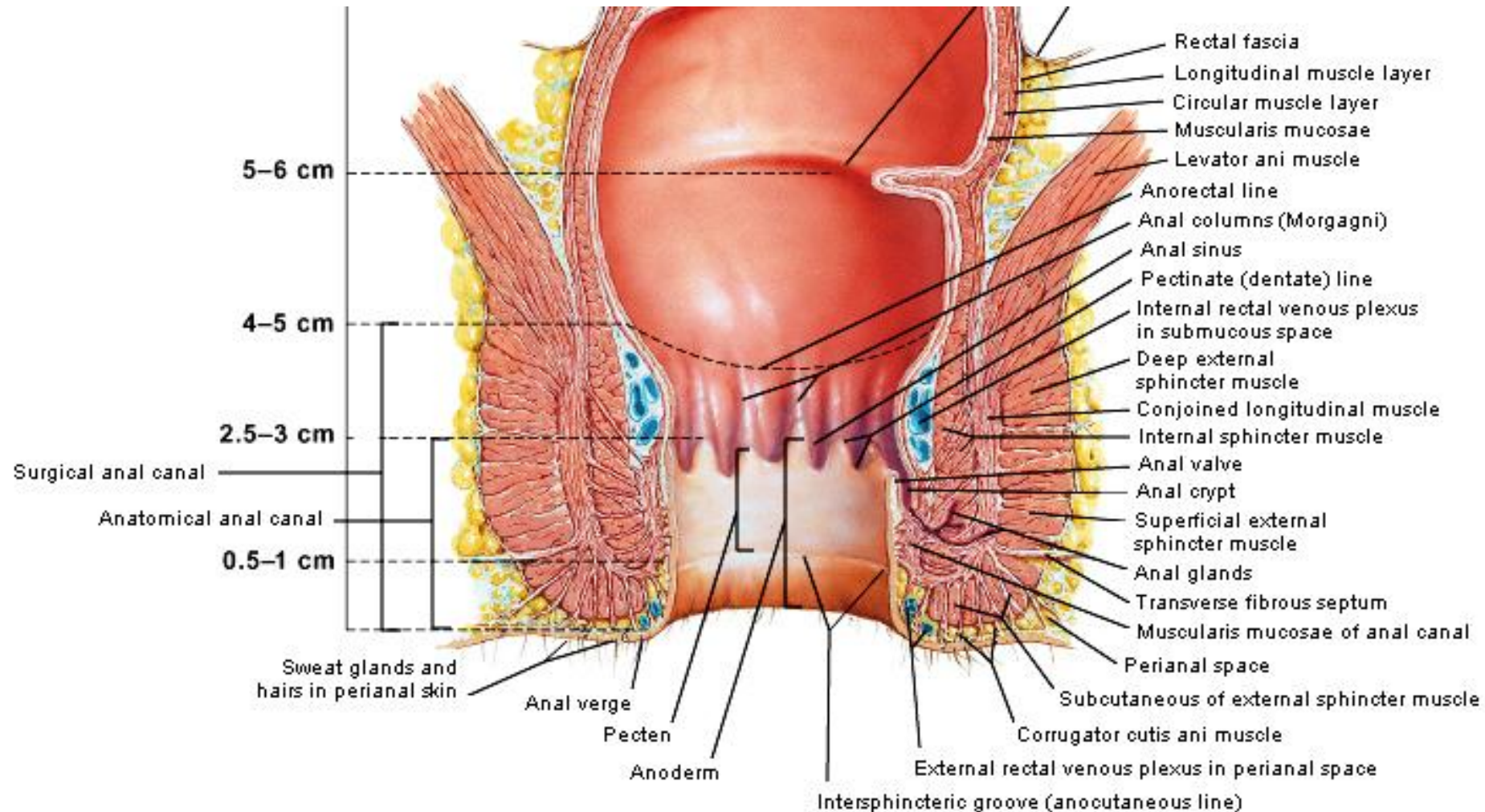
Anal canal

- It begins at the anorectal junction (the point passing through the levator ani muscles)
- is about 4 cm long
- terminates at the anal verge
- Anatomical versus surgical anal canal (better use upper anal and lower anal canal)

Anal canal

- Anal Columns (of Morgagni)
- Internal hemorrhoidal plexus
- Transitional area
- Dentate line (pectinate)
- Anoderm and (Pecten)
- External hemorrhoidal plexus

Anal canal

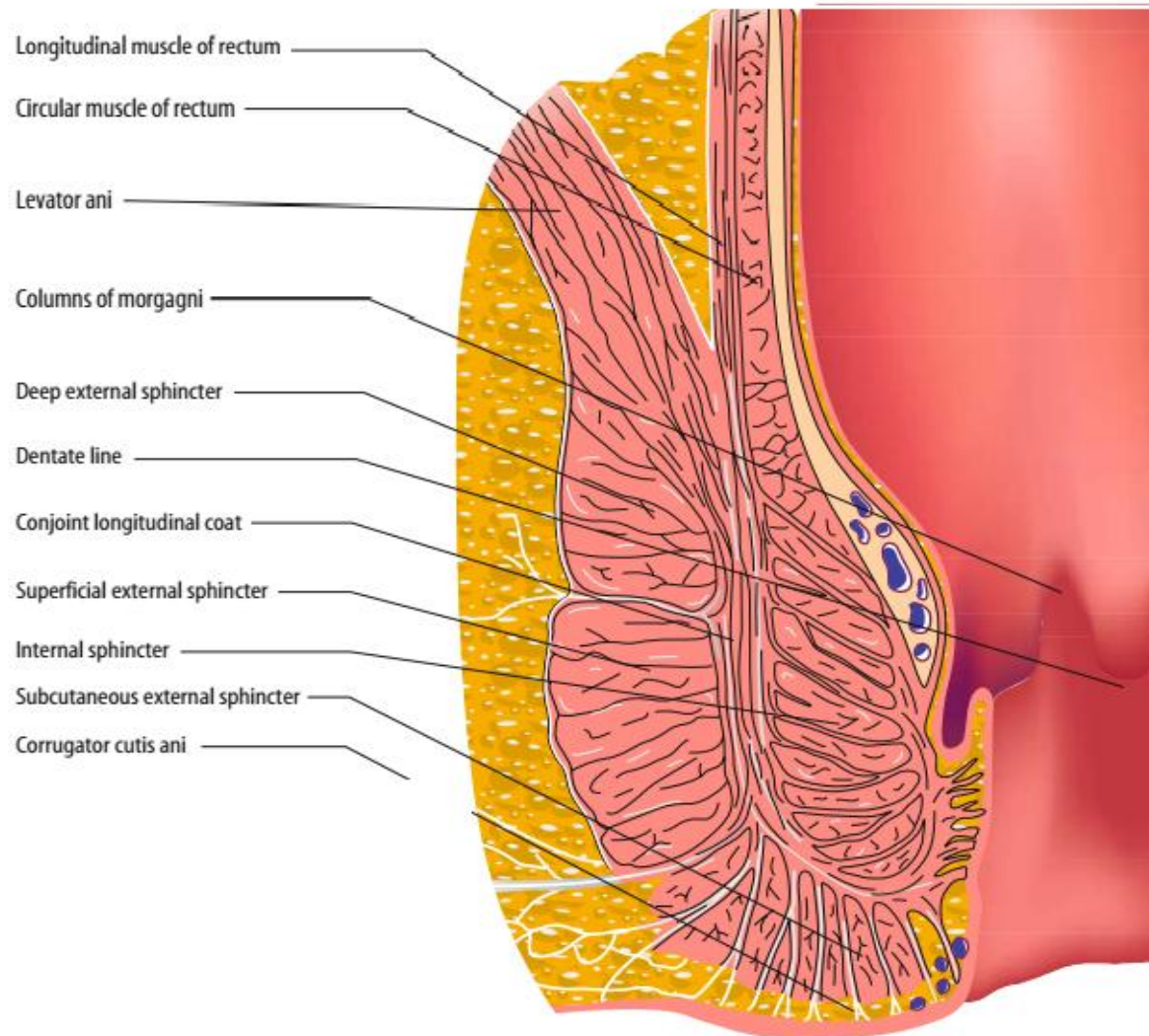


Anal canal

Dentate line (pectinate)

- At approximately the midpoint of the anal canal there is an undulating demarcation referred to as the dentate line
- This line is approximately 2 cm from the anal verge
- Composed of a series of anal valves
- Valves contain the anal sinuses (crypts)
- Anal glands ducts open in the crypts

Anal canal



Anal canal

dentate line (pectinate)

Separates two distinct zones different in

- Innervation; above visceral , below somatic
- Blood supply; above portal and systemic, below systemic
- Lymphatic drainage; above to internal iliac and inferior mesenteric, below to inguinal nodes.

Anal canal

Anal Columns (of Morgagni)

- longitudinal folds above dentate line
- 6 to 14 in number
- There is a small pocket or crypt at the lower end of and between adjacent columns of the folds

Anal canal

Transitional area

- The mucosa of the upper anal canal is lined by columnar epithelium.
- Below the dentate line the anal canal is lined with a squamous epithelium.
- For a distance of 6–12 mm above the dentate line there is a gradual transition where columnar, transitional, or squamous epithelium may be found.
- This anal transitional or cloacogenic zone, has extremely variable histology.

Anal canal

Anoderm and (Pecten)

- area below the dentate line to anal verge is anoderm
- The part below dentate line to intersphincteric groove is pecten
- devoid of accessory skin structures (e.g., hair, sebaceous glands, and sweat glands).
- pale, smooth, thin, and shiny stretched tissue
- Extends approximately 1.5 cm below the dentate line.

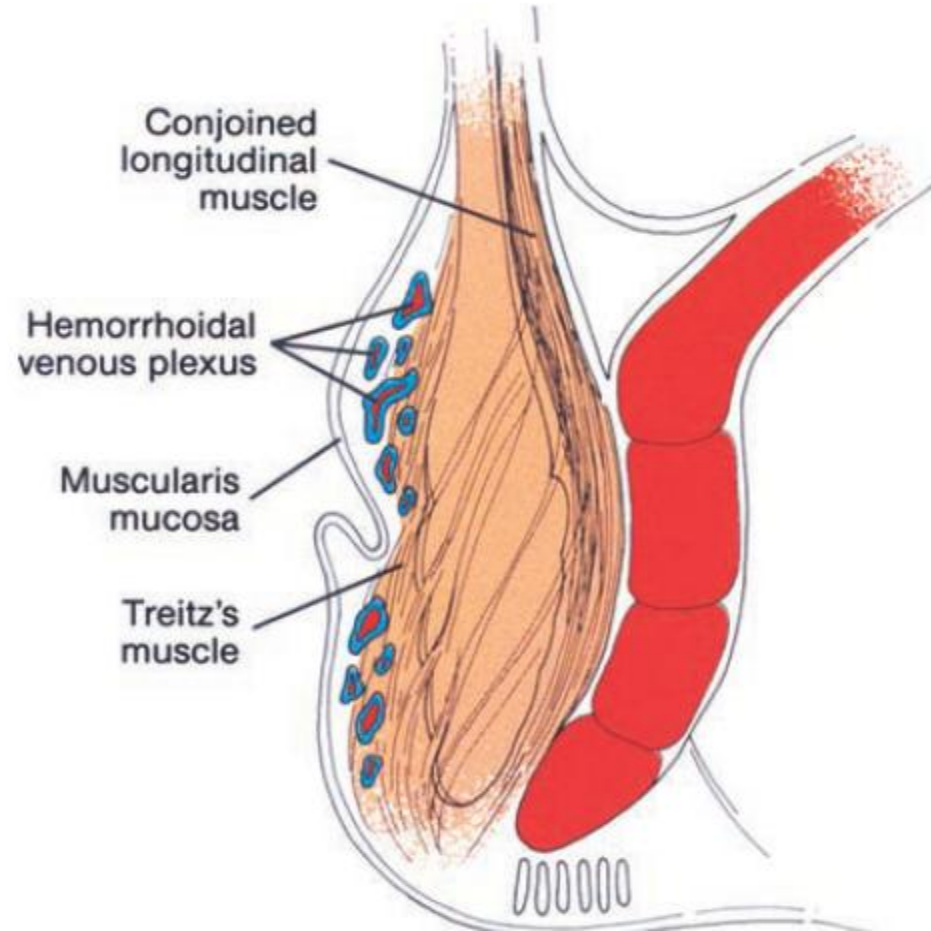
Anal canal

Internal hemorrhoidal plexus

- The **corpus cavernosum recti** (erectile tissue)
- They are located in the upper anal canal, from the dentate line to the anorectal ring
- Three cushions lie in the following constant sites: left lateral, right anterolateral, and right posterolateral.
- Smaller discrete secondary cushions may be present between the main cushions.
- The configuration is remarkably constant and apparently bears no relationship to the terminal branching of the superior rectal artery

Anal canal

Internal hemorrhoidal



Anal canal

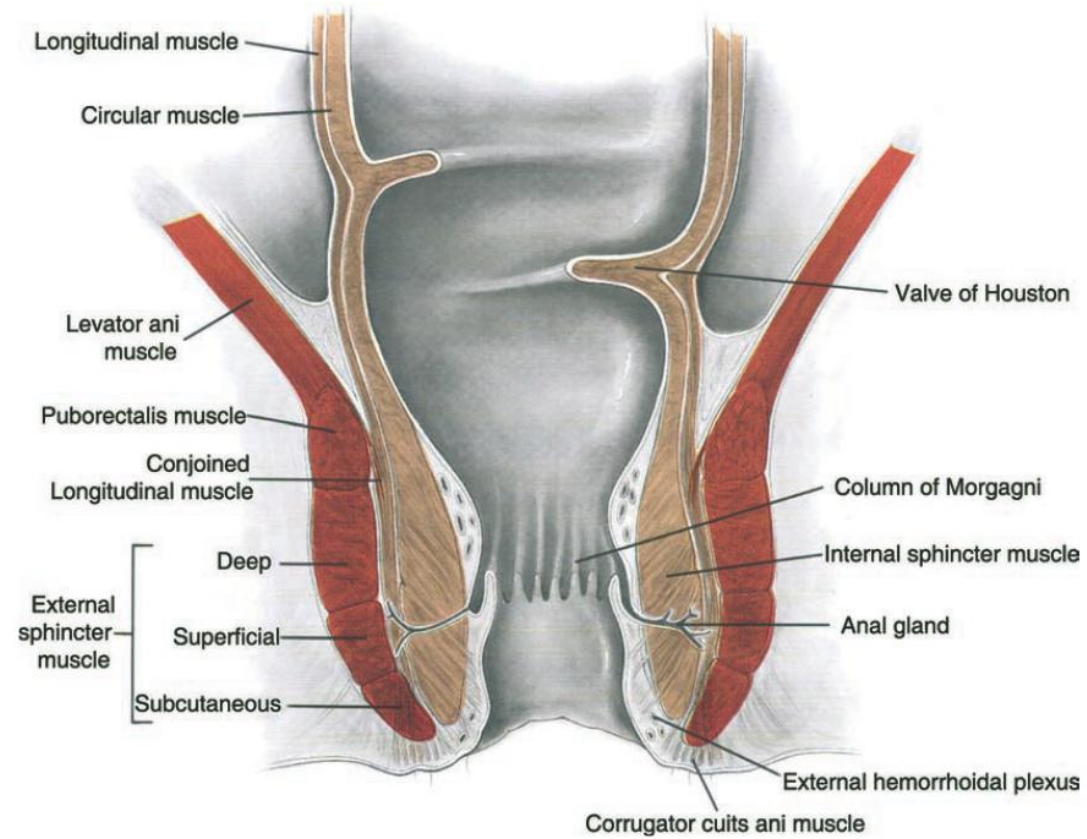
- Anal glands
- Anal sphincters
- Levator ani
- Perianal spaces

Anal canal

Anal glands

- The average number is six (range, 3–10)
- Each gland is lined by stratified columnar epithelium with mucus-secreting or goblet cells interspersed has a direct opening into an anal crypt at the dentate line.

Anal canal anal glands



Anal canal

INTERNAL SPHINCTER MUSCLE

- The downward continuation of the circular, smooth muscle of the rectum becomes thickened and rounded at its lower end
- Its lowest portion is just above the lowest part of the external sphincter 1–1.5 cm below the dentate line

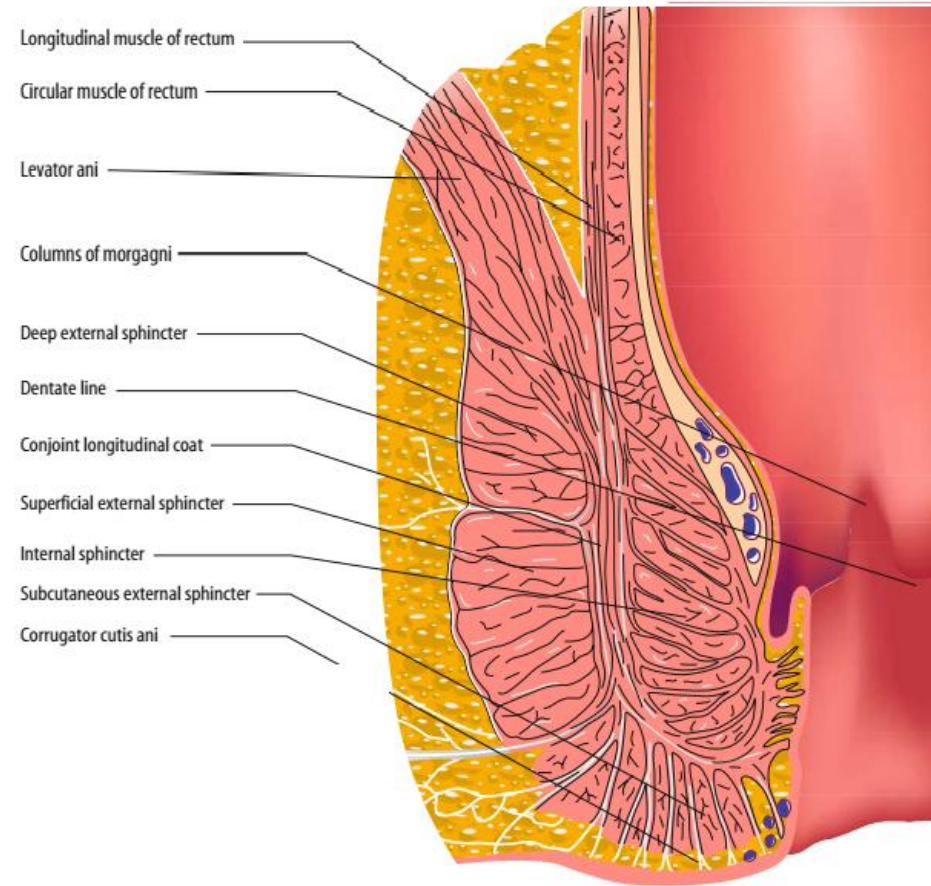
Anal canal

CONJOINED LONGITUDINAL MUSCLE

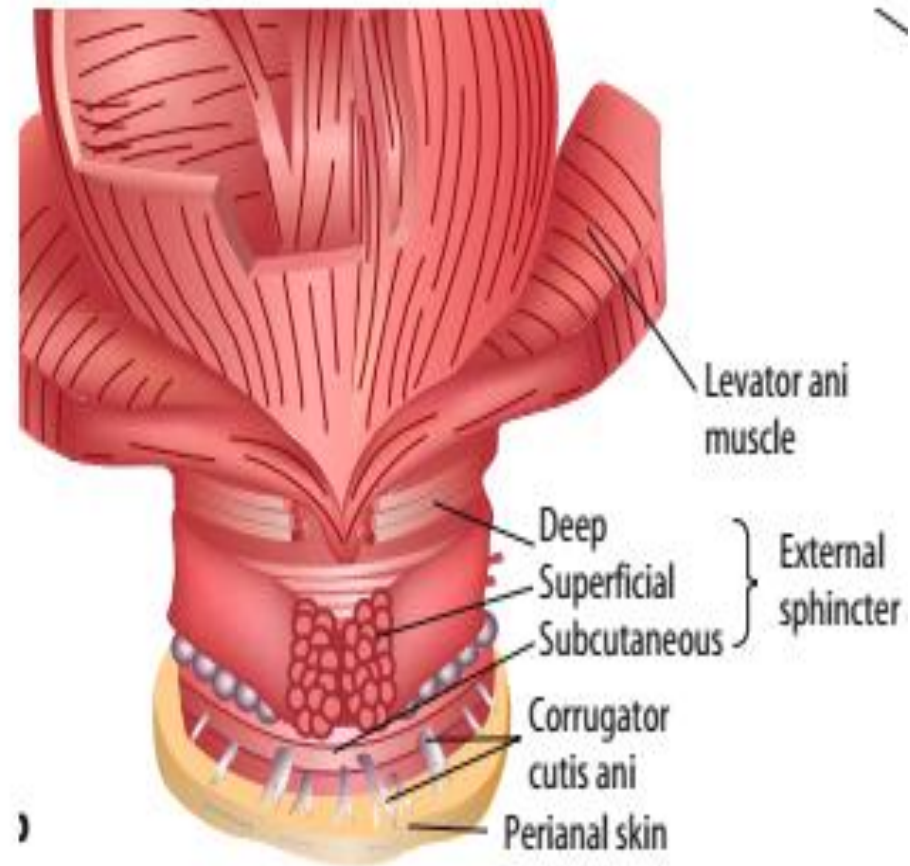
- At the level of the anorectal junction, the longitudinal muscle coat of the rectum is joined by fibers of the levator ani and puborectalis muscles
- It descends between the internal and external anal sphincters
- Many of these fibers traverse the lower portion of the external sphincter to gain insertion in the perianal skin and are referred to as the corrugator cutis ani
- Some fibers that traverse the internal sphincter muscle

Anal canal

MUSCLES



Anal canal MUSCLES



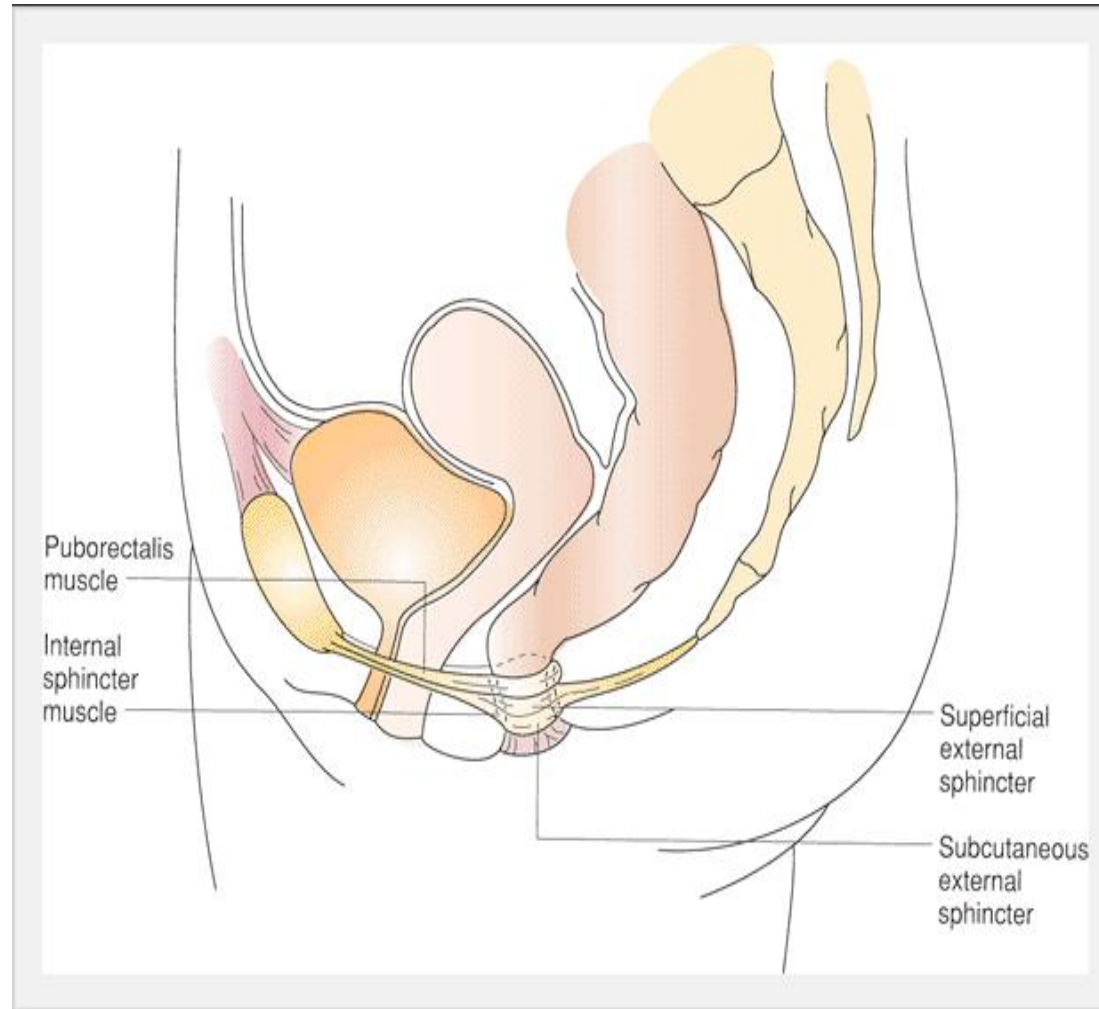
Anal canal

EXTERNAL SPHINCTER MUSCLE

- An elliptical cylinder of skeletal muscle that surrounds the anal canal
- Three distinct divisions: the subcutaneous, superficial, and deep
- the lowest portion of the external sphincter occupies a position below and slightly lateral to the internal sphincter.
- A palpable groove at this level has been referred to as the intersphincteric groove corresponding to the **anocutaneous line** (**white**)
- The superficial part is attached to the coccyx by a posterior extension of muscle fibers that combine with connective tissue, forming the **anococcygeal ligament** (**raphe**).

Anal canal

EXTERNAL SPHINCTER MUSCLE



PELVIC FLOOR MUSCLES

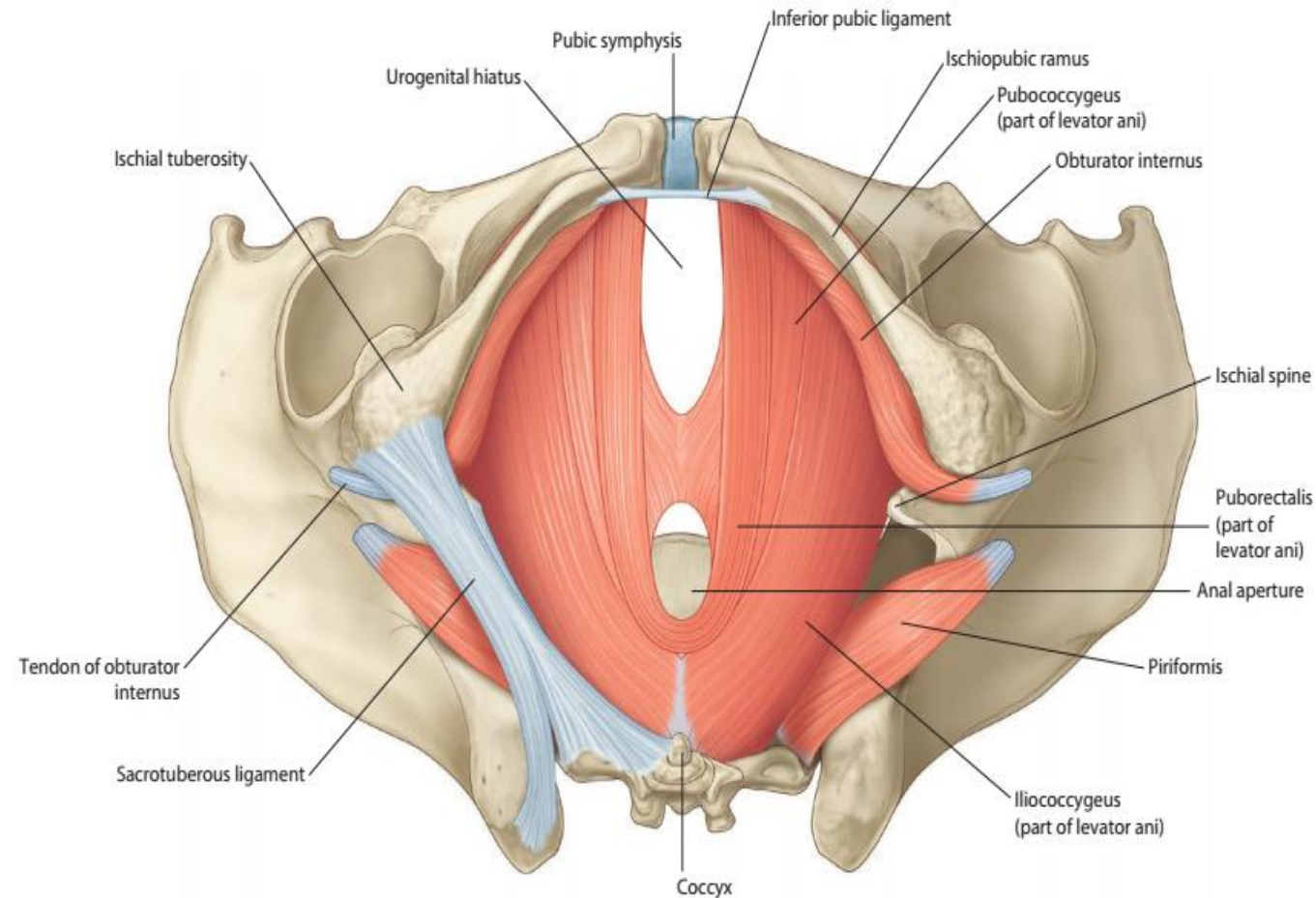
- Puborectalis Muscle
- Iliococcygeus Muscle
- Pubococcygeus Muscle
- Coccygeus

Anorectal ring

- surrounds the junction of the rectum and the anal canal.
- It is composed of the upper borders of the internal sphincter and the puborectalis muscle and deep external sphincter.
- functionally important ring of muscle
- division of this ring will inevitably result in anal incontinence

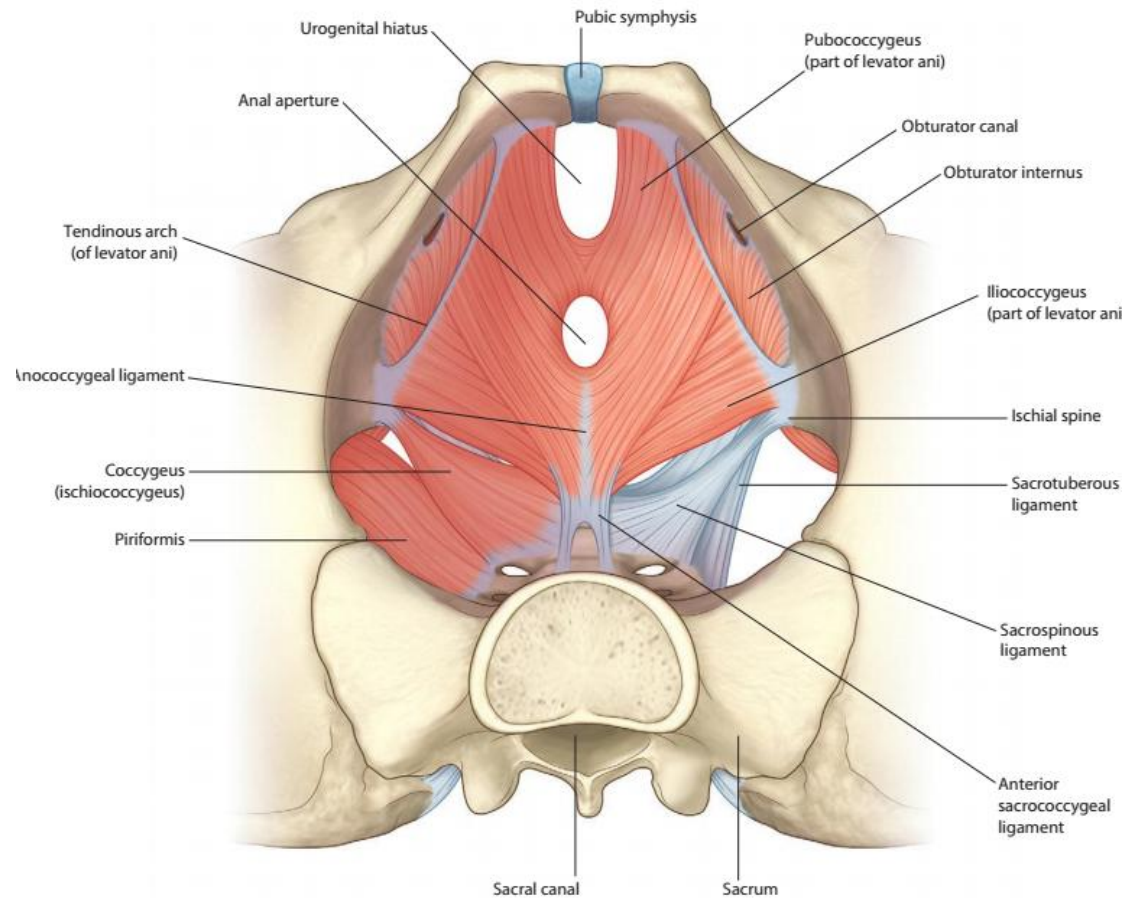
PELVIC FLOOR MUSCLES

perineal view



Levator ani muscle (inferior view)

pelvic view



Levator ani and coccygeus (ischiococcygeus) muscles (anterosuperior view)

ANORECTAL SPACES

perianal space

ischioanal space

intersphincteric space

supralevator space

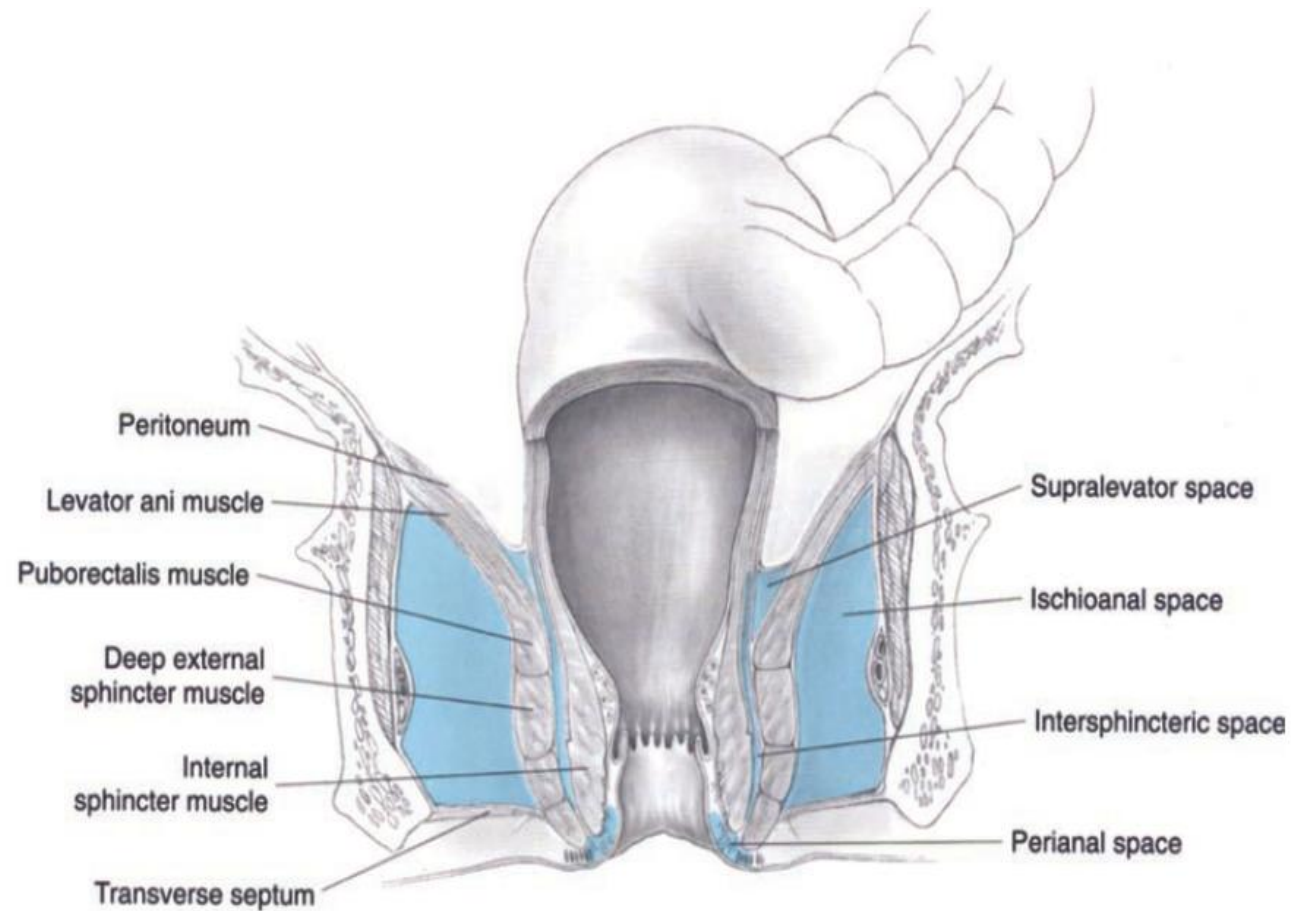
submucous space

superficial postanal space

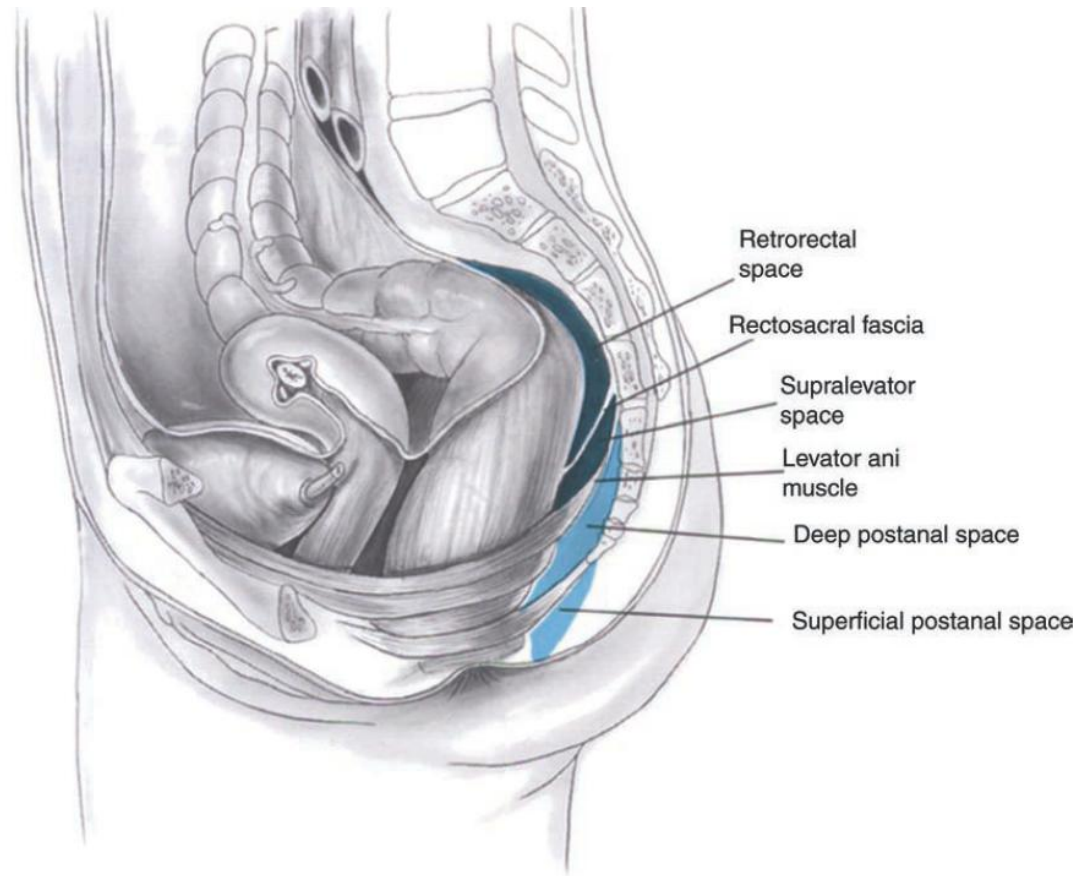
deep postanal space

retrorectal space

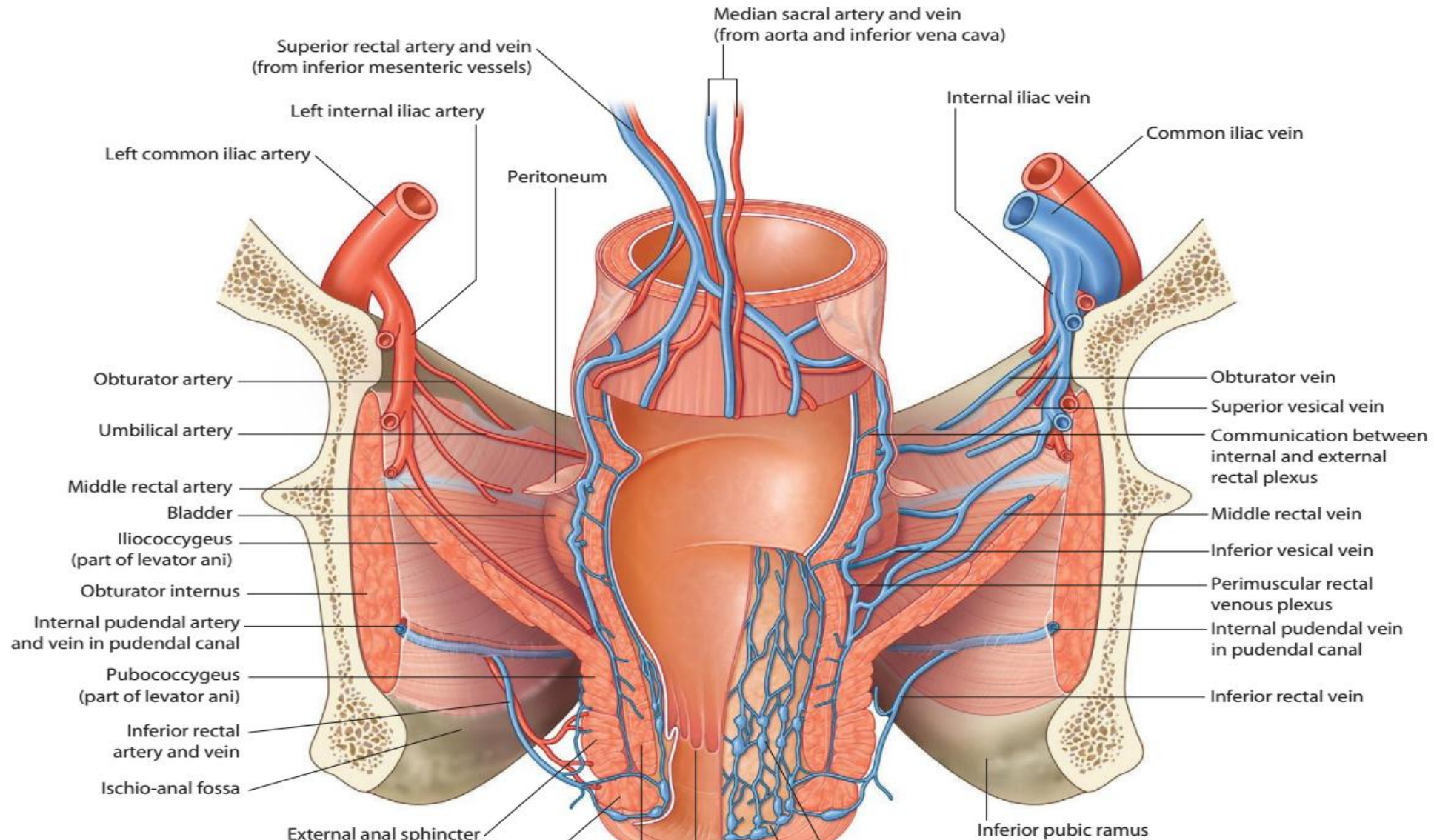
Perianal spaces



Perianal spaces



Blood supply of the Anorectum



Anorectum

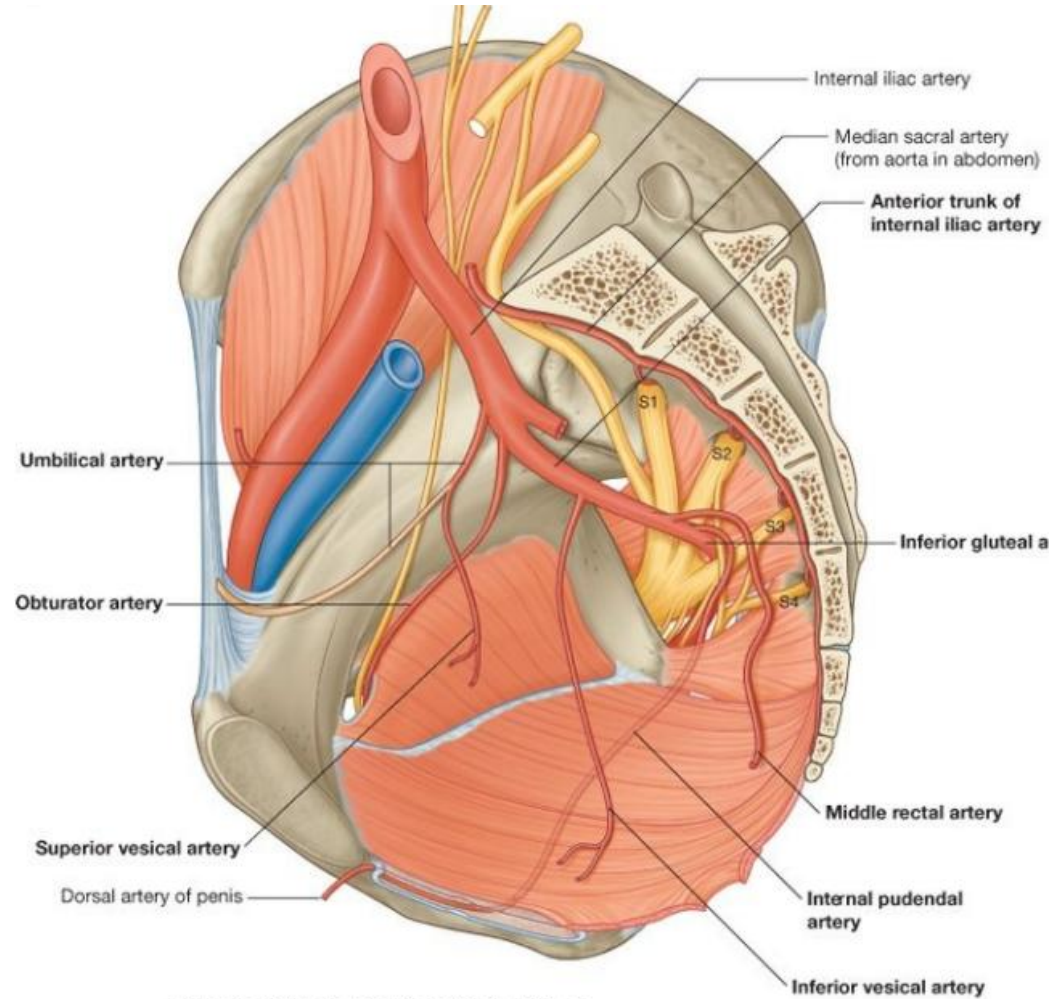
ARTERIAL SUPPLY

SUPERIOR RECTAL ARTERY

- Continuation of the inferior mesenteric artery proceeds downward, crossing the left common iliac artery and vein to the base of the sigmoid mesocolon.
- It lies posterior to the right of the sigmoid colon, coming in close contact with the posterior aspect of the bowel at the rectosigmoid junction.
- It gives a rectosigmoid branch and upper rectal branch
- divides into *left and right* terminal branches.
- The terminal branches extend downward and forward around the lower two thirds of the rectum to the level of the levator ani muscle.

Anorectum

ARTERIAL SUPPLY



Anorectum

ARTERIAL SUPPLY

MIDDLE RECTAL ARTERIES

- Variable from internal iliac artery or its branches
- middle rectal arteries in only 22% of the specimens.
- terminal branches pierce the wall of the rectum at variable points but usually in the lower third of the rectum.

Anorectum

ARTERIAL SUPPLY

INFERIOR RECTAL ARTERIES

- Arise from the pudendal artery (in Alcock's canal).
- They traverse the ischioanal fossa and supply the anal canal and the external sphincter muscles.
- There is no extramural anastomosis between the inferior rectal arteries and other rectal arteries.

Anorectum

ARTERIAL SUPPLY

MEDIAN SACRAL ARTERY

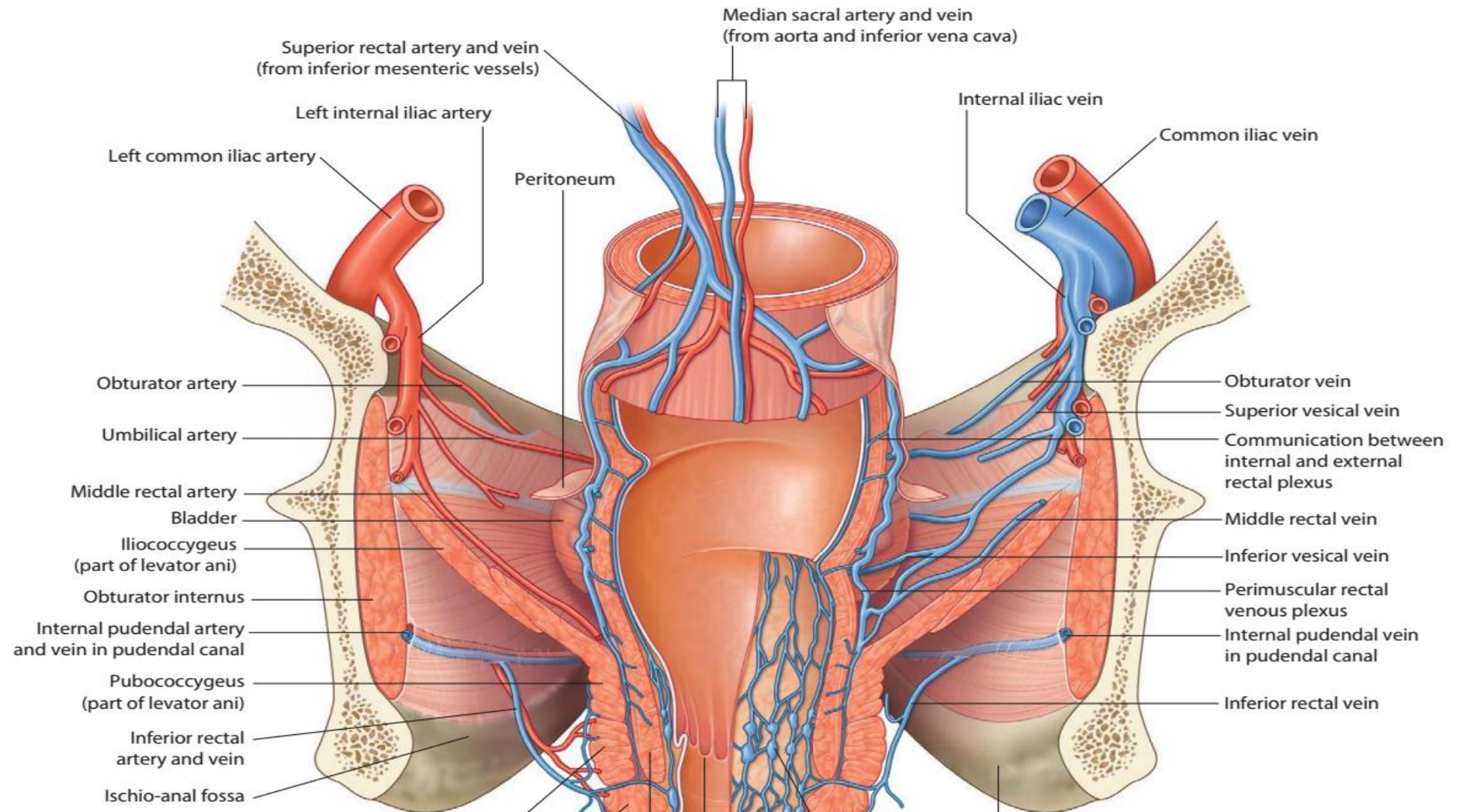
- arises from the back of the aorta at 1.5 cm above its bifurcation,
- descends over the last two lumbar vertebrae, the sacrum and the coccyx, and behind the left common iliac vein
- No obvious anastomosis exists between these twigs and other rectal arteries.
- The presence of this artery is inconsistent (often it is absent),

Anorectum

VENOUS DRAINAGE

- Blood return from the rectum and anal canal is via two systems: **portal and systemic**. Hence a site of **porto-systemic anastomosis**.
- The **superior rectal vein** drains the rectum and upper part of the anal canal, where the internal hemorrhoidal plexus is situated, into the portal system via the inferior mesenteric vein.
- The **middle rectal veins** drain the lower part of the rectum and the upper part of the anal canal into the systemic circulation via the internal iliac veins.
- The **inferior rectal veins** drain the lower part of the anal canal, where the external hemorrhoidal plexus is located, via the internal pudendal veins, which empty into the internal iliac veins
- Controversy exists regarding the presence or absence of anastomoses formed by these three venous systems.

Blood supply of the Anorectum



RECTUM

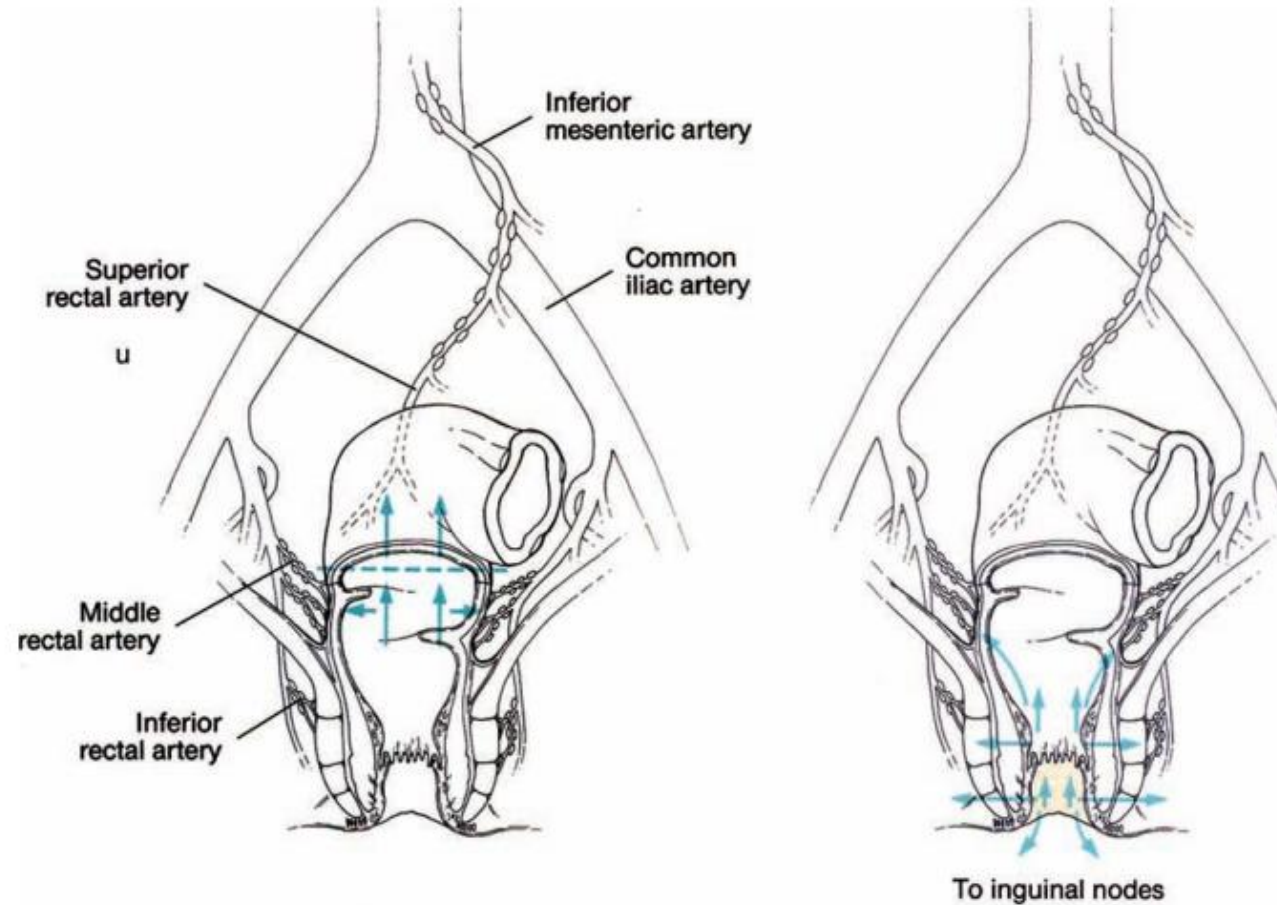
lymphatics

- Lymph from the upper and middle parts of the rectum ascends along the superior rectal artery and subsequently drains to the inferior mesenteric lymph nodes.
- The lower part of the rectum drains cephalad via the superior rectal lymphatics to the inferior mesenteric nodes and laterally via the middle rectal lymphatics to the internal iliac nodes

Anal canal lymphatics

- above the dentate line
 - drain cephalad via the superior rectal lymphatics to the inferior mesenteric nodes and
 - laterally along both the middle rectal vessels and the inferior rectal vessels through the ischioanal fossa to the internal iliac nodes.
- below the dentate line
 - usually drains to the inguinal nodes.
 - It also can drain to the superior rectal lymph nodes or along the inferior rectal lymphatics through the ischioanal fossa if obstruction occurs in the primary drainage

Anorectum lymphatics



RECTUM

Sympathetic Innervation

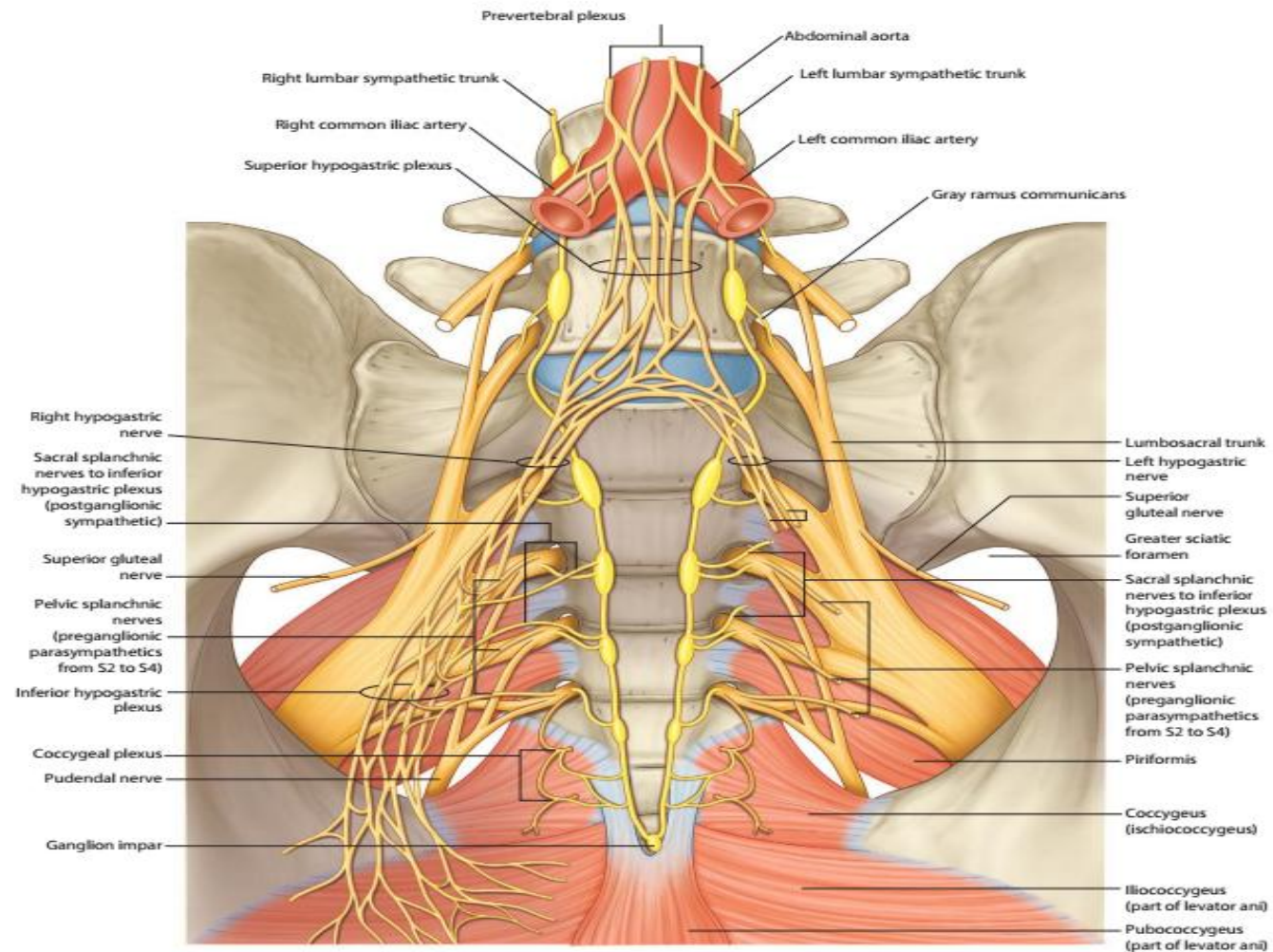
- derived from the first three lumbar segments as a lumbar sympathetic nerve that joins the preaortic plexus.
- extends along the inferior mesenteric artery as the mesenteric plexus and reaches the upper part of the rectum.
- The **superior hypogastric plexus** or presacral nerve arises from the aortic plexus and the two lateral lumbar splanchnic nerves
- The plexus divides into two **hypogastric nerves**.
- The hypogastric nerves are identified at the sacral promontory, approximately 1 cm lateral to the midline and 2 cm medial to each ureter
- The hypogastric nerve on each side continues caudally and laterally following the course of the ureter and the internal iliac artery along the pelvic wall.
- It joins the branches (S2-4) of the **sacral parasympathetic nerves**, or nervi erigentes, to form the **pelvic plexus**.

RECTUM

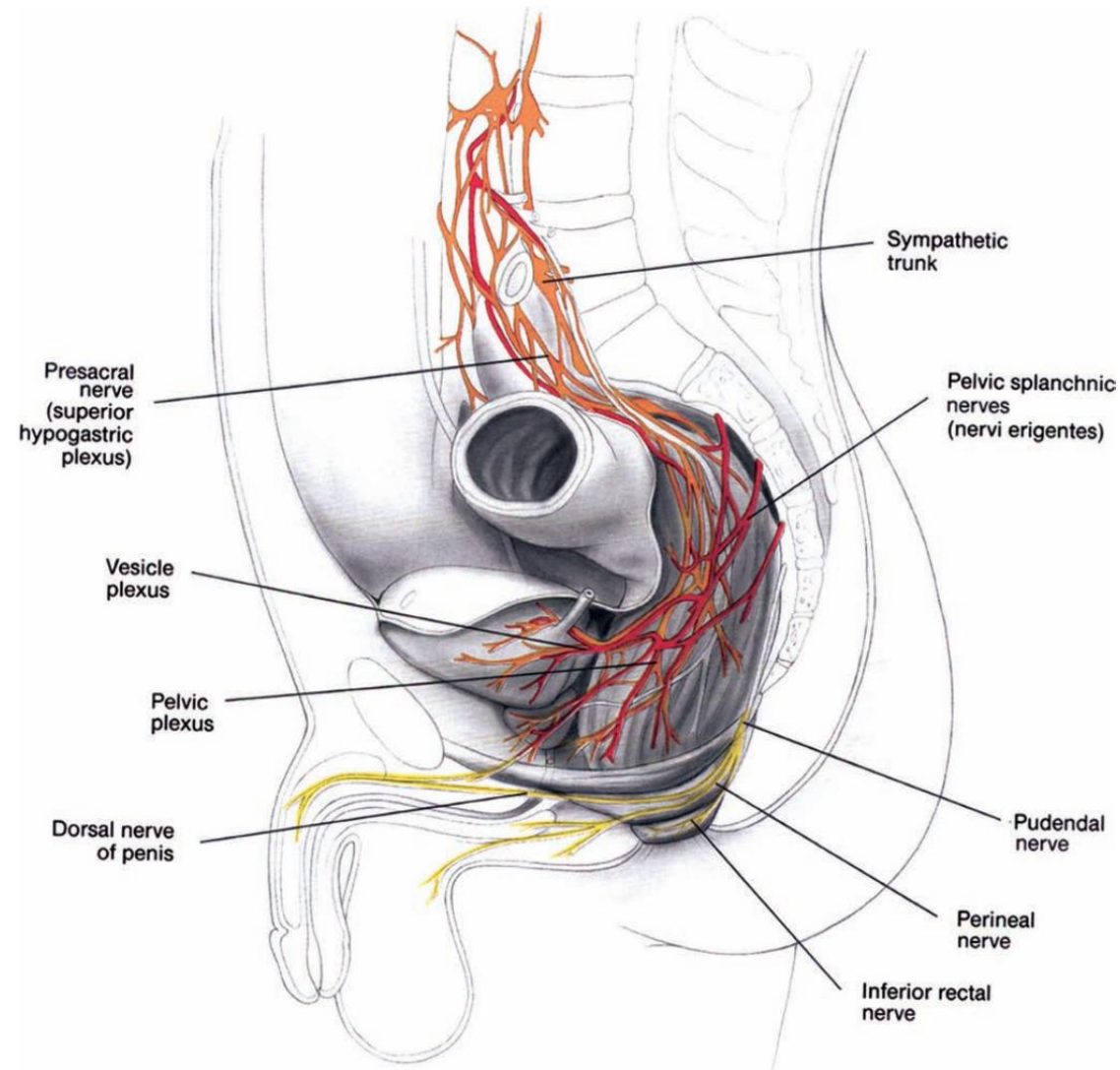
Parasympathetic Innervation

- from the **nervi erigentes**, which originate from the second, third, and fourth sacral nerves on either side of the anterior sacral foramina.
- The third sacral nerve is the largest of the three and is the major contributor
- The fibers pass laterally, forward, and upward to join the sympathetic nerve fibers to form the **pelvic plexus** on the pelvic side walls
- From here, the two types of nerve fibers are distributed to the urinary and genital organs and to the rectum

Anorectum Innervation



Anorectum innervation

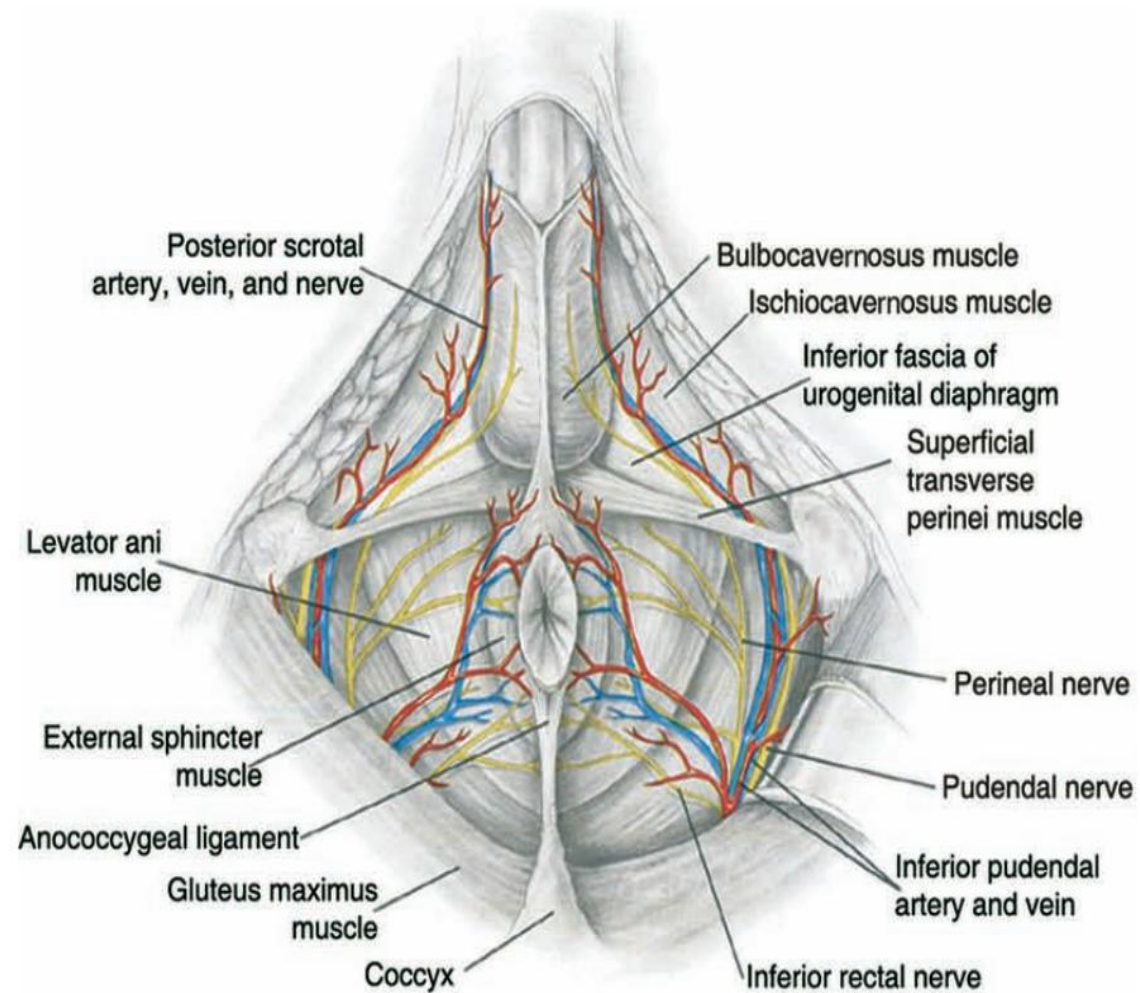


Anal canal Innervation

Pudendal Nerve

- arises from the sacral plexus (S2 to S4).
- It leaves the pelvis through the greater sciatic foramen, crosses the ischial spine, and continues in the pudendal canal (Alcock's canal) toward the ischial tuberosity in the lateral wall of the ischioanal fossa on each side.
- Three of its important branches are the inferior rectal, perineal, and dorsal nerves of the penis or clitoris

Anal canal Innervation



Anal canal

Motor Innervation

internal anal sphincter

- is supplied by both sympathetic and parasympathetic nerves that presumably reach the muscle by the same route as that followed to the lower rectum.
- The parasympathetic nerves are inhibitory to the internal sphincter.
- The action of sympathetic nerves to the internal sphincter is conflicting

Anal canal

Motor supply

external sphincter

- inferior rectal branch of the internal pudendal nerve and the perineal branch of the fourth sacral nerve.
- The pudendal nerve passes through the greater sciatic foramen and crosses the sacrospinous ligament accompanied by the internal pudendal artery and vein.
- The pudendal nerve lies on the lateral wall of the ischioanal fossa, where it gives off the inferior rectal nerve
- inferior rectal nerve crosses the ischioanal fossa with the inferior rectal vessels to reach the external sphincter

Anal canal

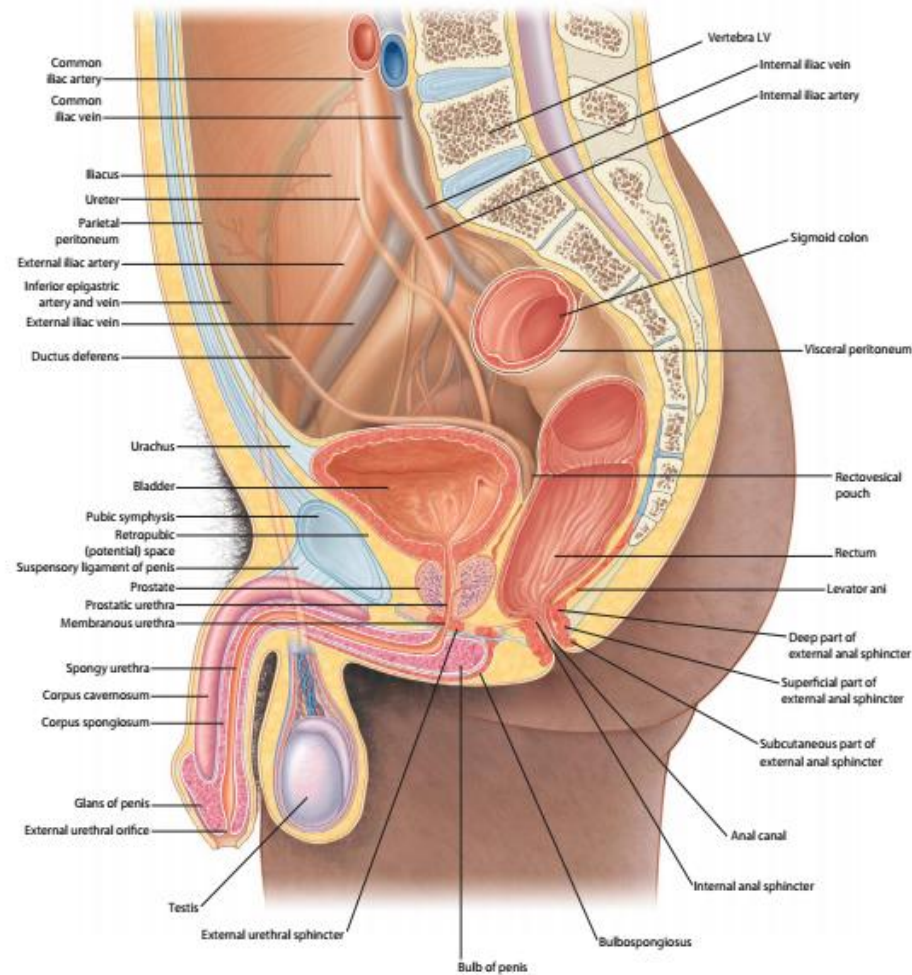
Sensory Innervation

- The sensory nerve supply of the anal canal is the inferior rectal nerve, a branch of the pudendal nerve.
- The epithelium of the anal canal is profusely innervated with sensory nerve endings, especially in the vicinity of the dentate line
- Pain sensation in the anal canal can be felt from the anal verge to 1.5 cm proximal to the dentate line
The anal canal can sense touch, cold, and pressure.

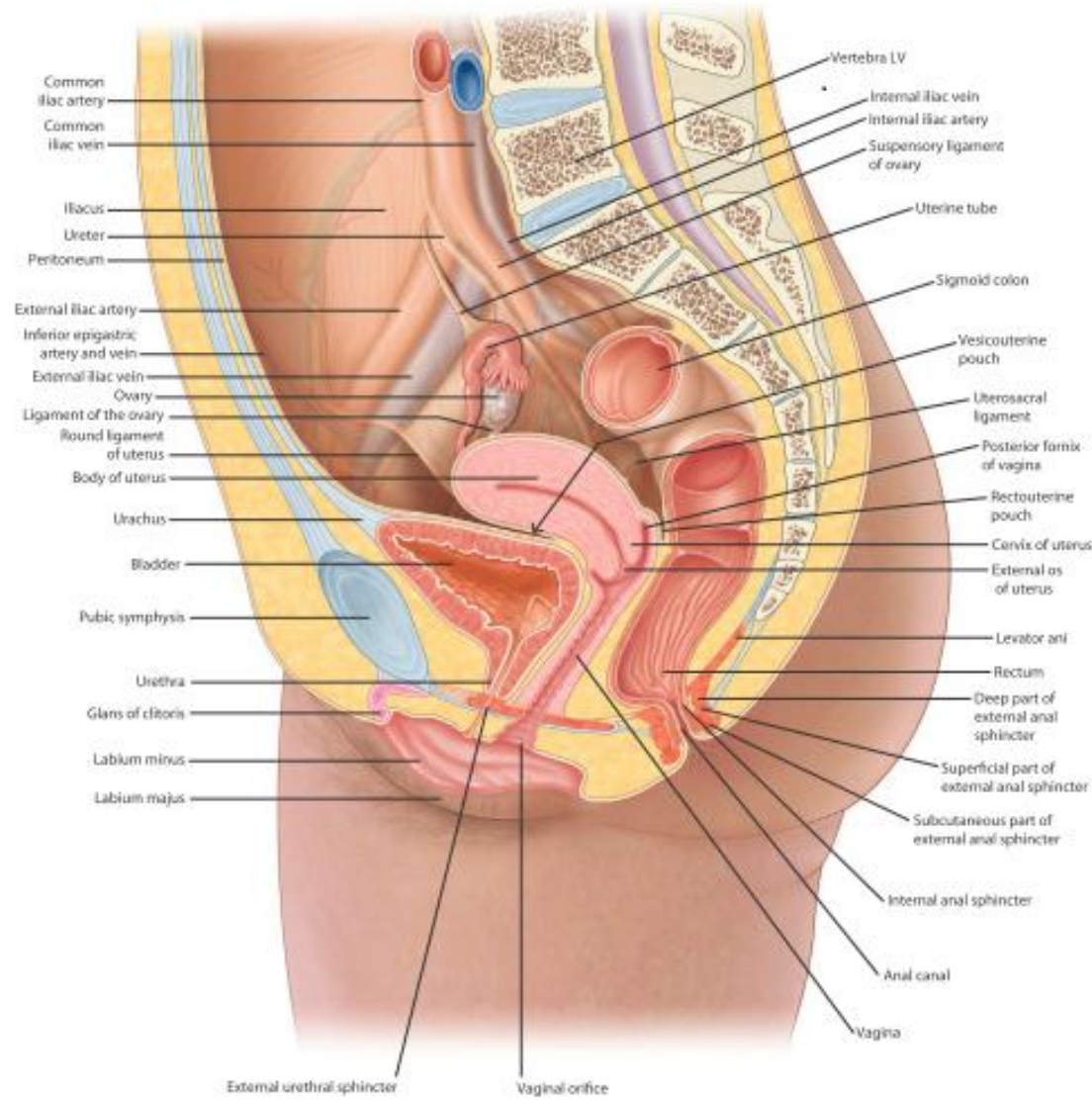
Some Clinical notes

- Digital rectal examination
- rectal tumors
- Bleeding from hemorrhoids
- Pain of anal fissure
- Perianal suppurations
- Pudendal nerve block

The rectum male



The rectum female



anal fissure

Acute vs. chronic

