Anatomy

Faculty of Medicine - JU2017

Number >>	14
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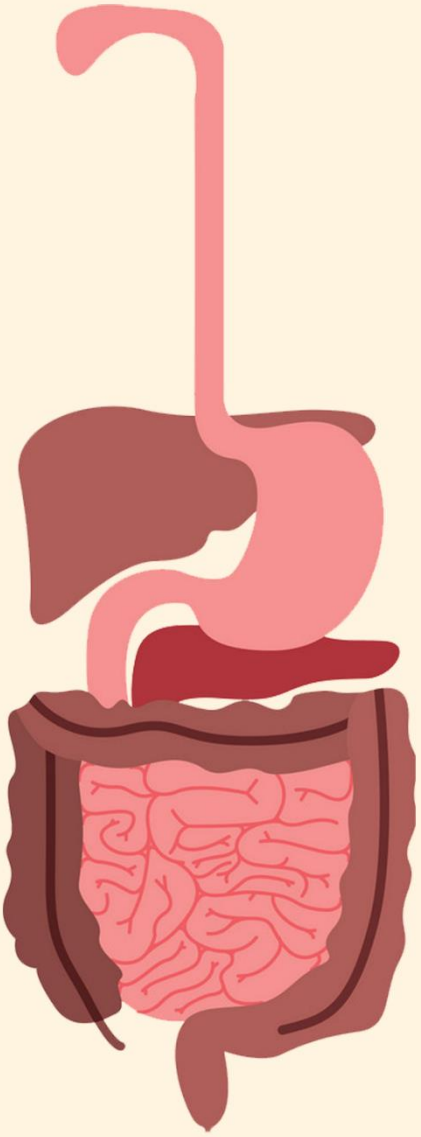


2nd system - GI

Pelvic colon

It involves the sigmoid colon, rectum, and upper part of the anal canal (upper 2 cm).

⇨ *Why did we say upper part of anal canal?*

Because the anal canal is divided to two parts: upper 2 cm, and lower 2 cm (4 cm in total). The upper 2 cm follow the rectum, their epithelium is simple columnar, they originate from the endoderm, sensitive for stretch (autonomic innervation), and their lymphatic drainage goes to the inferior mesenteric lymph nodes (preaortic). Whereas the lower 2 cm are completely different, their epithelium is stratified squamous, they originate from the ectoderm, sensitive to pain, touch and temperature (somatic innervation from S4), and their lymphatic drainage goes to the inguinal lymph nodes in the femoral triangle.

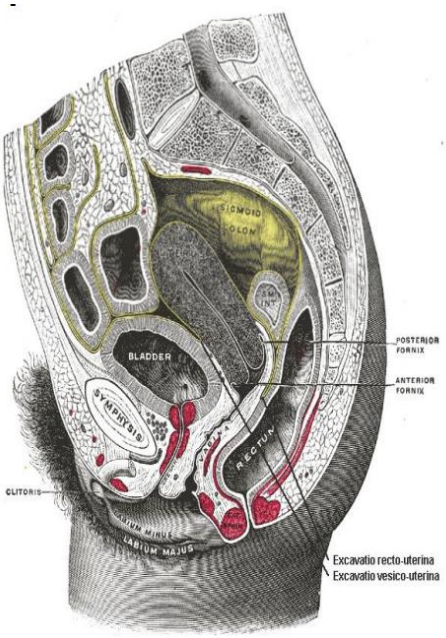
Sigmoid colon

- Retroperitoneal (mobile) part of large intestine, its long is 10-15 inches (25-38) cm, hangs down into the pelvic cavity in the form of a loop and attached to the posterior pelvic wall by the fan-shaped sigmoid mesocolon (NOT pelvic mesocolon).
- Begins as a continuation of the descending colon on the left side of the pelvic brim (inlet) it goes to the right and ends at the mid of sacrum anterior to the third sacral vertebra where it continues with the rectum.
- Usually occupies the recto-vesical pouch in males and the rectouterine pouch in females.
- Has four parts:
  a. The root (mesocolon): has an inverted V-shape.
  b. The lateral limb: contains lower Left Colic artery.
  c. The medial limb: contains Superior Rectal artery(continuation of the inferior mesenteric artery)
  d. The free edge: curved to the right of mid line and contains the end of sigmoid colon.

- Its mesocolon has inverted V shape, with two attachments:
  a. Medial attachment blends with fascia of the middle piece of sacrum, in front of its concavity.
  b. Lateral attachment, the bifurcation of left common iliac artery and blends with the fascia of external iliac artery.

- Has **very long** appendices epiploicae.
- Relations of sigmoid colon:

  - Left: left external iliac vessels, lateral wall of pelvis, and vas deference in males or ovary in females.
  - Right: small intestine
  - Superior: coils of small intestine
  - Inferior: urinary bladder in males, uterus in females
  - Posterior: rectum, sacrum, lower coils of terminal part of ileum, sacral plexus, left piriformis muscle, left external iliac vessels, left ureter, and left internal common iliac artery.

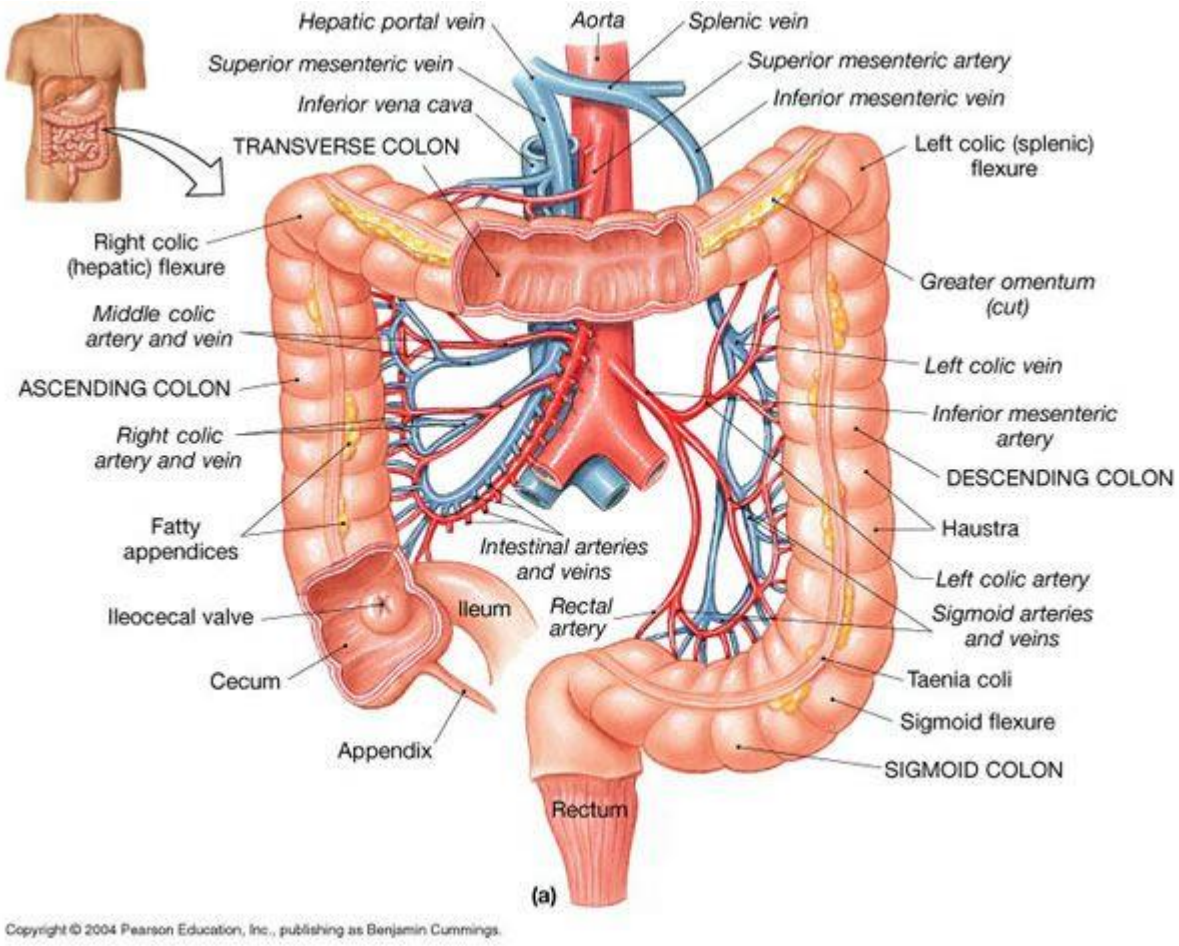


  - ❖ The sigmoid colon usually occupies the rectovesical pouch in males and the rectouterine pouch in females

- ***Blood supply of sigmoid colon***

1. The *inferior mesenteric artery* branches to the left colic artery, sigmoidal arteries and continues as the **superior rectal** artery.
2. *Sigmoid arteries* from the inferior mesenteric artery supplies the sigmoid colon.
3. *The most superior sigmoid artery anastomoses with the descending branch of the left colic artery*. i

The doctor specified that this picture is important-notice how arteries are exactly opposite to veins and how artery lies **medial** to veins, Arteries are inside and veins are outside.
(watch from 08:40)



- ***Venous drainage of sigmoid colon***

Sigmoid veins drain into *the inferior mesenteric vein* which terminates when reaching the splenic vein, which continues to form the portal vein.

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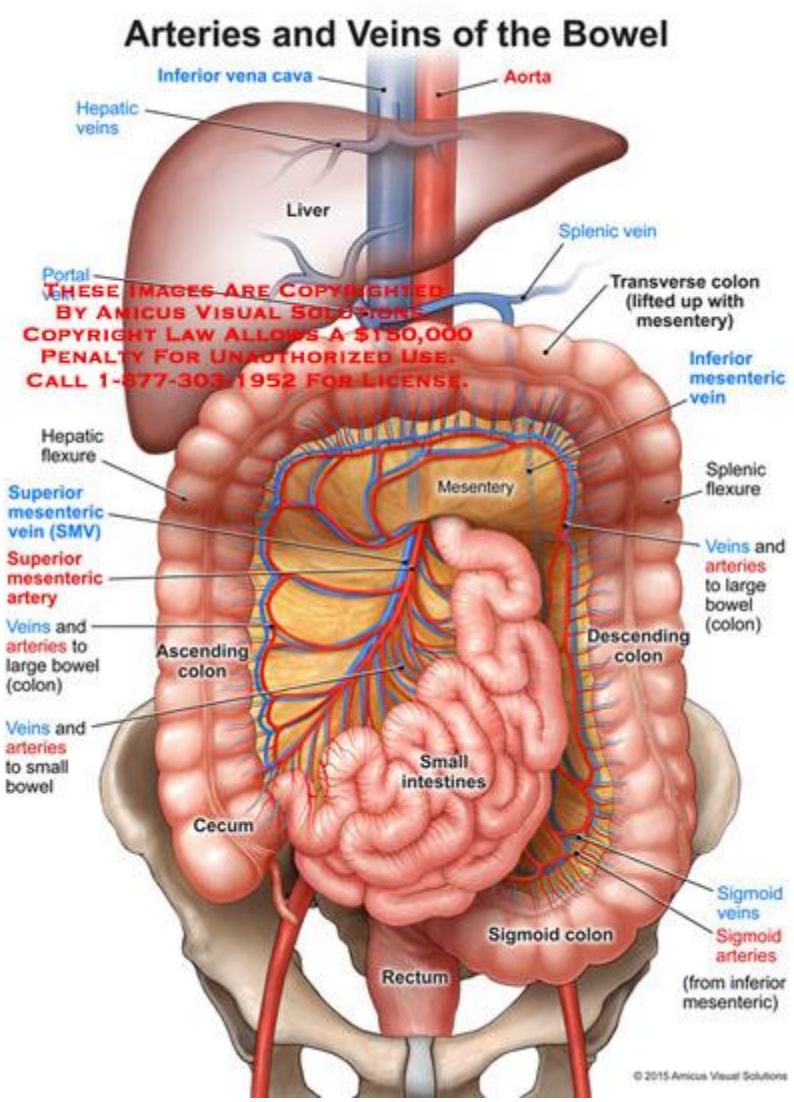


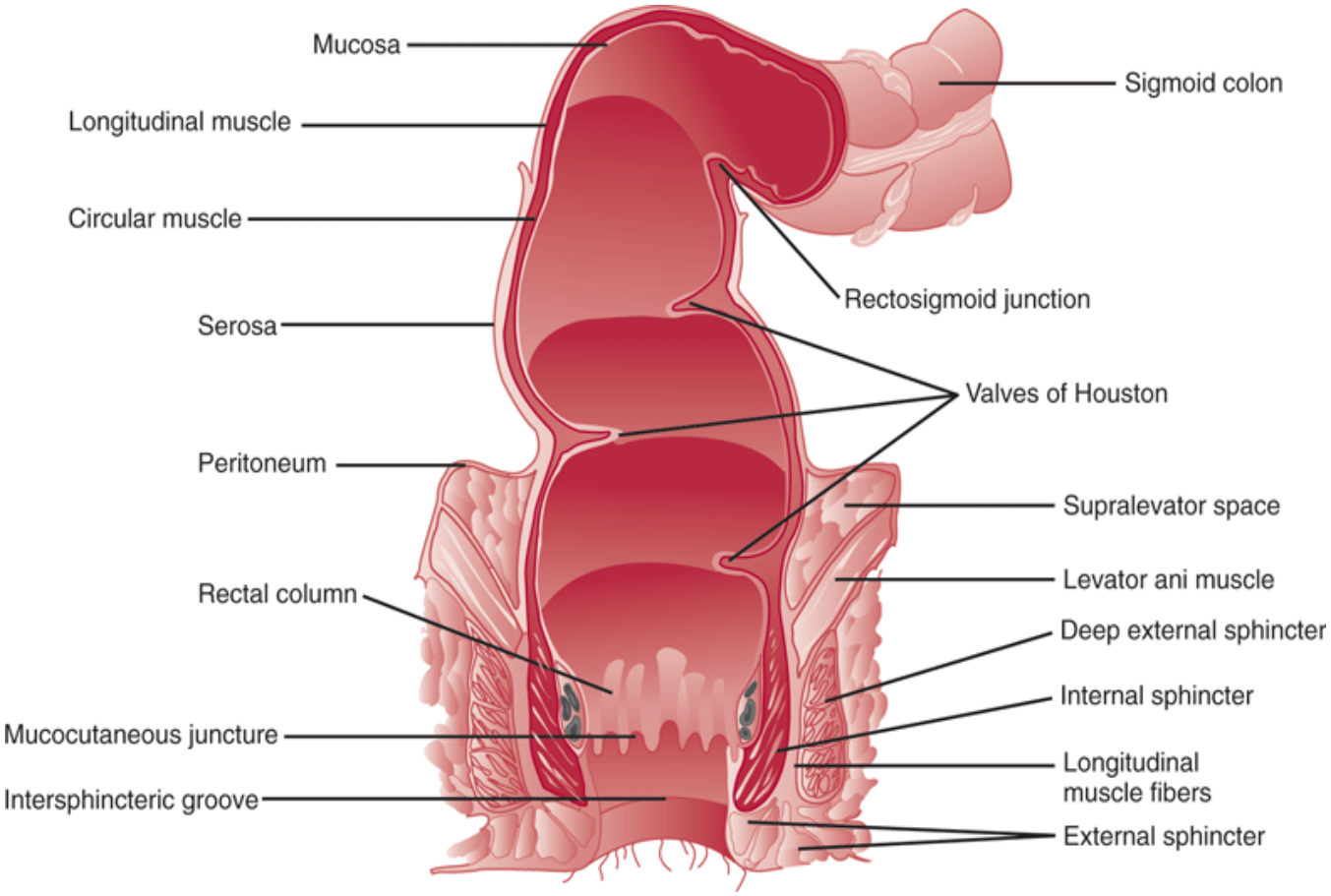
- ***Lymphatic drainage of sigmoid colon***

The lymph drains into nodes along the course of the sigmoid arteries to *the inferior mesenteric nodes (pre-aortic).*

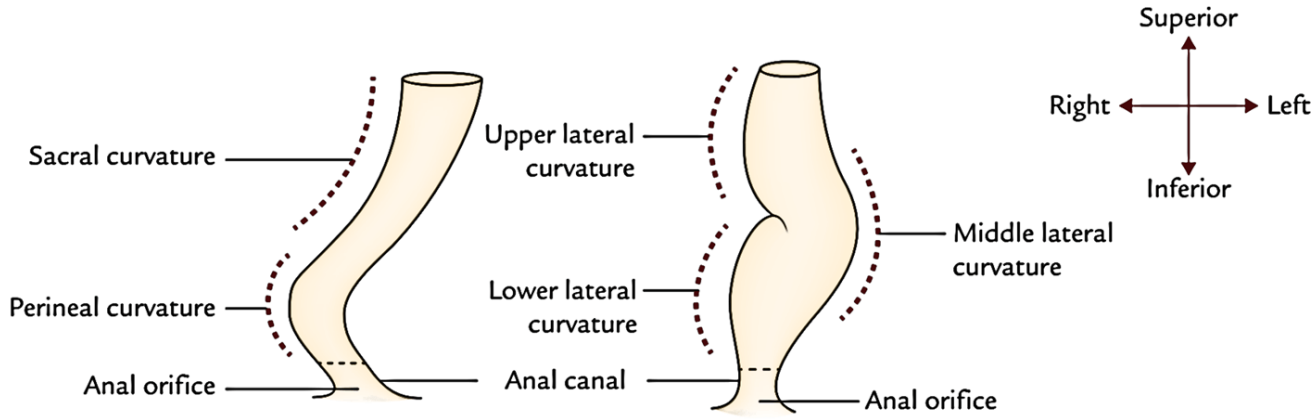
- ***Nerve supply of sigmoid colon***
  - ***a-*** The sympathetic and parasympathetic nerves from the *inferior hypogastric plexuses.*
  - **b-** Sympathetic from L1 and L2.(inferior mesenteric ganglia)
  - **c-** The parasympathetic supply is derived from the pelvic splanchnic nerves S2, S3, S4.

Rectum

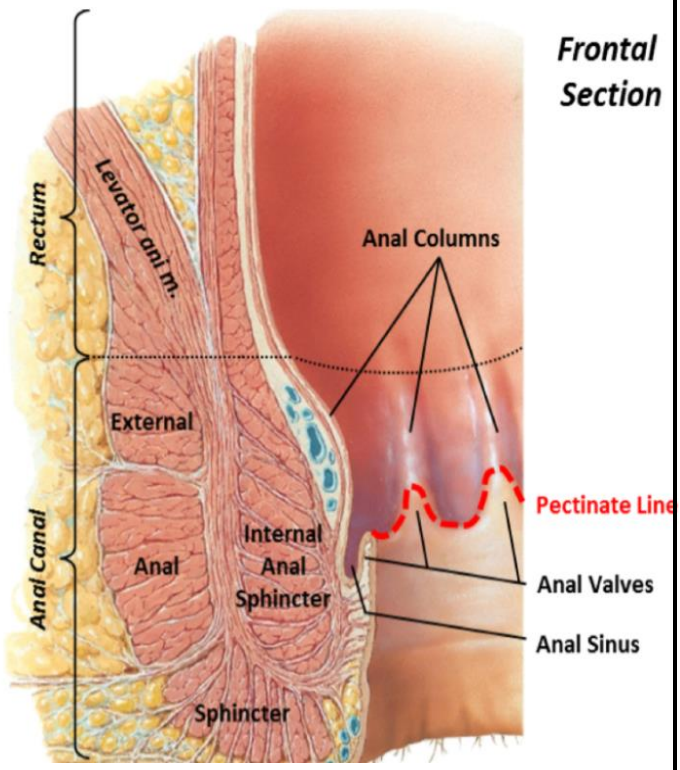
- The rectum is about 5 inches (13 cm) long.
- Begins at middle piece of sacrum in front of the third sacral vertebra as a continuation of the sigmoid colon and ends 1 inch beyond the tip of the coccyx by piercing the pelvic diaphragm and become continuous with the anal canal.
- The rectum in relation to the peritoneum is divided into thirds, upper third is covered anteriorly and on both sides, middle third is covered anteriorly, and lower third is devoid of the peritoneum.
- The lower part of the rectum is dilated to form the rectal ampulla-which is a reservoir for stool. The rectum deviates to the left, but it quickly returns to the median plane.
- *Looking anteroposterior* to it, we can see that it follows the *anterior* concavity of the sacrum.



- *Looking at it laterally* looks like number 4 in Arabic ‘٤’ meaning that t here are ***two concavities on the left and one on the right.***



- One of the features of the rectum is the presence of *transverse and longitudinal mucosal folds.* There are three transverse folds: upper, lower, and middle.
- The transverse folds are called ***Houston's valve***: were upper fold projects from right, middle fold projects from anterior and right wall, and lowest fold projects from left wall.
- The *longitudinal folds* are called *anal columns* and form *anal sinuses (pockets) and anal valves at their ends.* Below them is a line called pectenate line separating upper and lower parts of anal canal.



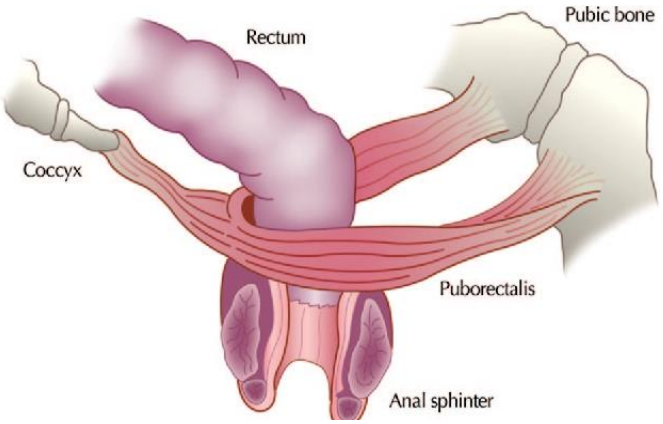
  - At both sides of the rectum and anal canal is the **ischiorectal fossa** (wedge-shaped) which is filled with fat to provide space for the rectum and anal canal during defecation, but this also permits infection causing a recurrent perianal abscess in the fossa
- There are *three external anal sphincters* (subcutaneous, superficial, and deep) which are *voluntary* and *one internal sphincter* just below the submucosa which is *involuntary*. The external sphincter is more important than the internal sphincter in the prevention of incontinence (lack of voluntary control over defecation).
- In the wall of obturator internus fascia is the *pudendal canal* on the lateral side of ischiorectal fossa, it is crossed by the internal pudendal vessels and pudendal nerve which *gives the inferior rectal nerve supplying the*

external anal sphincter.

- *Puborectalis muscle*

✓ The puborectalis portion of the levator ani muscle forms a sling at the junction of the rectum with the anal canal and pulls this part of the bowel **forward**, producing the anorectal angle. It defines the junction between the rectum and anal canal, and is very important in defection.

✓ It takes origin from the pubis and goes posteriorly to wrap around the rectoanal junction and back to the pubis like the letter 'U'.

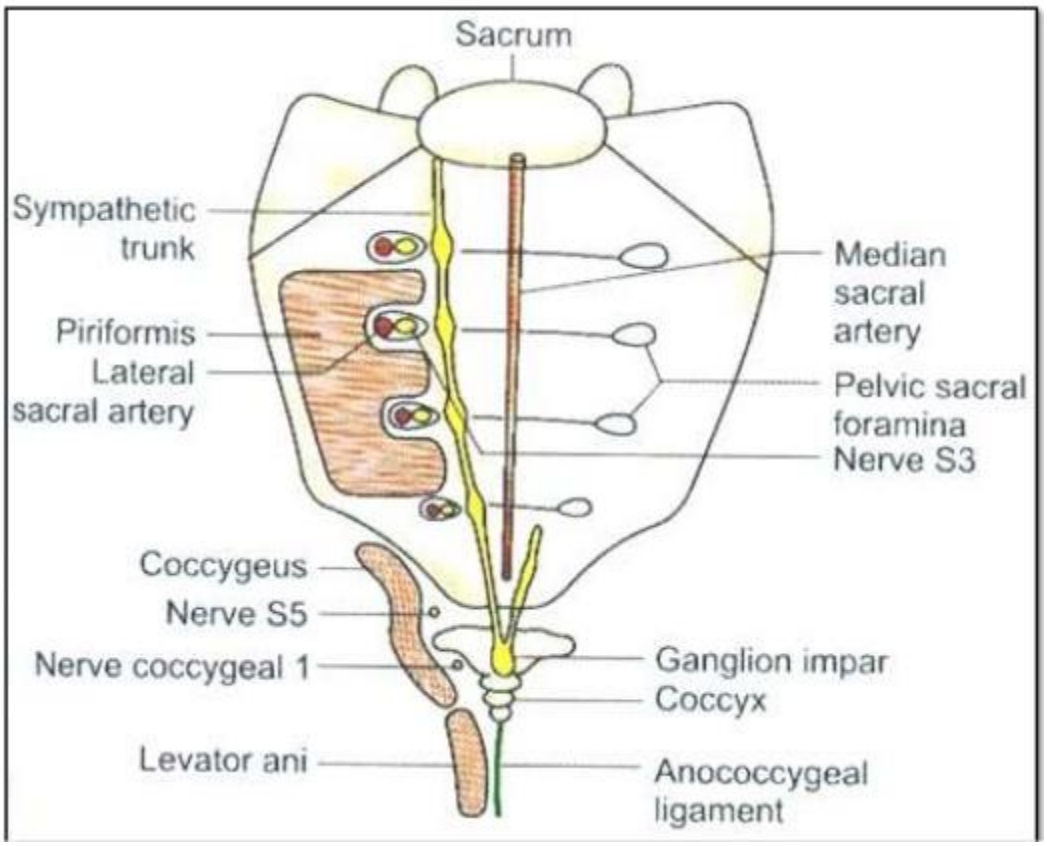


- ***Structures at the level of anorectal junction***
  - Puborectalis, internal sphincter, deep part of external anal sphincter.
  - Any trauma or damage to this area may cause incontinence.

- ***Relations of the rectum***

I. Posteriorly:

The rectum is in contact with the sacrum and coccyx - the piriformis muscle - Coccygeus muscle - levatores ani muscle - the sacral plexus - the sympathetic trunks and anococcygeal body.



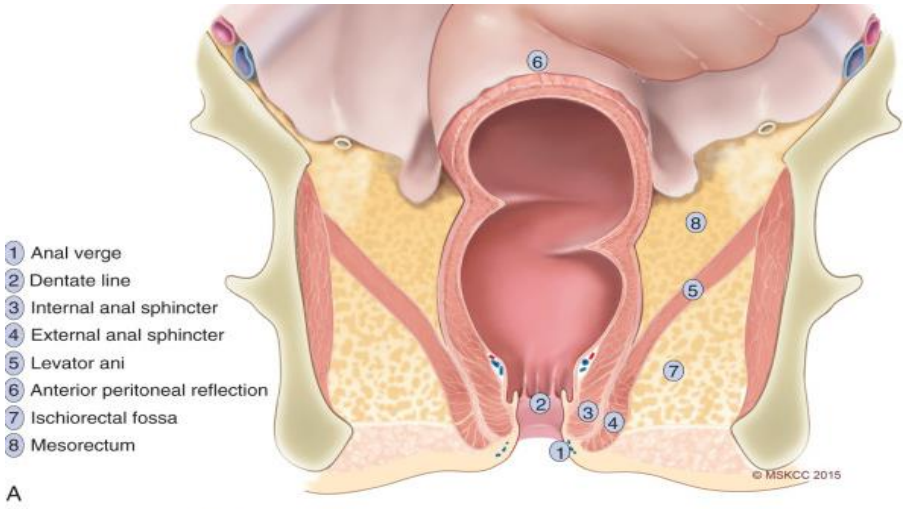
II. Anteriorly:

In the male

1. The upper two thirds of the rectum: covered by peritoneum, and related to the sigmoid colon and coils of ileum that occupy the rectovesical pouch.
2. The lower third of the rectum: devoid of peritoneum , and related to the posterior surface of the bladder, termination of the vas deferens, seminal vesicles on each side, prostate and to the perineal body.

In the female

1. The upper two thirds of the rectum: covered by peritoneum, related to the sigmoid colon and coils of ileum that occupy the rectouterine pouch (pouch of Douglas).
2. The lower third of the rectum: devoid of peritoneum, related to the posterior surface of the vagina and perineal body.


1 Anal verge
2 Dentate line
3 Internal anal sphincter
4 External anal sphincter
5 Levator ani
6 Anterior peritoneal reflection
7 Ischiorectal fossa
8 Mesorectum
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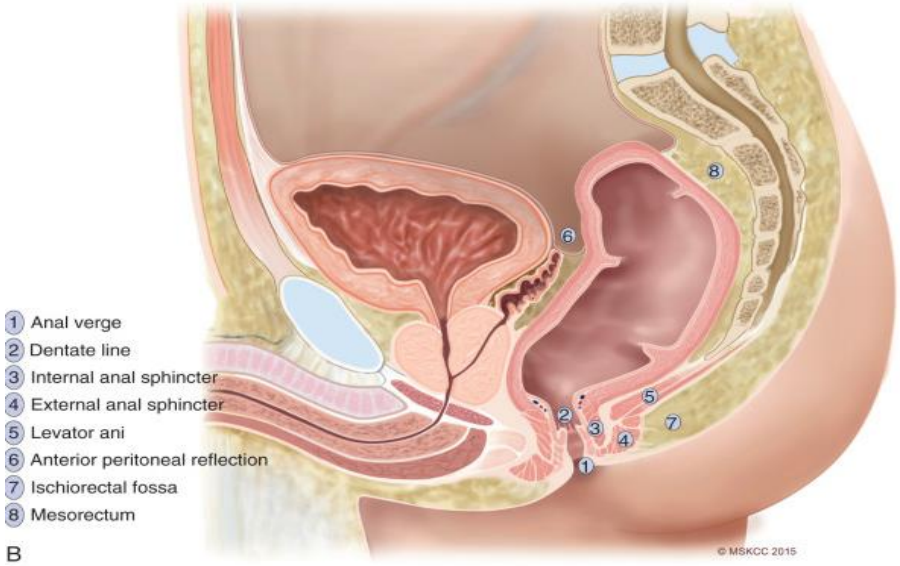
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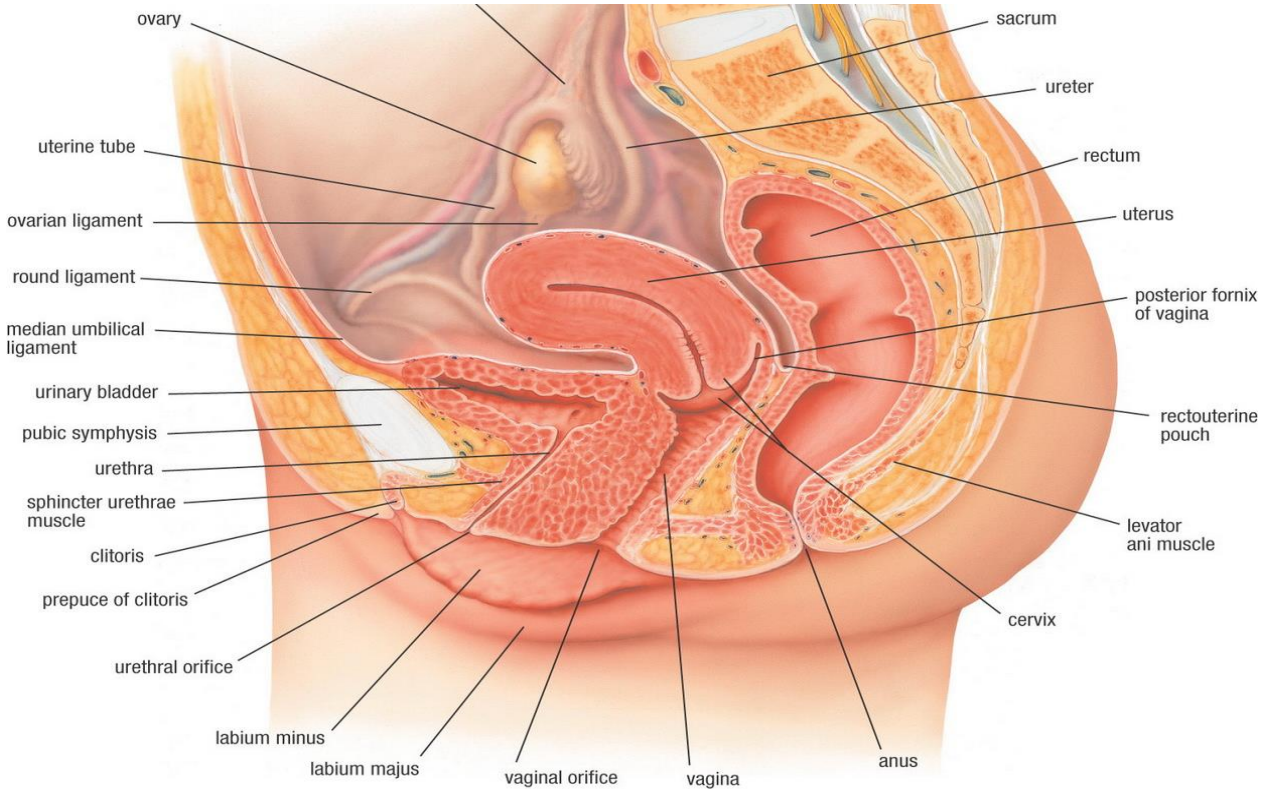
ovary
sacrum
ureter
uterine tube
rectum
ovarian ligament
uterus
round ligament
posterior fornix of vagina
median umbilical ligament
urinary bladder
rectouterine pouch
pubic symphysis
urethra
levator ani muscle
sphincter urethrae muscle
clitoris
cervix
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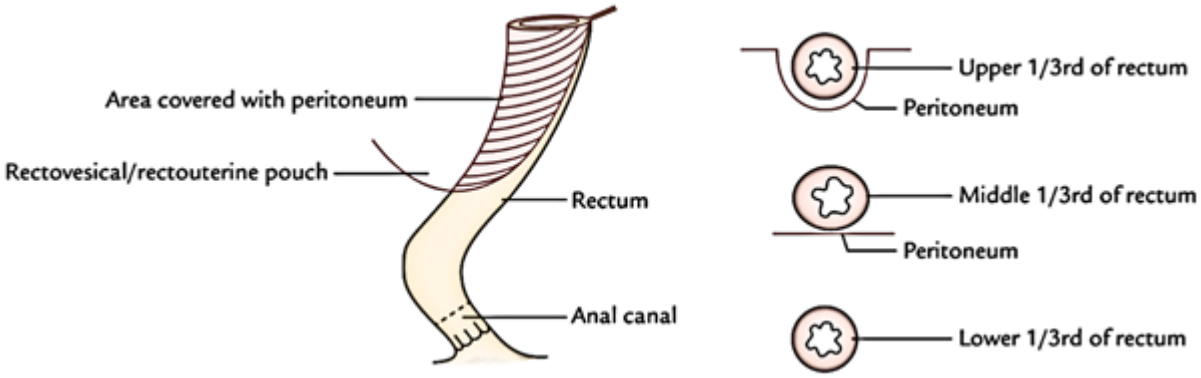
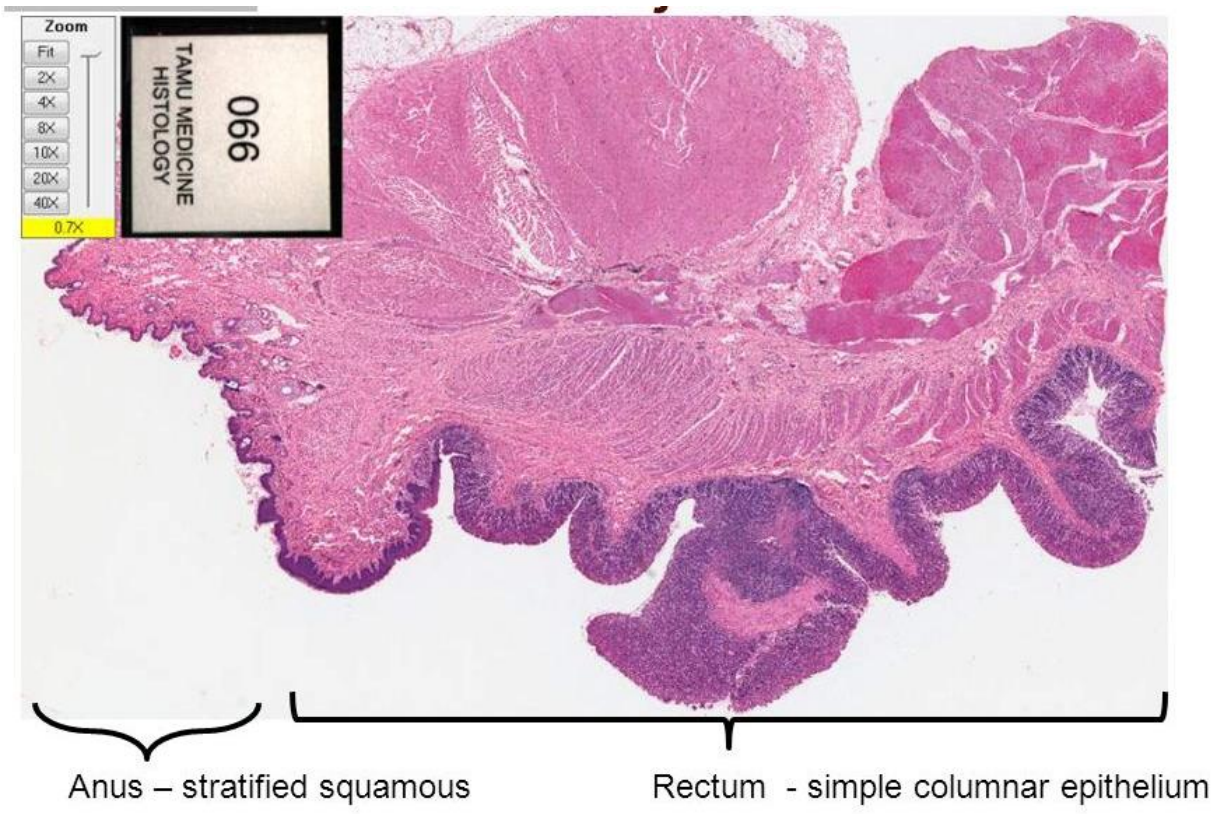
urethral orifice
labium minus
labium majus
vaginal orifice
vagina
anus



- *Histology of rectum*
  - Rectal epithelium is simple columnar epithelium with the upper half of anal canal with few goblet cells.
  - It forms columns transverse and columns longitudinal
  - Has crypts of Lieberkühn.
  - Muscularis externa, outer longitudinal and inner circular **lacks tenia coli**



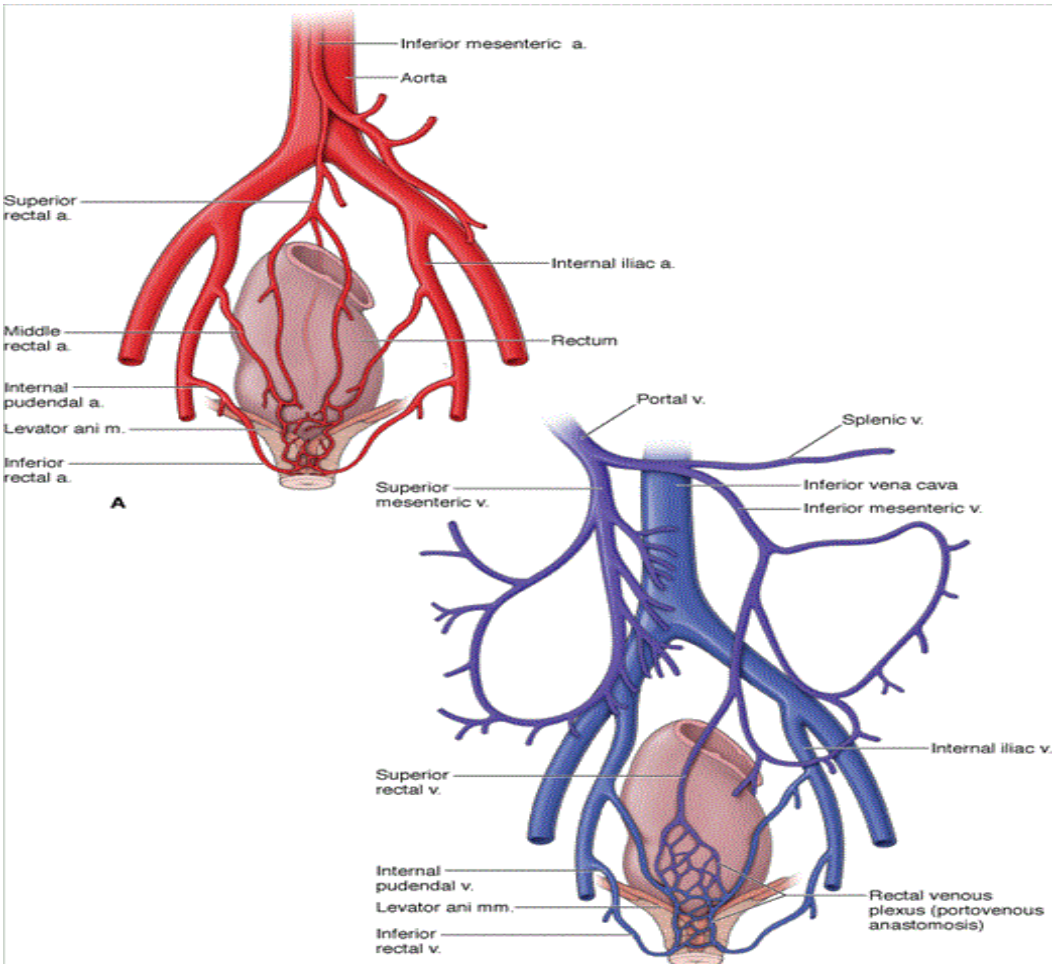
- *Blood supply of rectum*
- *Arterial supply*

We have internal and external iliac arteries, the internal gives anterior division and posterior division.

a- *Superior rectal artery, which is a direct continuation of the inferior mesenteric artery, supplies Rectum and upper half of anal canal. . It enters the pelvis by descending in the root of the sigmoid mesocolon and divides into right and left branches, which pierce the muscular coat and supply the mucous membrane. It is the chief artery supplying the mucous membrane.*

b- *Middle rectal artery which is the anterior division of internal iliac artery, supplies the junction between the rectum and anal canal. It is distributed mainly to the muscular coat.*

c- *Inferior rectal artery which is a branch of pudendal artery (from internal iliac artery), supplies the lower half of anal canal. It anastomoses with the middle rectal artery at the anorectal junction.*



- ***Venous drainage***

The veins of the rectum correspond to the arteries:

a- *The superior rectal vein* is a tributary of the portal circulation and drains

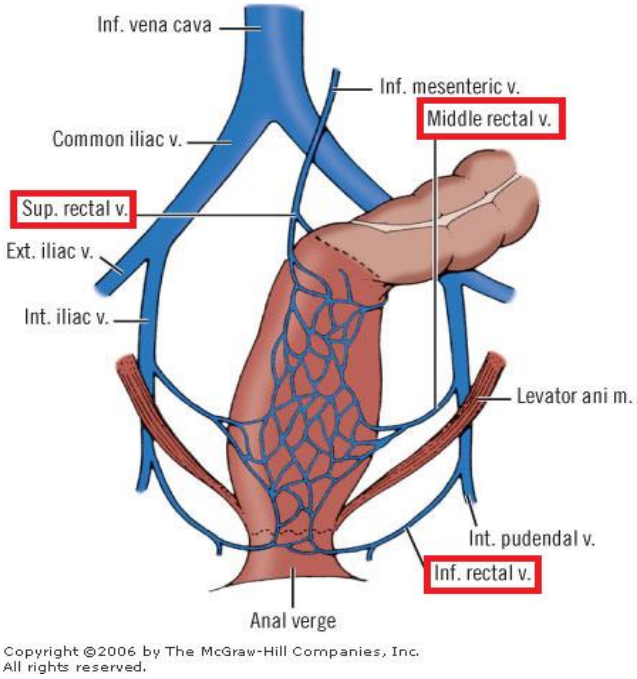
into the inferior mesenteric vein.

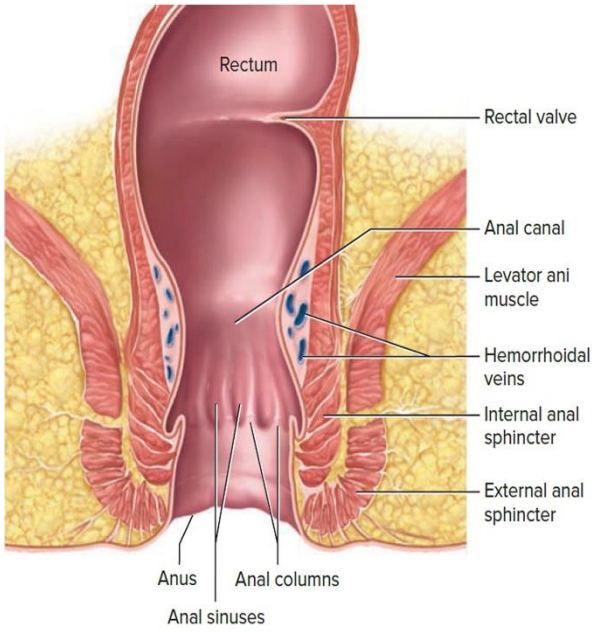
b- *The middle rectal vein* drains into the internal iliac vein to the inferior vena cava.

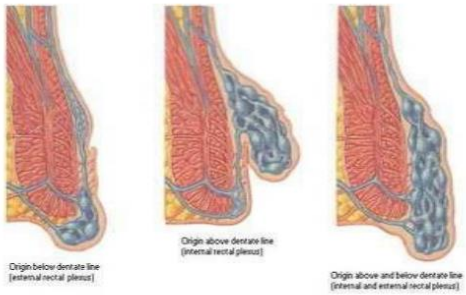
c- *The Inferior rectal vein* drains into the internal pudendal veins which drain into the internal iliac vein to the inferior vena cava.

The union between the rectal veins forms an important portosystemic anastomosis.

- **The hemorrhoidal plexus (or rectal venous plexus)**
  - It surrounds the rectum, and communicates in front with the vesical venous plexus in the male, and the uterovaginal plexus in the female.
  - It forms a free communication between the portal and systemic venous system.







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- ***Lymphatic drainage of the rectum***

I. The rectum and upper part of anal canal drain into the pararectal

nodes and then the inferior mesenteric lymph nodes >> common iliac lymph nodes **>> preaortic** lymph nodes.

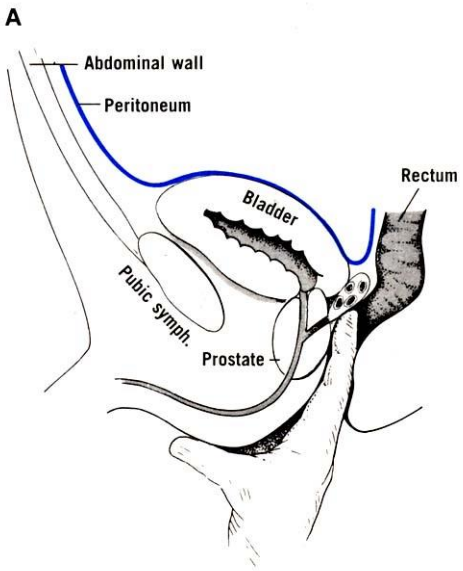
II. The lower half of anal canal drains into the superficial inguinal lymph nodes deep in the femoral triangle.

- ***Nerve supply of rectum***

- The nerve supply is from the sympathetic and parasympathetic nerves from the inferior hypogastric plexuses.
- The rectum and upper half of anal canal are sensitive **only to stretch.**

PR examination (per rectal examination)

- ✓ An internal examination where the physician slips a lubricated finger into the rectum through the anus and palpates the inside for a short time. Structures around the anal canal and lower third of rectum can be sensed.
- ✓ In females, the physician can sense only the vagina anteriorly.
- ✓ In males, the prostate, vas deference, seminal vesicles and urinary bladder can be sensed.
- ✓ PR examination is a must for male patients of an old age because the prostate in males over 40 becomes hypertrophic.
- ✓ Normal prostate is soft but if it is hypertrophic one is hard. When the patient is asked if he uses the bathroom at night he would say he uses it 4-6 times and that he lacks the force of the urine flow while urinating. This means that the prostate is hypertrophic and compresses the urethra. The patient should be treated or else the urine would move from the bladder to the kidney causing it to become hypertrophic and thus loses his kidney.
- ✓ Also, through this examination you can palpate the calcification in vas deferens.



Anal Canal

– It is the terminal part of the large intestine, 3.8 cm long, extends from the anorectal junction to the anus, situated below the level of the pelvic

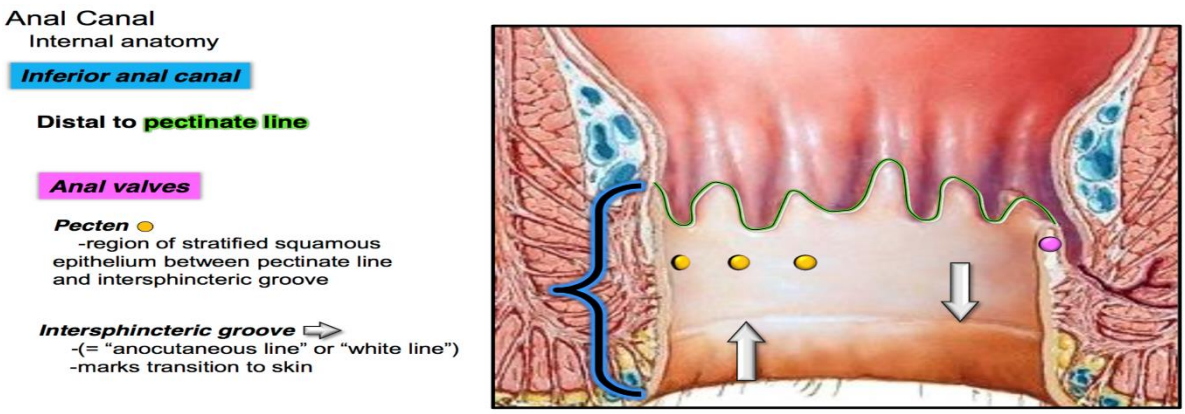
diaphragm and lies in the anal triangle of the perineum.

- The anorectal junction is marked by the forward convexity of the perineal- flexure of the rectum, the anus is the surface opening of the anal canal, situated about 4 cm below and in front of the tip of the coccyx in the cleft between the two buttocks.
- In the book and the slides, the anal canal is divided into three parts but the doctor divides it into two parts only by the pectinate line:

✓ *Upper 2 cm, originates from endoderm in the embryo, sensitive to stretch only(autonomic).*

✓ *Lower 2 cm, originates from ectoderm in the embryo, sensitive to pain, touch and temperature via inferior rectal nerve(somatic,S4). The White line further divides the lower part of anal canal to upper and lower parts:*

1. The upper part of lower anal canal (1 cm) has stratified squamous non-keratinized epithelium.
2. The lower part of lower anal canal (1 cm) has stratified squamous keratinized epithelium.

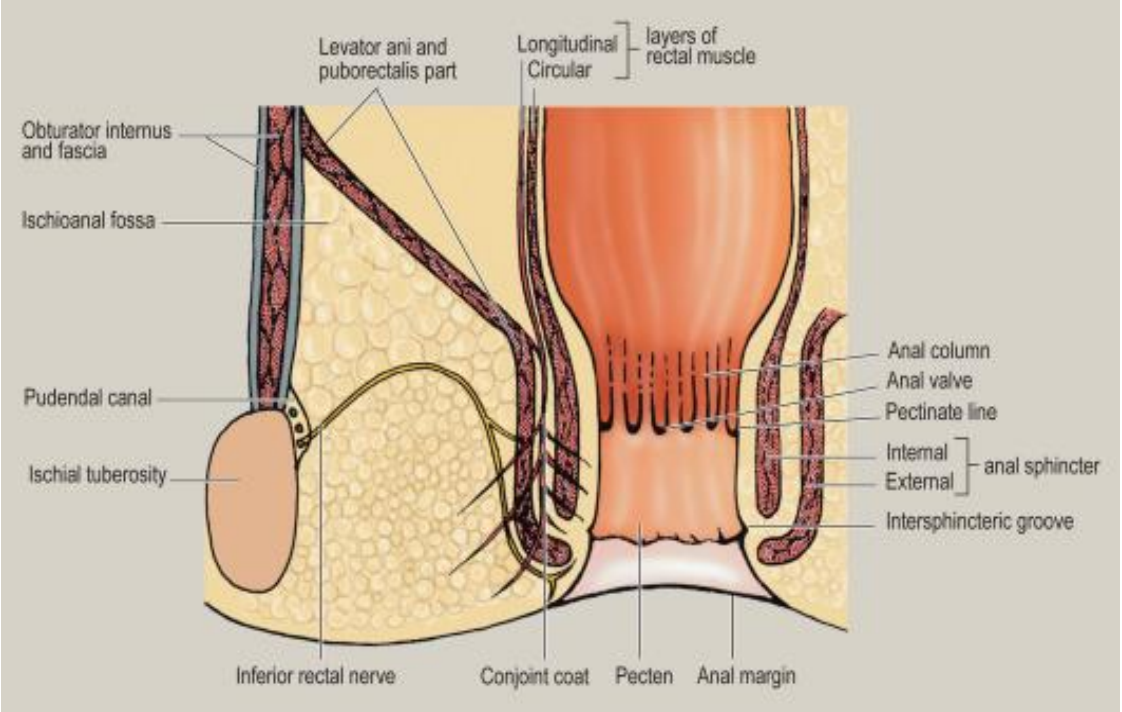


– ***The anorectal ring*** is a muscular ring present at the anorectal junction formed by the fusion of puborectalis, internal anal sphincter and deep external anal sphincter, which can be felt during rectal examination.

– ***Interior of the anal canal*** shows many features and can be divided into three parts:

1- The upper part

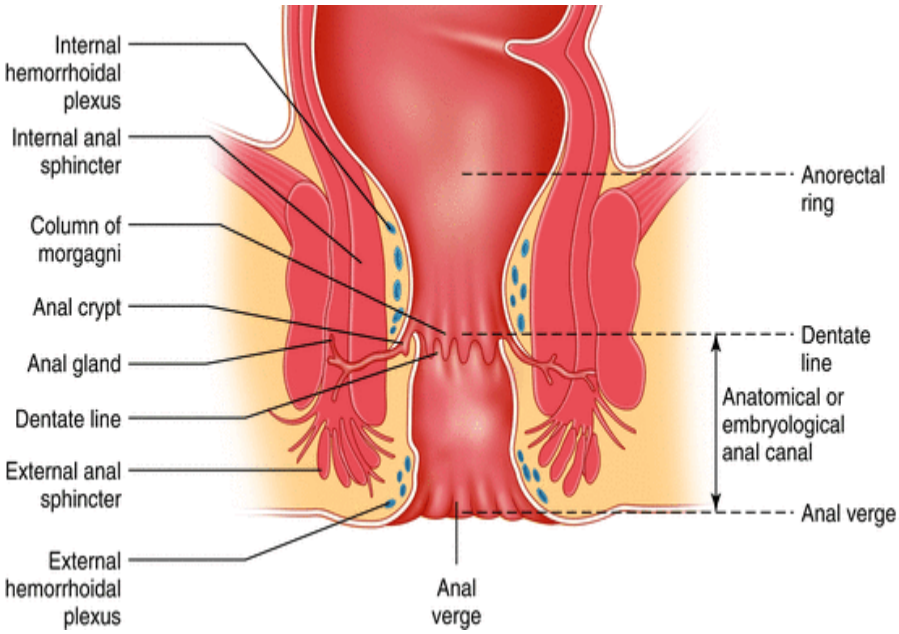
- Lined by mucous membrane (endodermal origin). The mucous membrane shows 6 to 10 vertical folds, these folds are called the anal columns of Morgagni.
- *The lower ends of the anal columns are united to Each other by short semilunar folds of mucous membrane, these folds are called the anal valves. Above each valve there is a depression in the mucosa which is called the anal sinus, the anal valves together form a transverse line that runs all-round the anal canal, called pectenate line.*



2- The middle part

- It is termed as transitional zone or pecten, it is also lined by mucous membrane.
- The mucosa has a bluish appearance because of a dense venous plexus that lies beneath.
- The lower limit of the pecten often has a whitish appearance because of which it is referred to as the white line or Hilton's line, is situated at the level the interval between the subcutaneous part of external anal sphincter and the lower border of internal anal sphincter.

3- The lower part: a cutaneous part, about 8mm long and is lined by true skin containing sweat and sebaceous glands.



- *Relations to the anal canal:*

Anteriorly

- In male: Perineal body, membranous urethra, bulb of penis.
- In female: Lower end of the vagina and perineal body.

The perineal body and anococcygeal body are fibrous connective tissue which can be sensed. Perineal body gives attachment to the perineal membrane or urogenital diaphragm and it lies between the vagina and anal canal

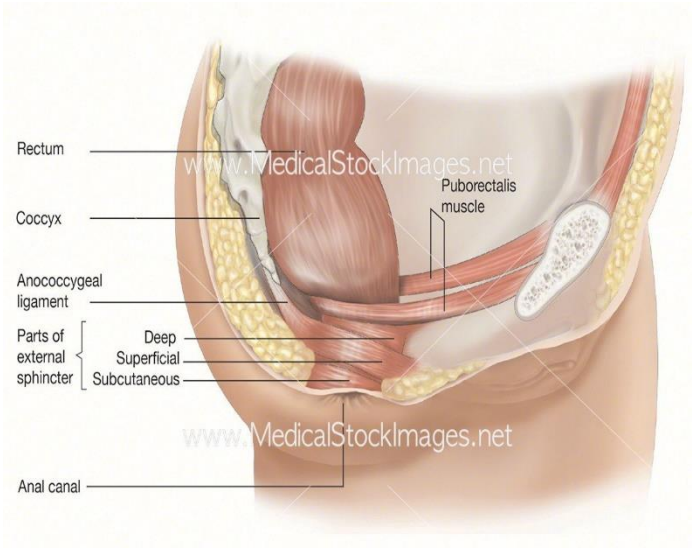
Posteriorly: Anococcygeal ligament and tip of the coccyx.

Laterally: ischiorectal fossae.

- *Musculature of the anal canal:*

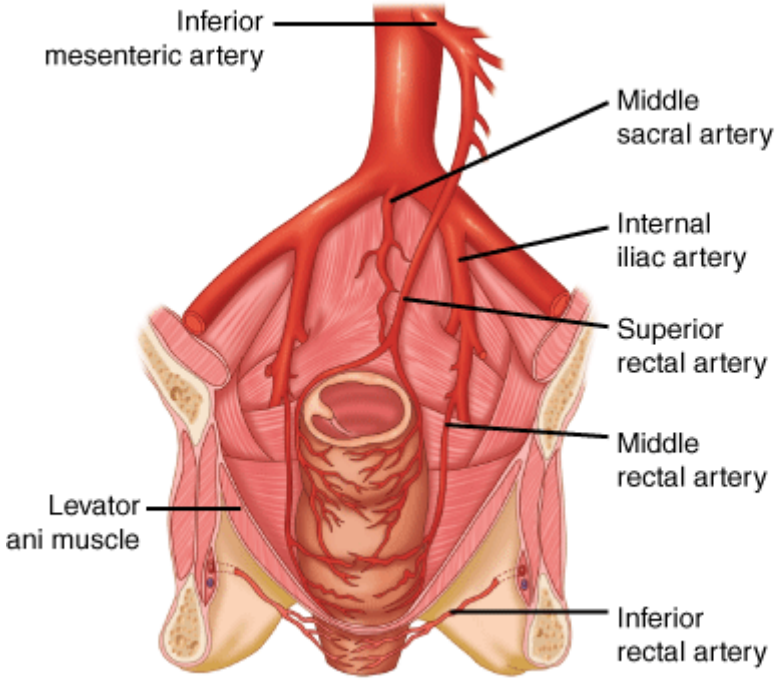
✓ Internal anal sphincter is involuntary in nature, has autonomic innervation, it is formed by the thickened circular muscle coat of this part of the gut,
✓ The external anal sphincter is under voluntary control & has three parts: subcutaneous, superficial and deep parts.
✓ Subcutaneous part lies below the level of internal sphincter and surrounds the lower part of the anal canal.

- ✓ The superficial part is elliptical in shape and arises from the terminal segment of the coccyx and anococcygeal ligament, the fibers surround the lower part of the internal sphincter and are inserted into the perineal body.
- ✓ The deep part surrounds the upper part of the internal sphincter and is fused with the puborectalis.
- ✓ All anal sphincters do not have a bony attachment except the superficial external anal sphincter.



- ***Blood supply of anal canal***
- ***Arterial supply***

The part of the anal canal above the pectenate line is supplied by *the superior rectal artery*, while the part below the pectenate line is supplied by *the inferior and middle rectal artery.*



- ***Venous drainage***

- Internal rectal venous plexus drains into superior rectal vein.
- The lower part of the external rectal venous plexus is drained by inferior rectal vein into the internal pudendal vein.
- The middle part by the middle rectal vein into the internal iliac vein.

- The Upper part by the superior rectal vein into the inferior mesenteric vein.
- The anal veins are arranged radially around the anal margin. They communicate with the internal rectal plexus and with the inferior rectal vein.

- *Lymphatic drainage of anal canal*

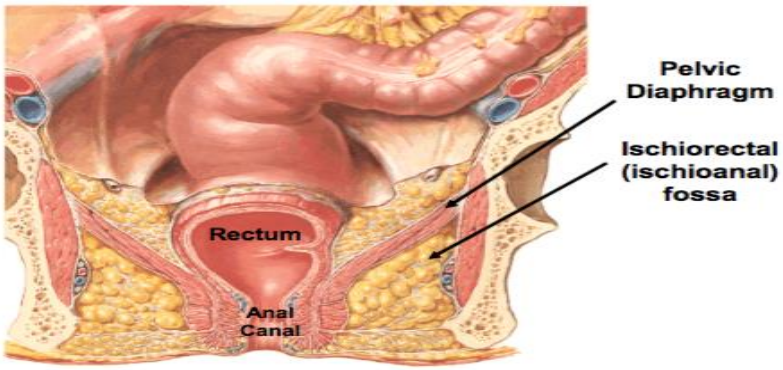
✓ Lymph vessels from the part above the pectenate line drain into the internal iliac nodes.
✓ Lymph vessels from the part below the pectenate line drain into superficial inguinal nodes.

- *Nerve supply of anal canal*

✓ Above the pectenate line, the anal canal is supplied by autonomic nerves (inferior hypogastric plexus and pelvic splanchnic).
✓ Below the pectenate line, it is supplied by somatic (inferior rectal) nerves.
✓ The external sphincter is supplied by inferior rectal nerve a branch of the fourth sacral nerve.

Ischiorectal Fossa

The ischiorectal fossa (ischioanal fossa) is a wedge-shaped space located on each side of the anal canal. The base of the wedge is superficial and formed by the skin. The edge of the wedge is formed by the junction of the medial and lateral walls. The medial wall is formed by the sloping levator ani muscle and the anal canal. The lateral wall is formed by the lower part of the obturator internus muscle, covered with pelvic fascia.



Contents of Fossa

The ischiorectal fossa is filled with dense fat which supports the anal canal and allows it to distend during defecation.

- The pudendal nerve
- Internal pudendal vessels are embedded in a fascial canal
- The pudendal canal, on the lateral wall of the ischiorectal fossa
- On the medial side of the ischial tuberosity, the inferior rectal vessels and nerve cross the fossa to reach the anal canal.

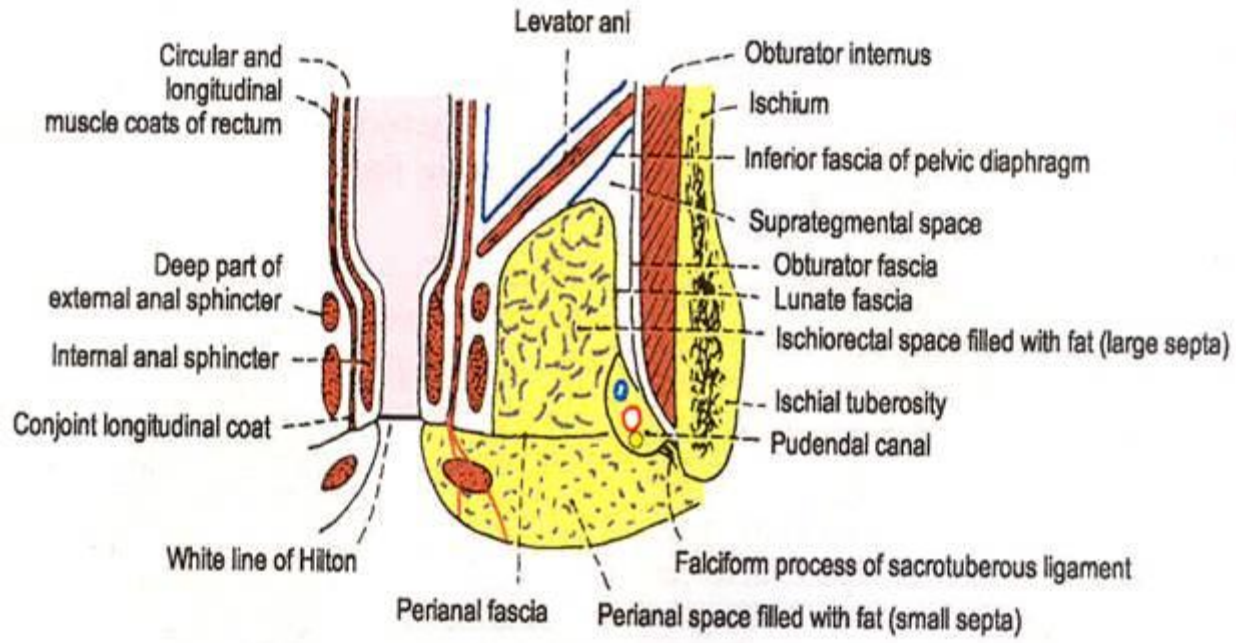


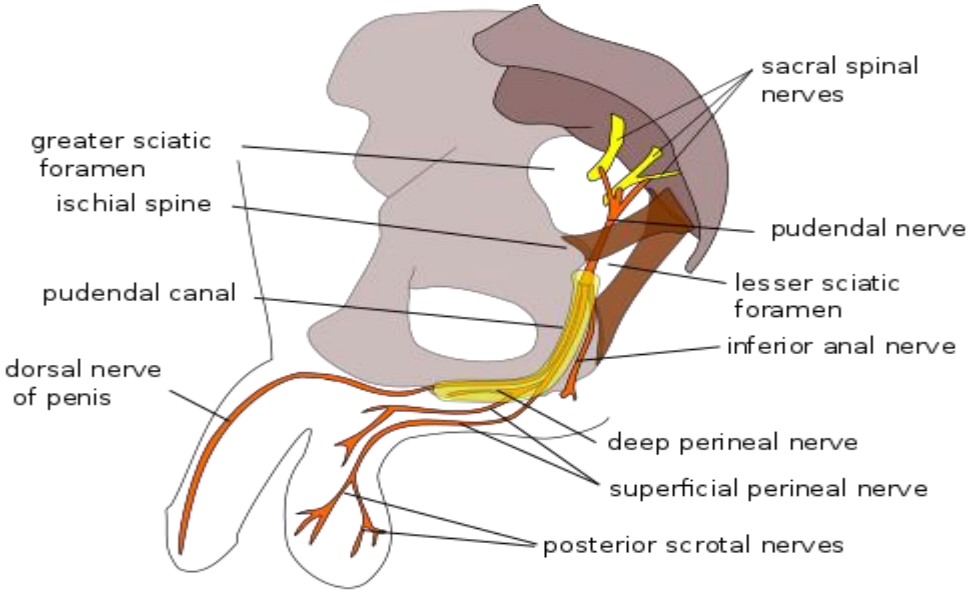
Fig. 28.7: Coronal section through the ischiorectal fossa.

– During operations in this area, an abscess called perianal abscess may form in the ischiorectal fossa also known as the dirty region. This abscess needs to be drained and you should be careful with the nerve going to the external sphincter from S4 (inferior rectal nerve) if cut, voluntary control is lost causing incontinence.
– If an abscess forms chances of recurrence are high because it is a dirty area.
  - Perianal sinus open to the skin.
  - Perianal fistula open to the anal canal, in this case stool contains pus and blood.

The pudendal canal

a. *The pudendal canal (also called Alcock's canal) is an anatomical structure in the pelvis formed by the obturator internus fascia*
b. *Runs in the lateral wall of the ischiorectal fossa, and ends in the deep perineal pouch.*
c. *It contains: Internal pudendal artery, internal pudendal veins, and Pudendal nerve.*
d. *These vessels and nerve cross the pelvic surface of the obturator internus.*

- The anal triangle will be covered in the urogenital system course.



Clinical cases

- *Hemorrhoids or Piles*

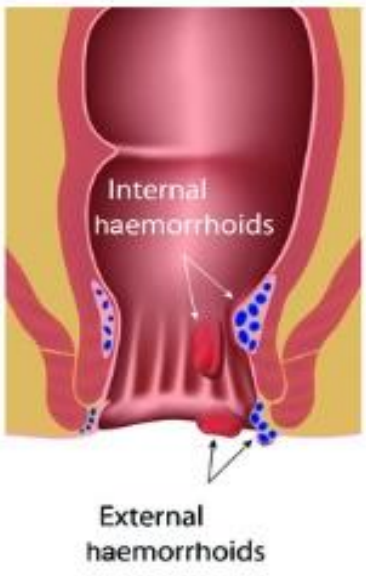
➢ The term hemorrhoids refers to a condition in which the veins around the anus or lower rectum are swollen, tortuous and inflamed. They arise from congestion of internal and/or external venous plexuses around the anal canal.

➢ It may result from:

- *Straining to move stool, Congenital weakness of the venous walls, Portal hypertension, Cancer in the rectum, Pregnancy (but after pregnancy it disappears), Food irritation like eating chili.*

- *Other contributing factors include aging, chronic constipation or diarrhea, and anal intercourse*.

➢ Superior rectal vein is the most dependent.



➢ Two types:

1- Both inside and above the anus (internal)
2- Under the skin around the anus (external).

Internal hemorrhoids (piles):

- Occur higher up in the anal canal, out of sight. Bleeding is the most common symptom of internal hemorrhoids, and often the only one in mild cases. Varicosities of the superior rectal vein.
- Painless because this area is sensitive to stretch not to pain, touch, or temperature
- Lies in the anal columns at 3,7,11 o'clock (lithotomy position).
- Sometimes, internal hemorrhoids will come through the anal opening when straining to move your bowels. This is called a prolapsed internal hemorrhoid; it is often difficult to ease back into the rectum, and is usually quite painful.
- Undergoes three stages:

The first stage – it stays high which means during defecation no discomfort at all

The second stage – during defecation it comes out through the anus and returns back after defecation.

The third stage – after defecation it remains outside through the anus and can cause bleeding.

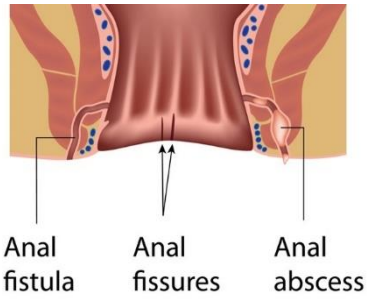
External hemorrhoids:

- Visible, occurring outside the anus.
- Basically, they are skin covered veins that have ballooned and appear blue. Inferior rectal vein is the affected vein.
- When inflamed they become red and tender.
- Thrombosis is common and very **painful**.
- When a blood clot forms inside external hemorrhoid, it often causes severe pain. This thrombosed external hemorrhoid can be felt as a firm, tender mass in the anal area, about the size of a pea.

Surgical classification of hemorrhoids is omitted, we are not asked to know it.

- *Anal fissure*

- A thin slit-like tear in the anal tissue, likely to cause itching, **severe pain,** and bleeding during bowel movement.
- A longitudinal ulcer is formed, extremely painful, its site is in the midline, either posterior or anteriorly to the superficial part of the external anal sphincter.
- Can be caused when a hard piece of stool enters the anal sinus (pocket shaped) and with straining can form a longitudinal ulcer by disrupting the mucosa.
- Patients go immediately to the doctor for surgical treatment.



- *Perianal abscess*

– It's most common cause is fecal trauma to the anal mucosa, which might spread to the submucosa.
– It's a complication of the anal fissure, located in relation to the external anal sphincter, anal fistula may rise as a result of the spread or inadequate treatment of the anal abscess.
– It's formed in **ischiorectal** fat, can be subcutaneous or deep between levator ani and obturator fascia.