

Rectum & Anal canal

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27/04/2019

EMBRYOLOGICAL basis – Nerve Supply of GUT

- Origin: Foregut (endoderm)
- Nerve supply: (Autonomic): Sympathetic Greater Splanchnic T5-T9 + Vagus – Coeliac trunk T12
- Origin: Midgut (endoderm)
- Nerve supply: (Autonomic): Sympathetic Lesser Splanchnic T10 T11 + Vagus – Sup Mesenteric artery L1
- Origin: Hindgut (endoderm)
- Nerve supply: (Autonomic): Sympathetic Least Splanchnic T12 L1 + Hypogastric S2S3S4 – Inferior Mesenteric Artery L3
- Origin :lower 1/3 of anal canal – ectoderm
- Nerve Supply: Somatic (inferior rectal Nerves)

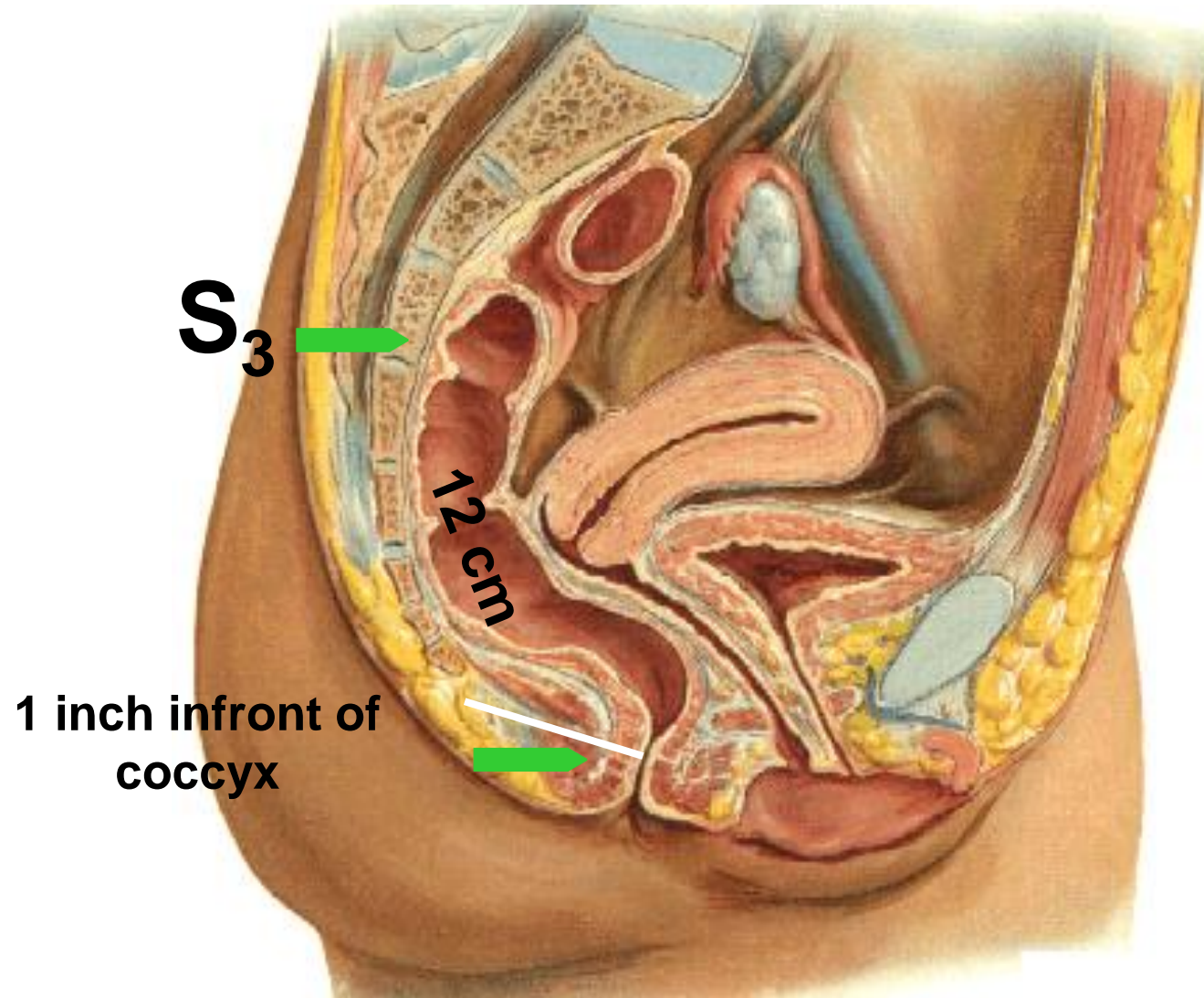
Rectum

- Straight – quadrupeds
- Curved anteriorly – puborectalis → levator ani
- Part of large intestine – continuation of sigmoid colon , **but lacks** → **Mesentery , taeniae coli , sacculations & haustrations & appendices epiploicae.**
- **Starts – S3** → anorectal junction – ant to tip of coccyx – apex of prostate
- 12 cms – 5 inches - transverse slit
- Ampulla – lower part

Development

- Mucosa above Houston's 3rd valve → **endoderm** pre allantoic part of **hind gut**.
- Mucosa below Houston's 3rd valve up to anal valves – endoderm from dorsal part of **endodermal cloaca**.
- Musculature of rectum is derived from splanchnic mesoderm surrounding cloaca.
- Proctodeum the surface ectoderm – mucocutaneous junction.
- Anal membrane disappears – and rectum communicates outside through anal canal.

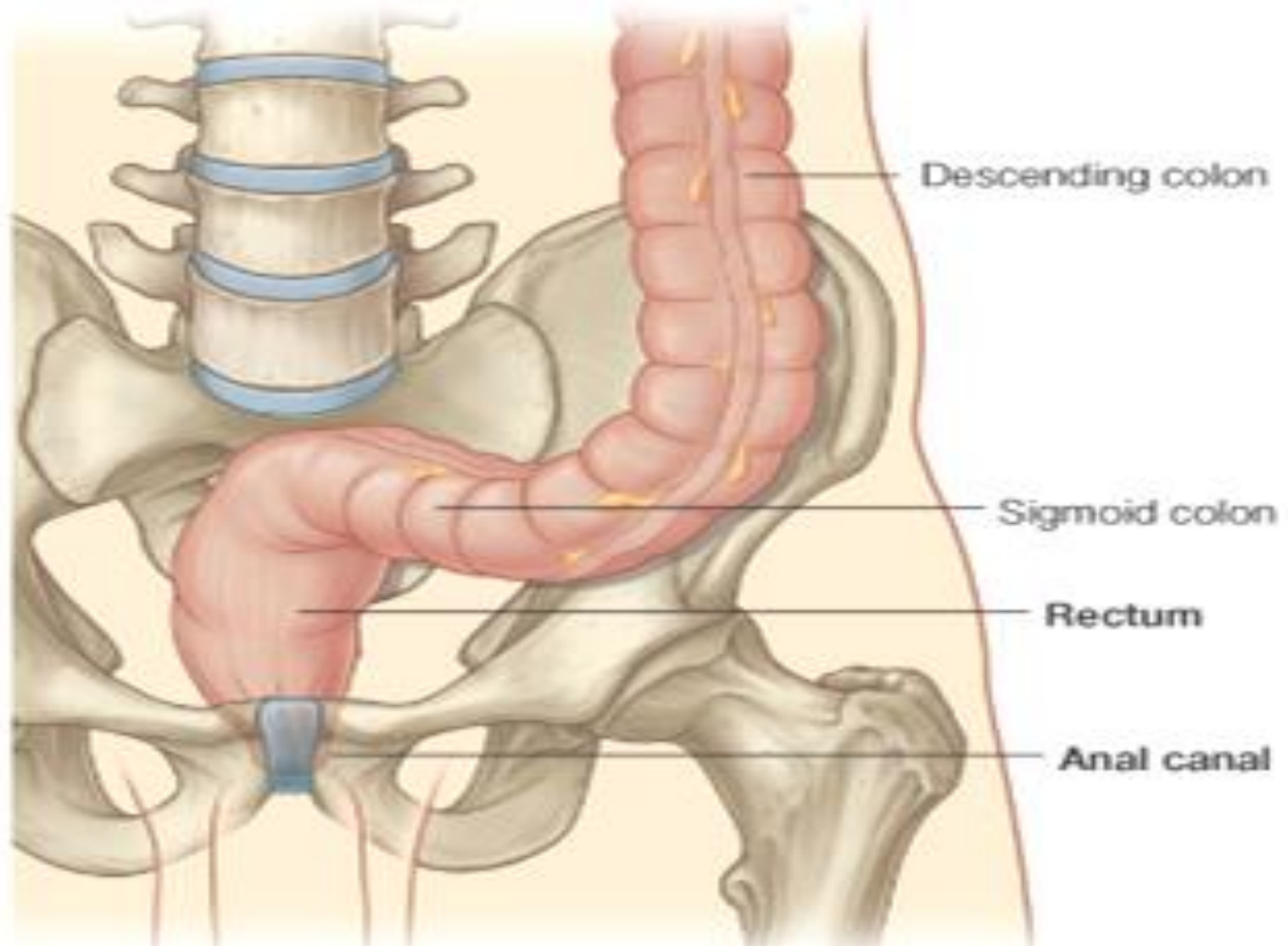
Location & peritoneal relations of Rectum



Rectum

- Beginning: continuation of sigmoid colon at S3.
- Termination: continues as anal canal,
- one inch below & front of tip of coccyx.
- End is dilated to form rectal ampulla.
- Length: 13 cm(5 inches)

Rectum



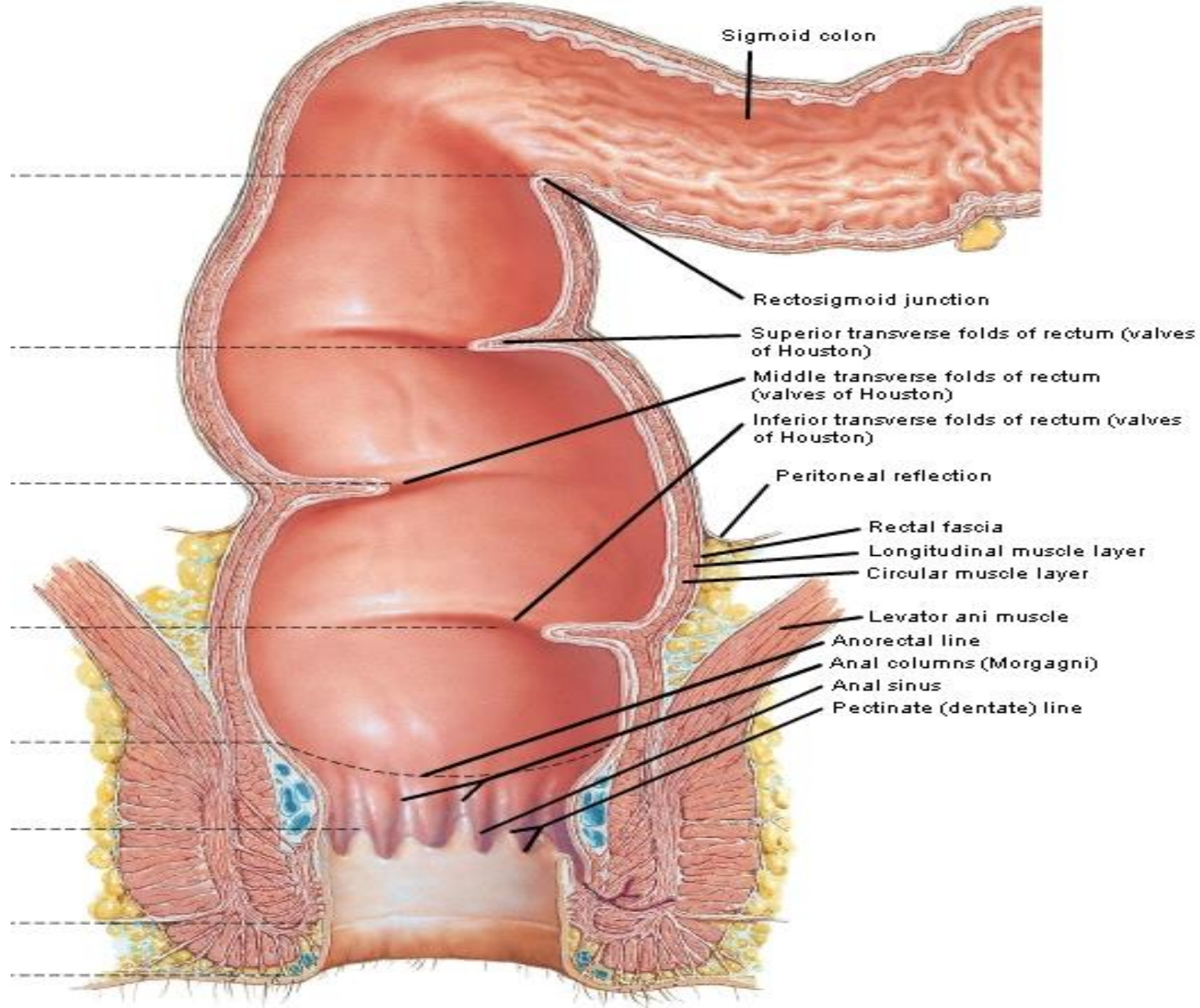
Flexures - Rectum

Anteroposterior curves – 2

- Sacral curve → Posterior
- Perineal curve → Anterior – puborectalis of levator ani.

Lateral curves – 3

- Upper convex to right – S3/S4
- Middle convex to **left** – **MOST Prominent** – SacroCoccygeal junction
- Lower convex to right – tip of coccyx



Rectum

- Lateral curvatures → rudimentary sacculations
- Horizontal rectal valves on concavity

Rectum

Peritoneal Covering + →

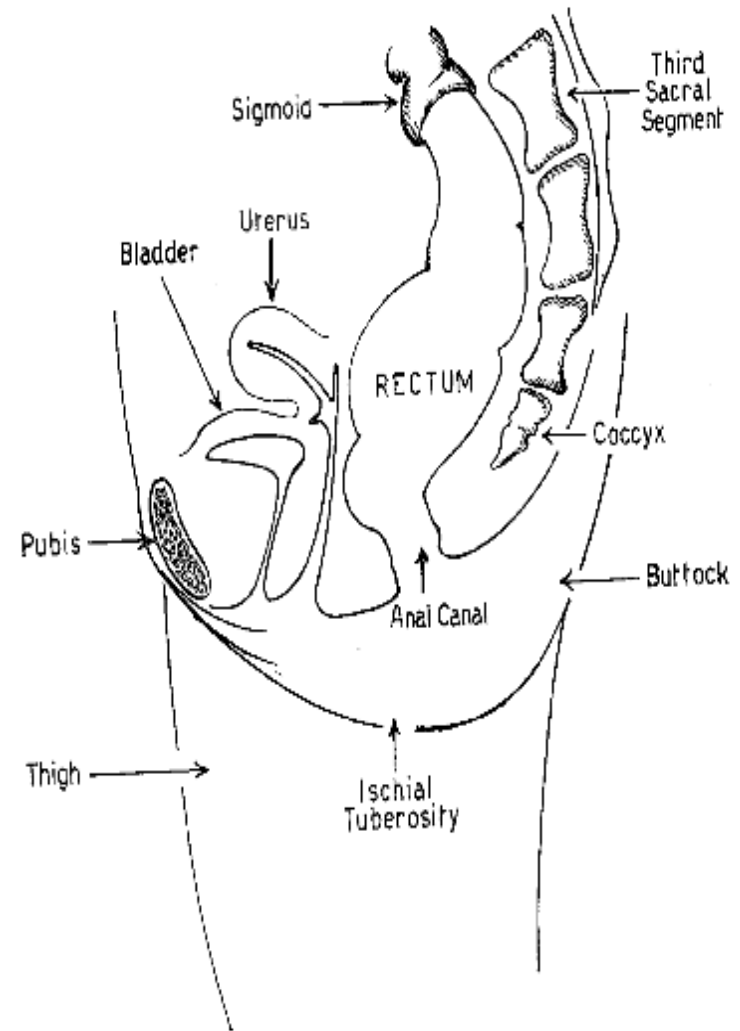
- Upper 1/3rd → ant & sides → para rectal fossa
- middle 1/3rd → anterior only
- Male – recto-vesical pouch - 7.5 cms anus
- Female – rectouterine pouch of Douglas 5.5 cms anus & 7.5 cm external vaginal orifice

Rectum

Peritoneal is absent →

- Posterior surface complete absence
- Lower 1/3 of rectum
- Anal canal

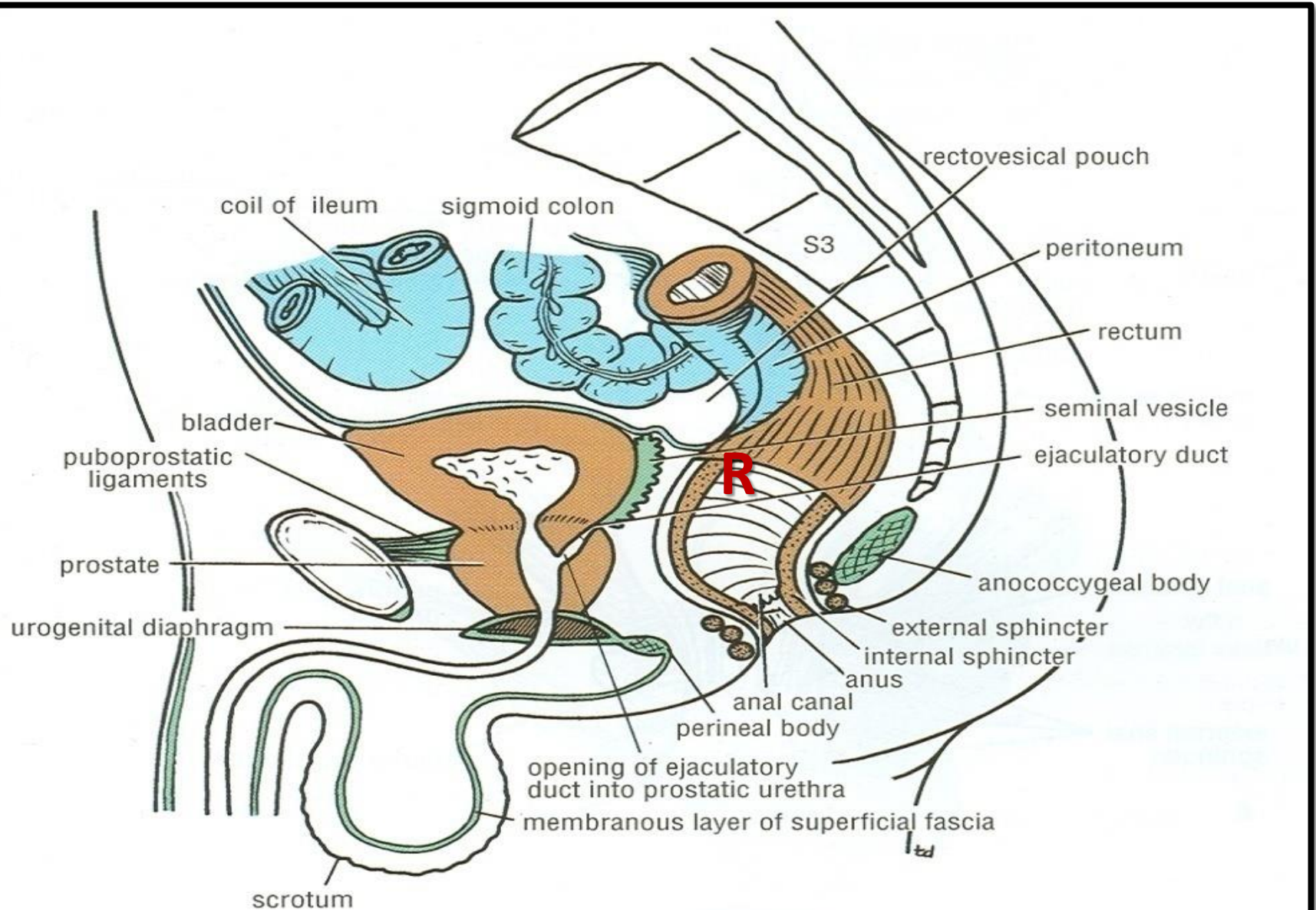
Upper 1/3rd front and sides are covered by peritoneum.
Middle 1/3rd front is only covered by peritoneum.
Lower 1/3rd has **No** peritoneal covering.



Peritoneal covering



Relations of Rectum in Pelvis



Relations of Rectum in Male

Anterior & peritoneal – sigmoid colon & small intestine

Anterior & non-peritoneal - seminal vesicles, ampulla of vas deferens, posterior surfaces of urinary bladder & prostate gland.

Recto-vesical fascia – Fascia of Denonvillier

Posterior: midline - sacrum, Sup rectal Vs, sacral plexus, ganglion impar & coccyx.

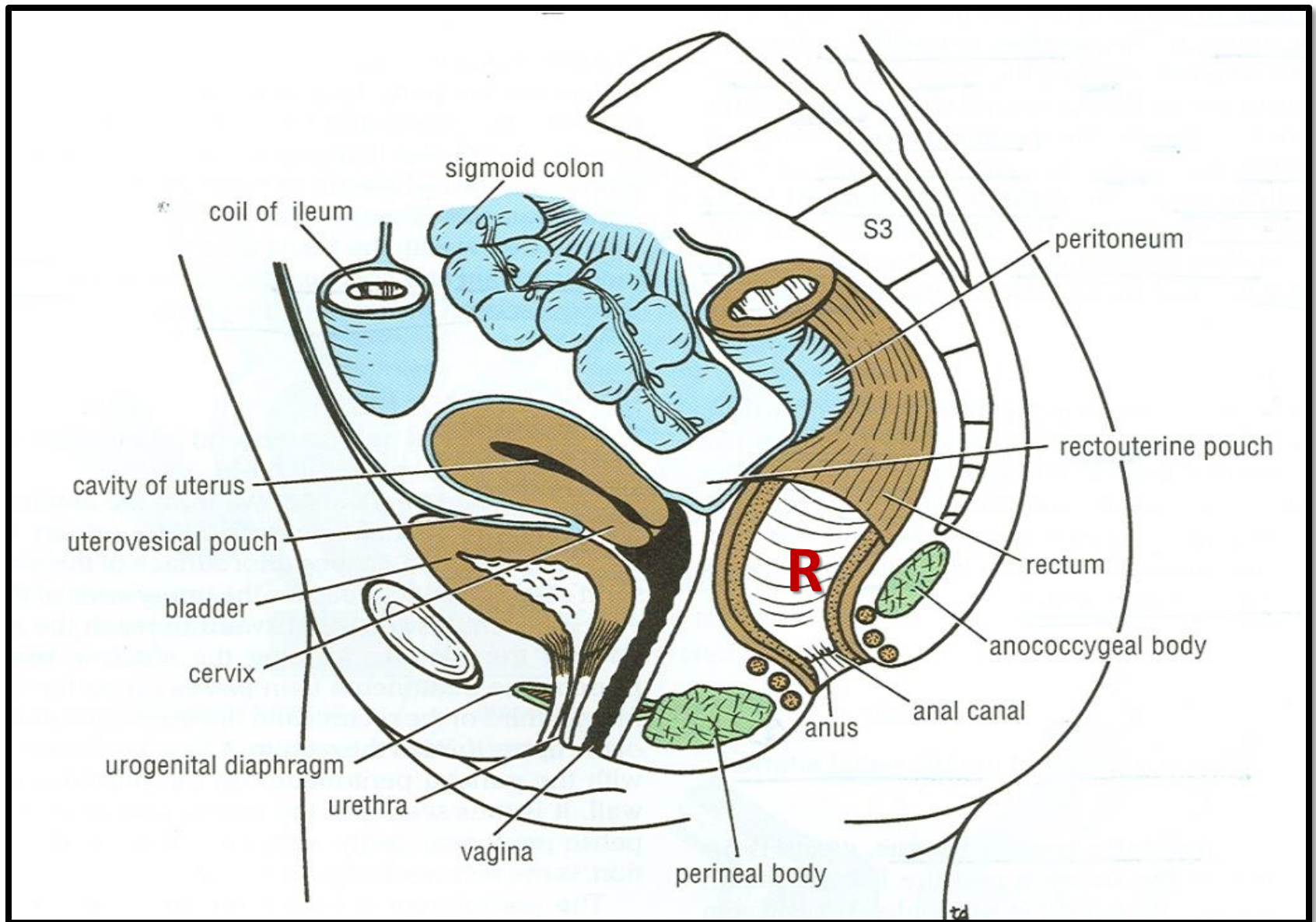
Fascia of Waldeyer

Posterior : lateral – piriformis, coccygeus & levator ani and sympathetic trunks

Rectum -

- **Lateral & upper 1/3rd** – para rectal fossa – containing sigmoid colon & small intestine
- **Lateral & middle 1/3rd** – pelvi rectal space & – levator ani muscle → fat & lateral ligaments of rectum – convey – middle rectal vessels
- **Lateral & lower 1/3rd** - ischio rectal or ischio anal fossa

Relations of Rectum in Pelvis



Relations of Rectum in Pelvis

FEMALE PELVIS

Anterior: posterior wall of vagina & recto vaginal fascia

Posterior: sacrum , sacral plexus & coccyx

Support of rectum

- Puborectal sling of levator ani – anorectal flexure
- Reflection of pelvic fascia & peritoneum
- **Waldeyer fascia** & lateral ligaments of rectum
- Pelvi rectal and ischiorectal fat

Wall of rectum

- Serous , muscular , submucosa & mucosa
- Serosa – peritoneum incomplete
- Muscular – outer longitudinal & inner circular
- **Longitudinal muscle** – anterior - blends at anorectal junction with puborectalis part of levator ani → corrugator ani cutis muscle & attached to white line of Hilton
- Some fibres also form – **urethra – recto urethral muscle of Roux**
- Coccyx – recto coccygeus muscle
- Circular muscle – entire rectum, in lower part → **internal anal sphincter** – covers upper 3/4th of anal canal

Rectum Interior -Mucosal folds

- Temporary – longitudinal & in lower part – disappear in distension
- **Permanent mucosal folds – Horizontal - Houston's valve - 04 ,**
- 1st & 3rd are constant.
- 1st - S3 - recto sigmoid junction
- 3rd - S5 - 5 cms above anus & if completely encircles – **Nelaton's sphincter.**
- 2nd - about 2.5cms superior to 3rd valve

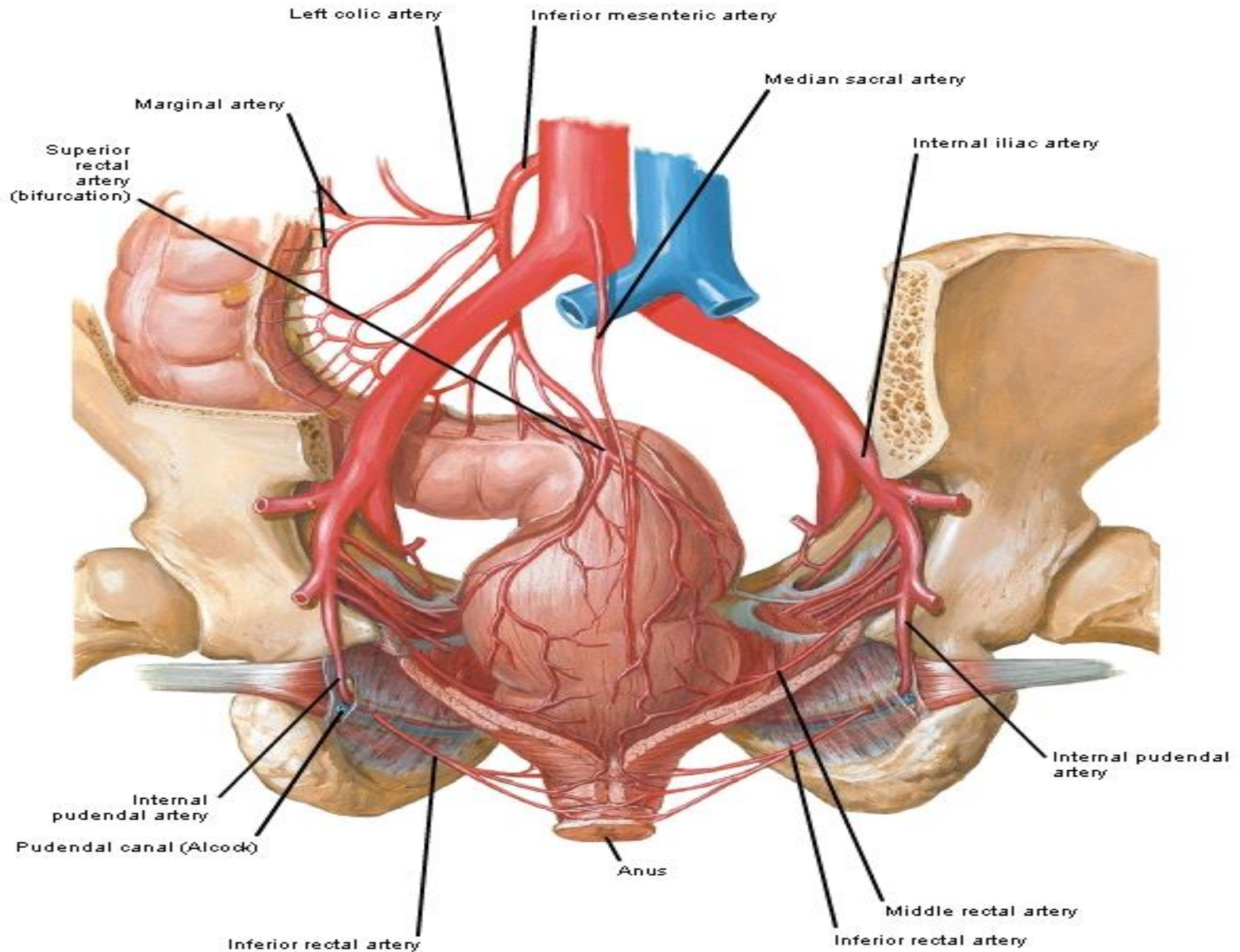
Rectum interior -Mucosal folds

- 3rd valve – S5 - is constant , 5 cms above anus & if completely encircles – **Nelaton's sphincter.**
- 3rd valve – divides rectum into upper chamber → pre - allantois part of hind gut. Contains faeces without reflex to defecate.
- Lower chamber develops from post –allantois part of cloaca. Sensitive for creating defaecation reflex in response to faeces.
- 4th valve – 2.5 cms below the 4th valve

Houston's valve

- Support weight of faeces due to erect posture
- Valves prevent passage – holding faeces /instrumentation
- Cannula / rectal washing – **left lateral** position to get easy passage and avoidance of injury to third valve

Arterial supply of rectum and anal canal



Arterial supply - Rectum

Median sacral artery – abdominal aorta

Superior rectal artery – continuation of inferior mesenteric artery

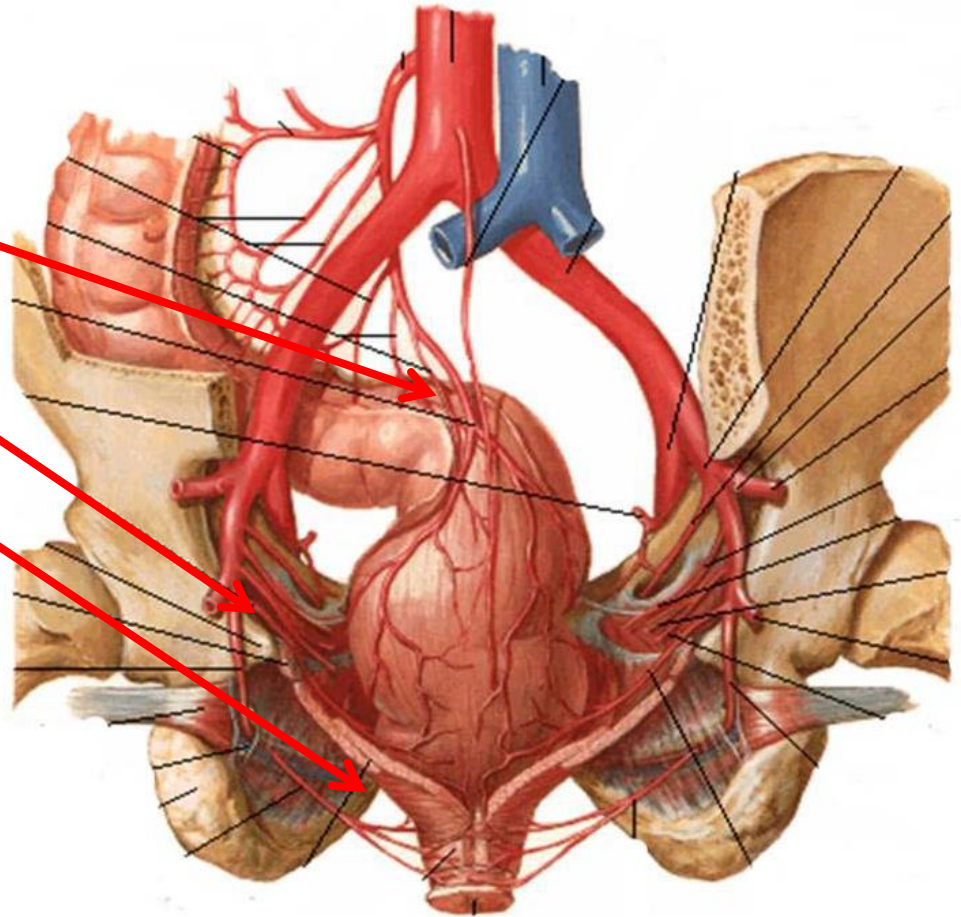
Middle rectal artery – ant div of internal iliac artery

Inferior rectal artery - internal pudendal artery

Inferior gluteal artery - internal iliac artery

Arteries of Rectum & Anal canal

- Superior rectal
- Middle rectal
- Inferior rectal

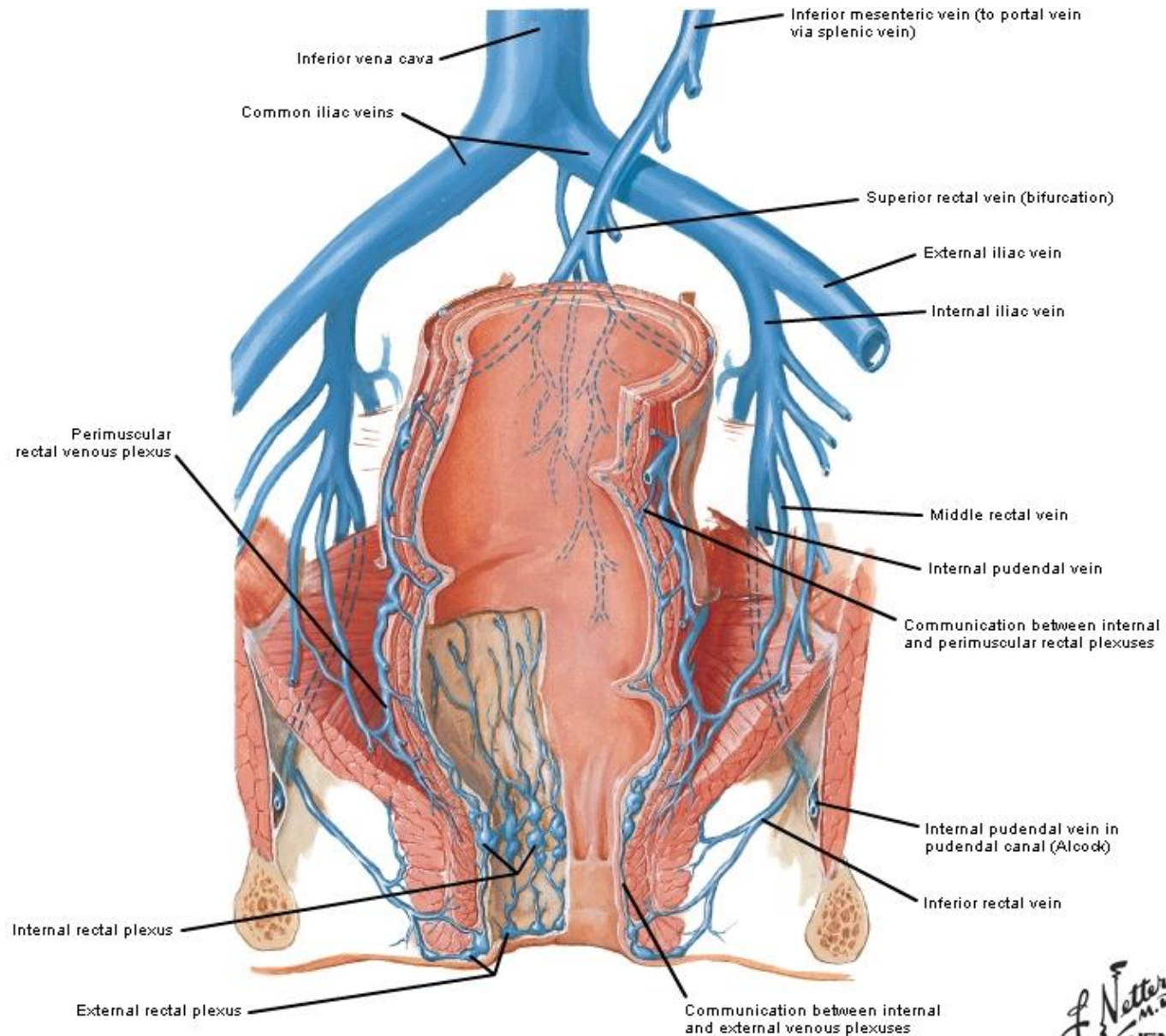


Arterial supply – Rectum – 5

- **Superior rectal artery** – unpaired – main arterial supply → **inferior mesenteric artery** – right & left branch its - Straight branches → **anastomose** with branches of inferior rectal arteries in anal columns at **pectinate line**
- **Middle rectal artery** – anterior division of internal iliac arteries → **lateral rectal ligaments** & supply lower part of rectum
- **Inferior rectal arteries** – **internal pudendal artery** → ischiorectal fossa and supplies peri anal skin , anal sphincter and **anastomose** with branches of superior rectal artery at **pectinate line**.

Veins of Rectum and Anal Canal

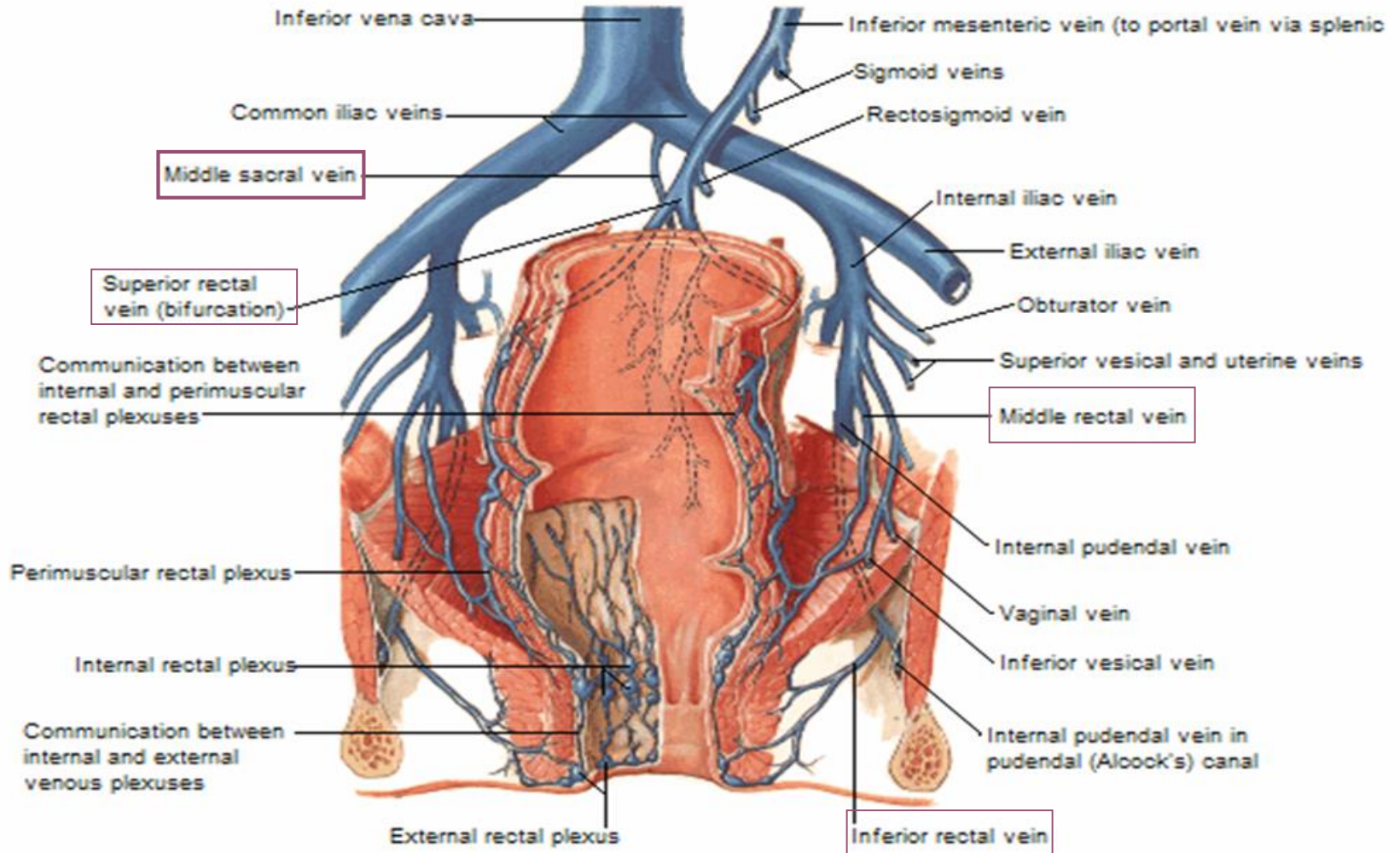
Anterior View



Rectum -Venous drainage -Porto-systemic anastomosis

- **Superior rectal vein** – inferior mesenteric vein – **Portal Vein**
- **Middle rectal vein** – internal iliac vein – **Systemic Vein**
- **Inferior rectal vein** – internal pudendal vein through – ischiorectal fossa – **Systemic vein**
- **Median sacral vein** – left common iliac vein

Veins of the rectum



Hemorrhoids

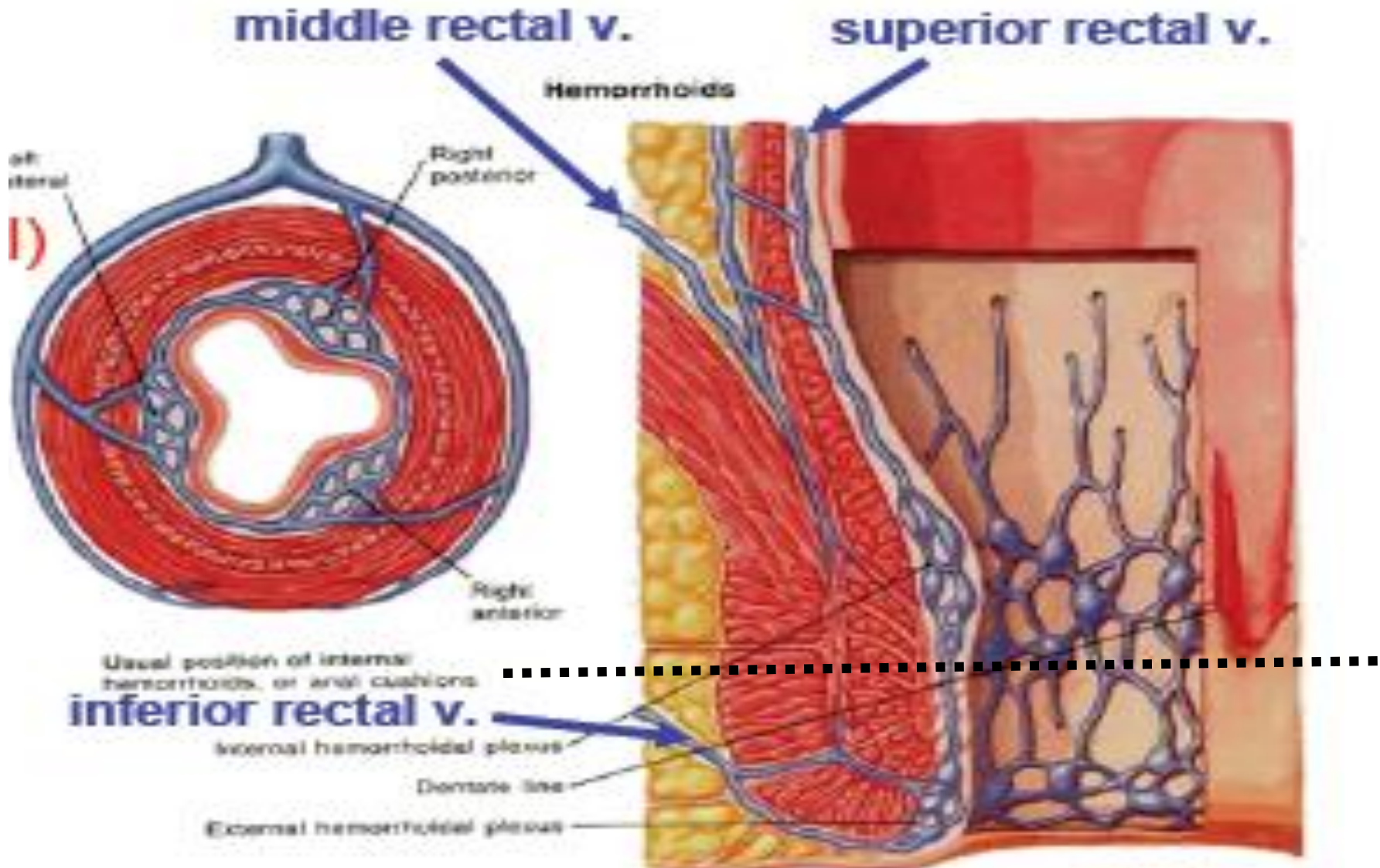
Internal hemorrhoids

- Tributary of superior rectal vein
- **Above Hilton's line**
- b/w mucosa & internal sphincter
- Generally painless

External hemorrhoids

- Tributary of inferior rectal vein
- **Below Hilton's white line**
- Around anus
- b/w peri anal skin & external sphincter
- Generally painful

Hemorrhoids



External hemorrhoid



Origin below dentate line
(external rectal plexus)

Internal hemorrhoid

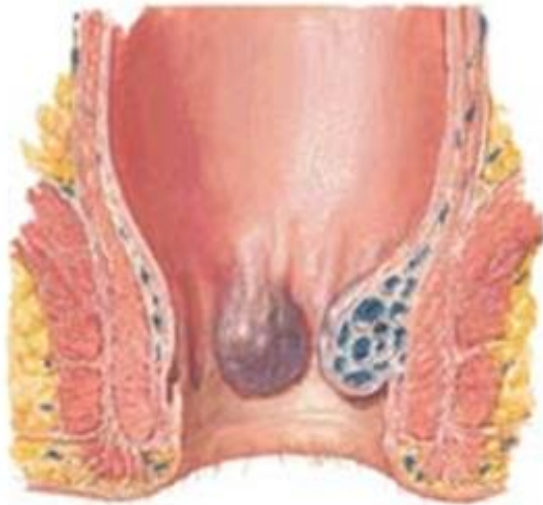


Origin above dentate line
(internal rectal plexus)

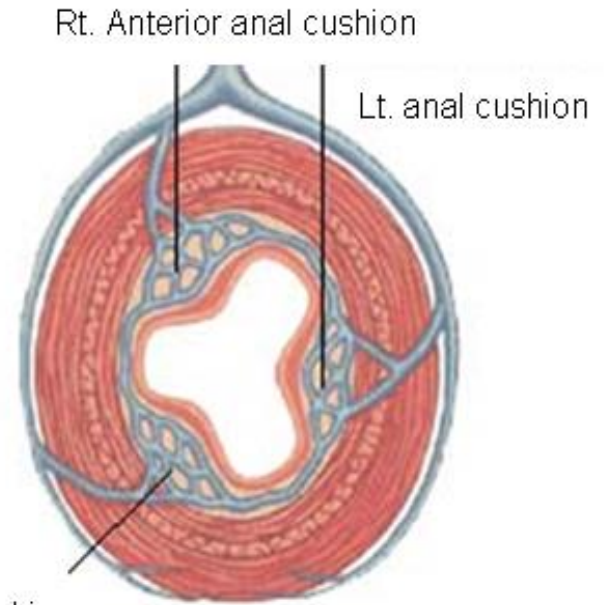
Mixed hemorrhoid



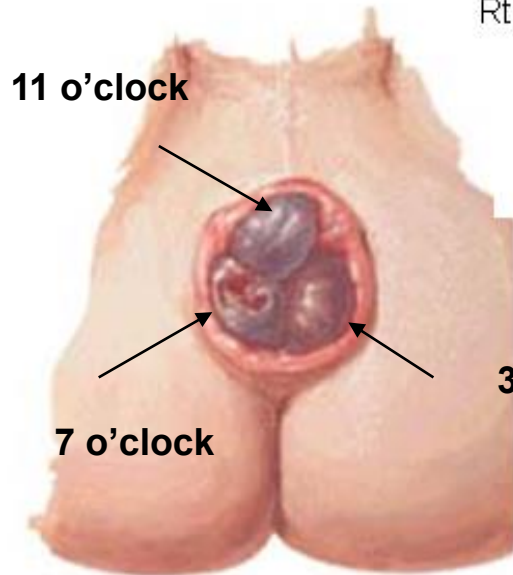
Origin above and below dentate line
(internal and external rectal plexus)



Enlarged anal cushions



Rt. Posterior anal cushion



11 o'clock

7 o'clock

3 o'clock

Usual position of anal cushions and sites of prolapse for internal hemorrhoids

Prolapsed "rosette" of internal hemorrhoids

Internal Hemorrhoids

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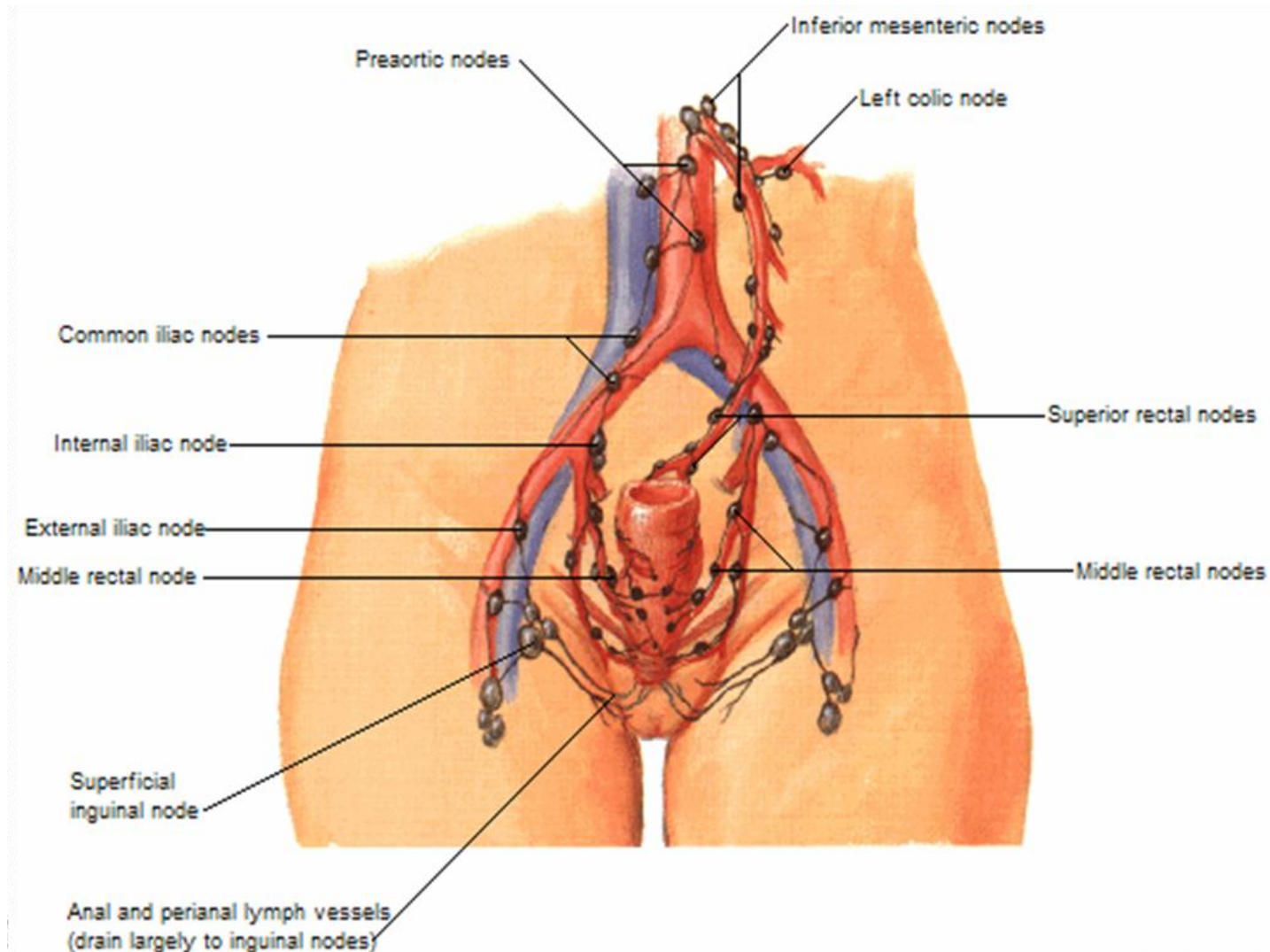
Primary internal piles

- Radicles and columns of superior rectal veins
- 3 o clock – left lateral
- 7 o clock – right posterior
- 11 o clock – right anterior

Lymphatic drainage

- **Intramural plexus** - submucosal & intramuscular
- **Extramural plexus** – extramural – outside rectal wall
- **Upper half** – **Sup rectal artery** - left common iliac lymph nodes & para rectal lymph nodes
- **Middle half** - internal iliac lymph nodes.
- **Lower part upto anal valves** – above levator ani & piercing through it - internal iliac lymph nodes
- **Below anal valves** – **Horizontal group** - superficial inguinal lymph nodes

Lymphatic drainage of the rectum



Nerve supply – Rectum

- **Sympathetic** – *sympathetic plexus* – L1L2
– vasomotor
- **Stimulate internal anal sphincter**
- **Inhibitory to rest of musculature**

- **Parasympathetic** – **inferior hypogastric plexus** – **S2S3S4** –
- **Secretomotor to glands ,**
- **stimulate peristalsis**
- **Relaxation to sphincters**

Peculiarities of anal canal

- 3.8 cms in length
- Antero posterior slit as lateral walls are approximated
- Anterior wall is shorter
- Posterior wall is longer

Anal canal

Beginning:

It begins one inch below and anterior to the tip of coccyx at recto-anal junction.

- **Course:** It runs down and backwards.
- **Termination:** ends at anus.

Anal canal

- **Relations:**

- **Laterally:** **Ischioanal** /ischiorectal fossa.

- **Posteriorly:**

- Anococcygeal raphe between it and tip of coccyx.

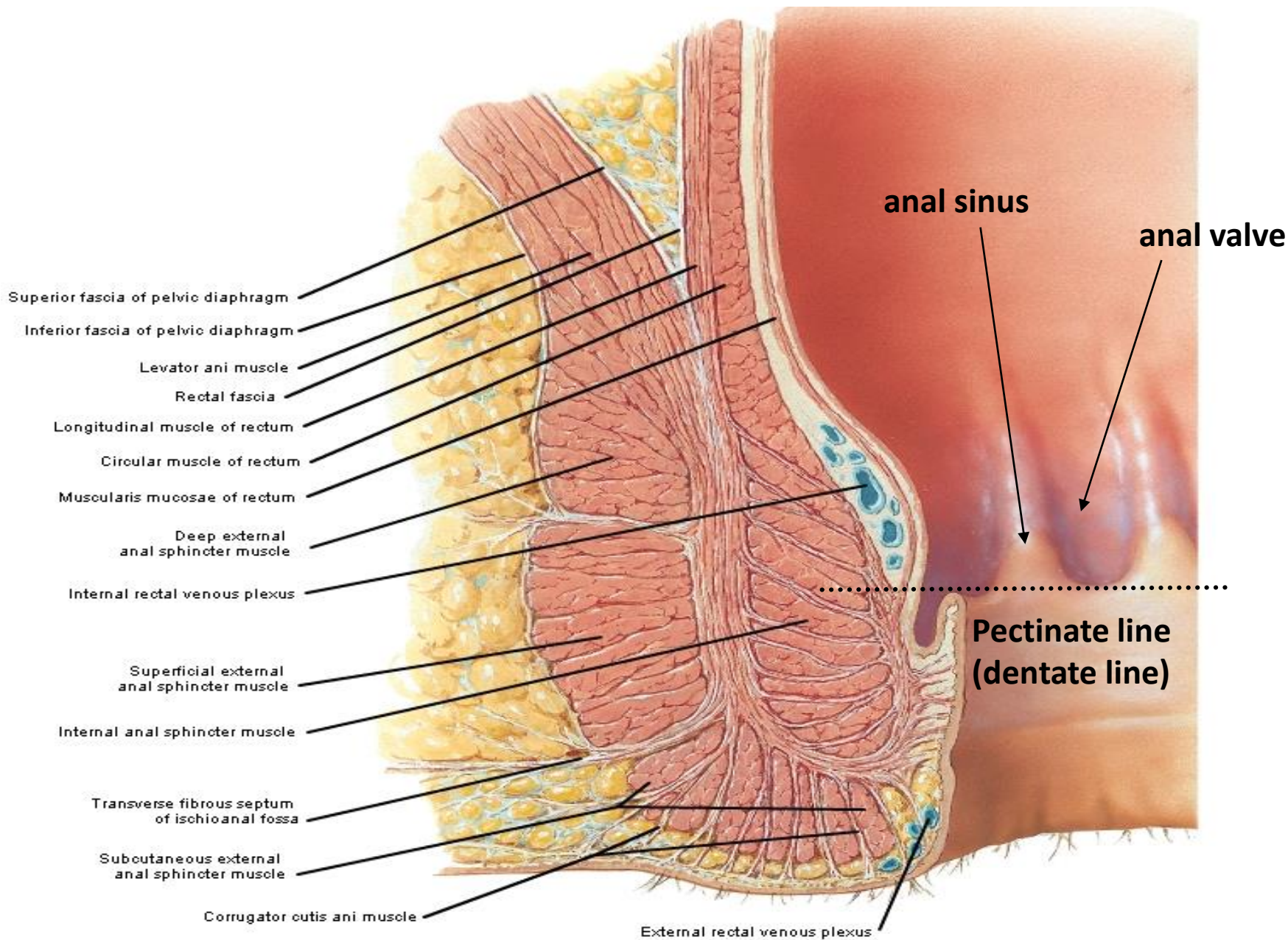
- **Anteriorly:**

- Perineal body , bulb of penis & spongy urethra in **males.**

- Perineal body & post wall of vagina in **females.**

Pectinate line

- Mucocutaneous junction of anal canal
- Anal valve level
- Middle of internal sphincter
- Upper part and lower part are different on all grounds



Anal canal – pectinate line – dentate line

Above

- Hind gut/endodermal
- Columnar
- Portal vein – Superior Mesenteric Vein
- Internal iliac lymph nodes
- Internal haemorrhoids
- Autonomic nerve
- Painless

Below

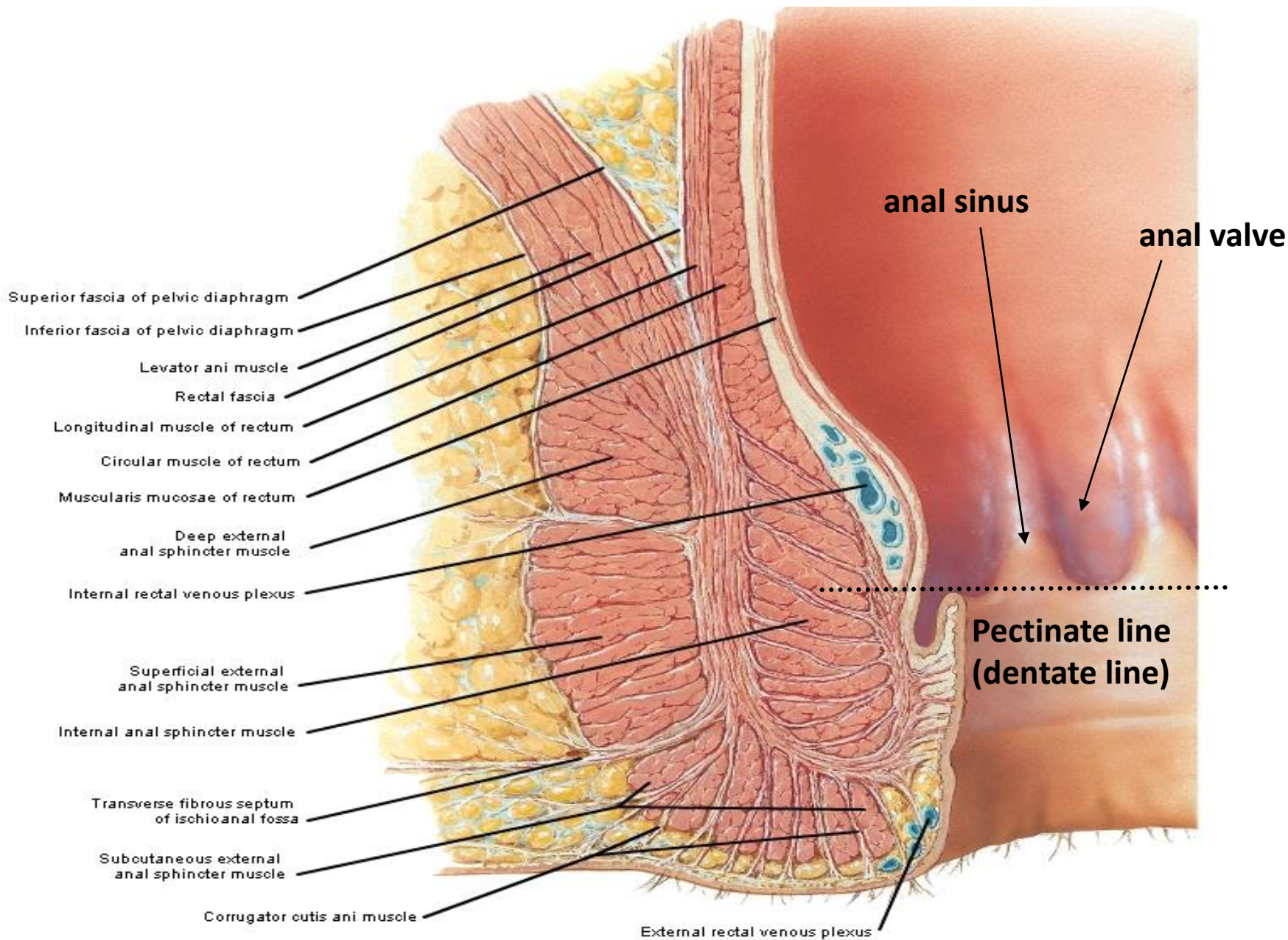
- Cloacal memb/ectodermal
- Stratified
- Middle /inferior rectal vein – caval or systemic
- Superficial inguinal lymph nodes
- External haemorrhoids
- Pudendal nerve
- painful

Interior of anal canal

- Pectinate line and white line of Hilton divide anal canal into three areas
- **Upper area** - 15 mm - anal columns / valves / papillae / sinuses glands
- **Intermediate area** – 15 mm - transition zone or area of pecten
- **Lower area** – 08 mm - anal verge

Interior of anal canal – upper 15 mm

- Internal rectal venous plexuses – plum red colour in living
- Simple columnar/stratified columnar epithelium
- Up to pectinate line
- **Features –**
 - **Anal columns – of Morgagni** - 6 to 10 longitudinal permanent mucosal folds with radicles of superior rectal veins → Primary OR Internal PILES
 - **Anal valves – of Ball** - **Horizontal mucosal folds** connecting lower ends of anal columns - form – **Pectinate or dentate line**
 - **Sentinel Pile** – rupture of **anal valve** with tag



Interior of anal canal – upper 15 mm

- **Anal papilla** – epithelial processes from free margin of the anal valves
- **Anal papilla** - represent **remnants of anal membrane**
- **Anal sinuses** – recesses above the anal columns
foreign bodies may lead to impaction and infection
- **Anal glands** – **floor of the anal sinuses** receive ducts of tubular anal glands → infection may lead to **anal fistula**

Interior of anal canal – intermediate area 15 mm

- **Area b/w pectinate line & Hiltons line :**
- **Area of Pecten /Transitional zone – stratified squamous epithelium *without sebaceous and sweat glands***
- Area is surrounded by internal rectal venous plexus and is bluish in colour

Interior of anal canal – Lower area 08 mm

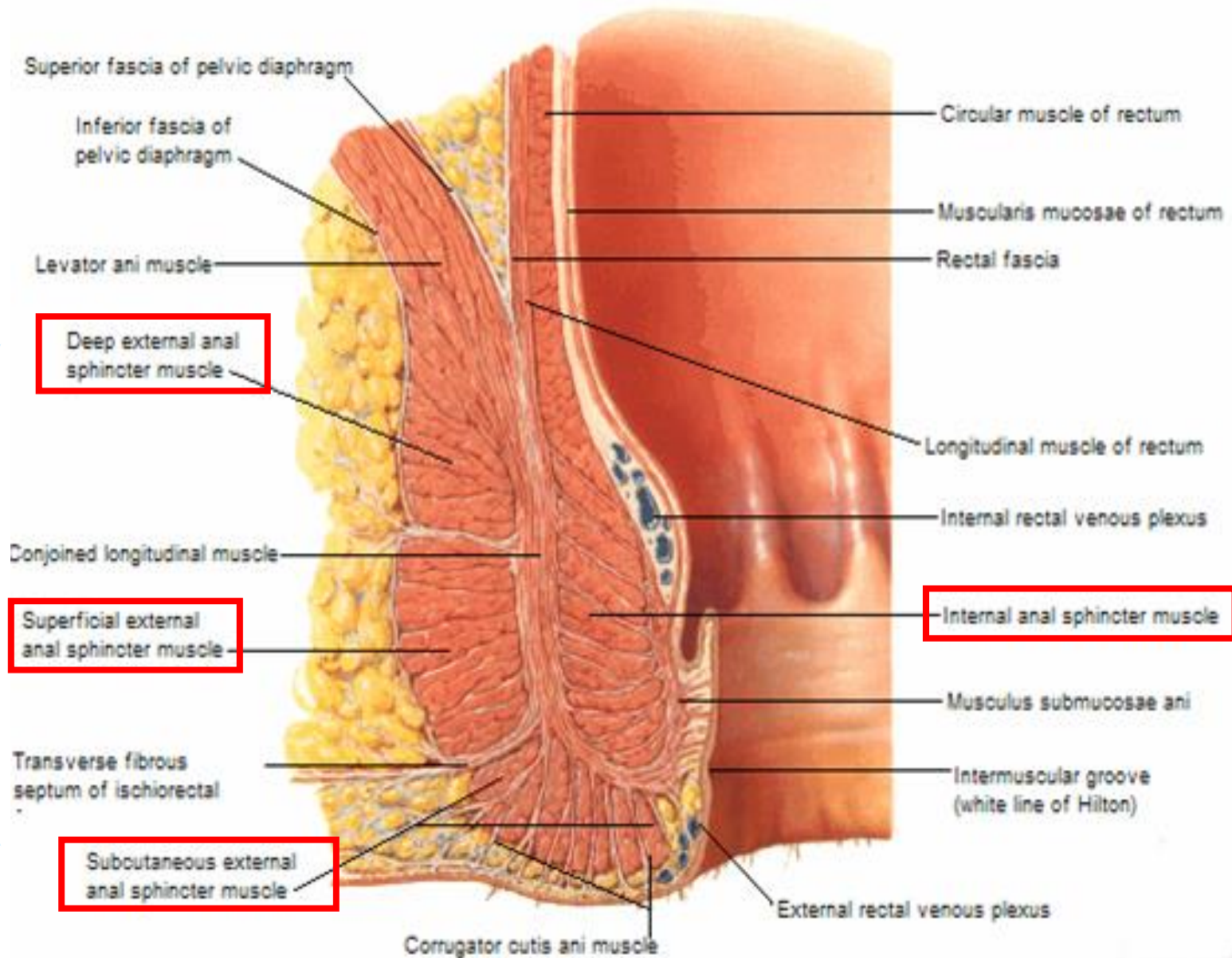
- Lined with **true skin**
- Fusion of fibers from longitudinal muscle of rectum and levator ani leads to formation of **Corrugator cutis ani muscle** .

Anal sphincters:

Internal anal sphincter:

- It is the thickened **inner involuntary circular** muscle layer of the anal canal.
- **Surrounds** the upper **3/4th** of the anal canal, extending from ano-rectal junction till the white line (Hilton's line).
- **Nerve supply:** autonomic – **sympathetic – L1L2**
→ inferior hypogastric plexus & **parasympathetic S2S3S4**

Sphincters of the anal canal



Blood ,nerve supply and lymph drainage of anal canal:

Pectinate line	Upper part	Lower part
<p style="color: red;">Blood supply</p>	<p style="color: red;">Superior rectal artery.</p> <ul style="list-style-type: none"> - drained by superior rectal vein - (portal circulation). 	<p style="color: red;">Middle rectal artery → internal iliac artery.</p> <p style="color: red;">Inferior rectal artery → internal pudendal artery.</p> <p>-veins drain into internal iliac vein (systemic circulation.)</p>
<p style="color: blue;">Nerve supply</p>	<p>autonomic nerve fibers. Pain insensitive/strech</p>	<p>Inferior rectal nerve Sensitive to pain & touch.</p>
<p style="color: red;">Lymphatic drainage</p>	<p>Internal iliac LNs.</p>	<p>Superficial inguinal LNs.</p>

Anal sphincters: External anal sphincter:

- Striated voluntary muscle fibers.
- Surrounds whole length of anal canal
- External sphincter is - outside internal anal sphincter.

Three Parts:

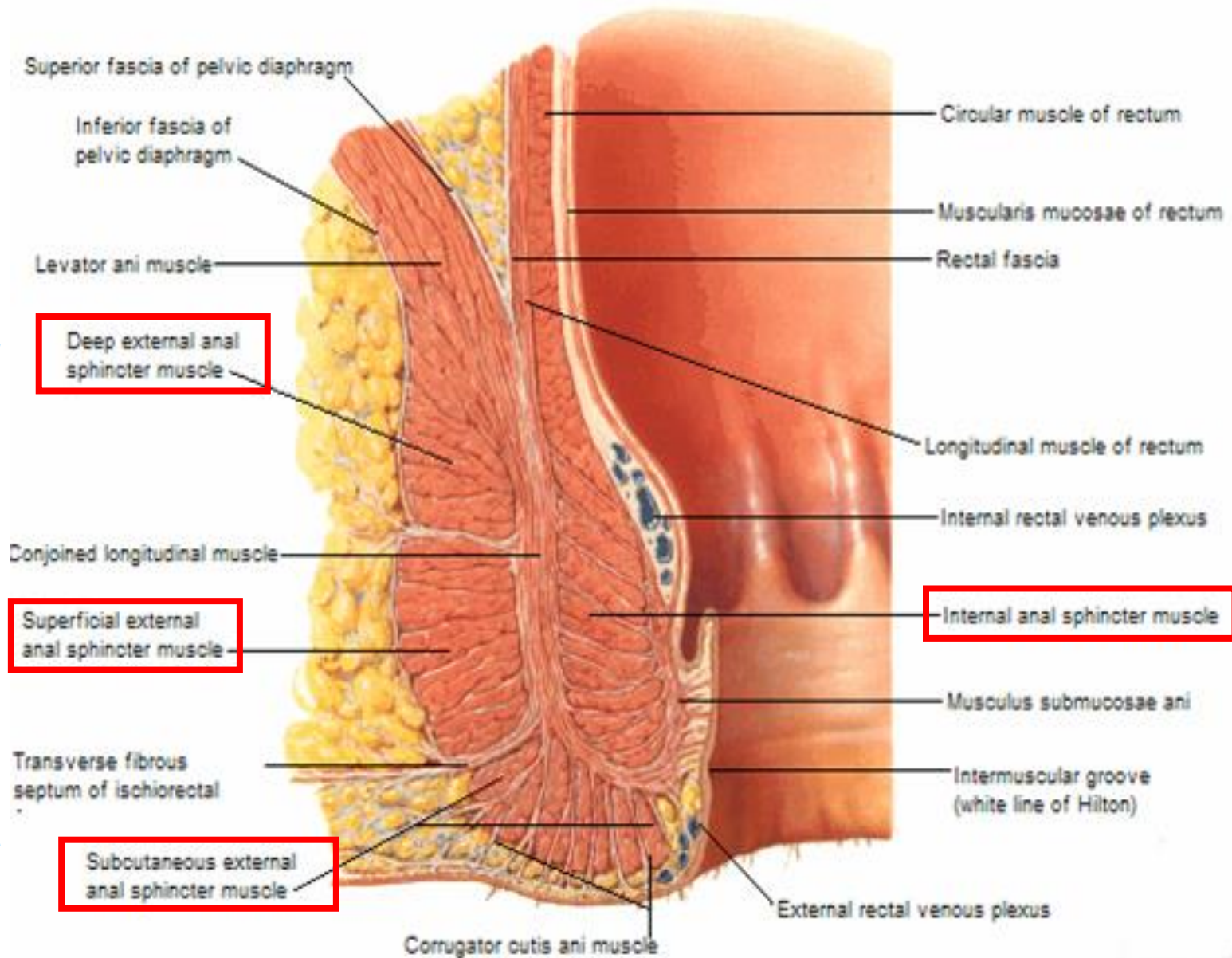
I) Subcutaneous Part:

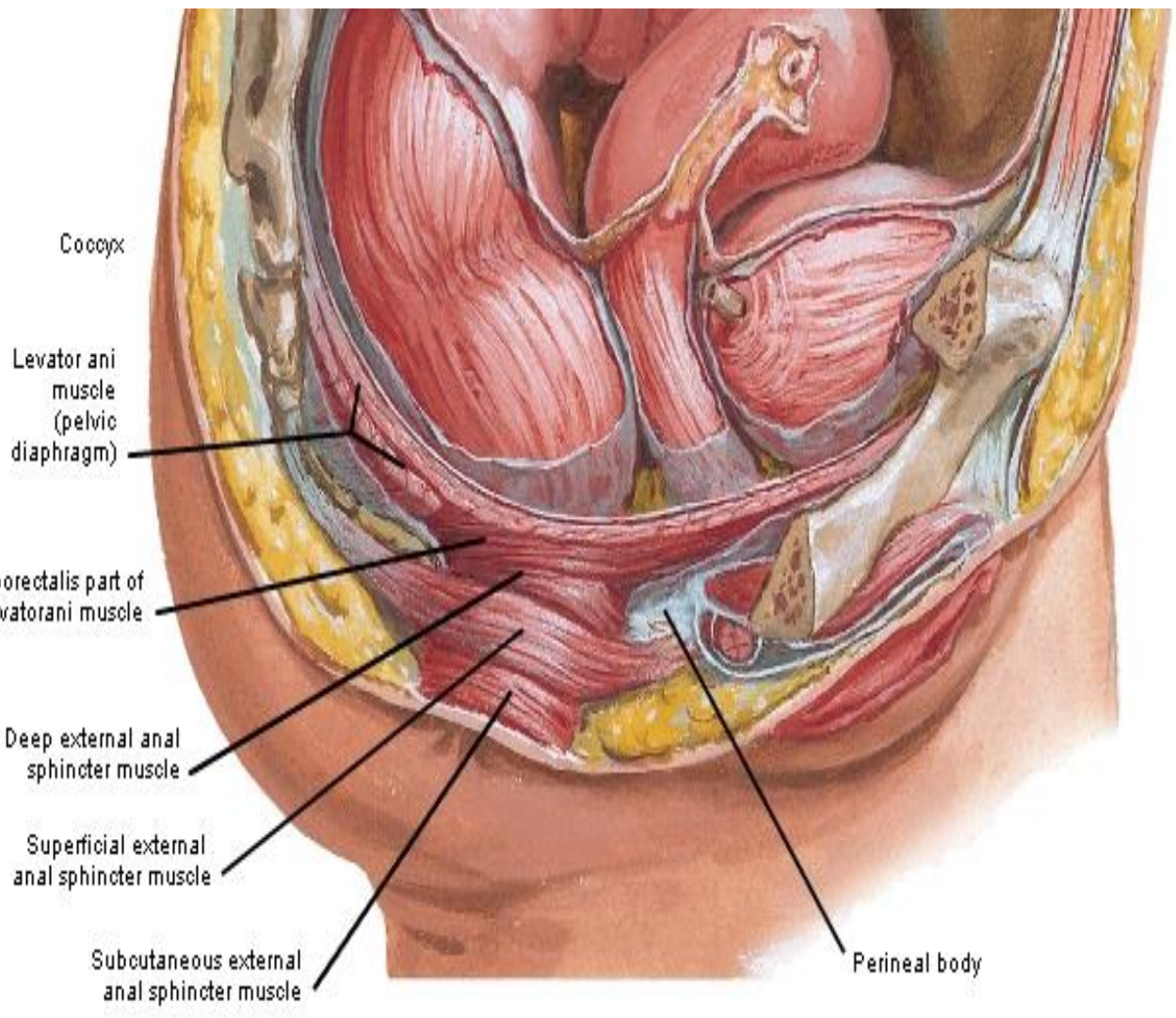
II) Superficial Part:

III) Deep Part

- Inferior rectal nerve → pudendal nerve & perineal branch of S4

Sphincters of the anal canal





Coccyx

Levator ani muscle
(pelvic diaphragm)

Puborectalis part of levatorani muscle

Deep external anal sphincter muscle

Superficial external anal sphincter muscle

Subcutaneous external anal sphincter muscle

Perineal body

**The external sphincter
(voluntary)**

External Anal sphincters:

- Inferior rectal nerve → pudendal nerve & perineal branch of S4

I) Subcutaneous Part:

- Surrounds anus just under perianal skin.
- Attached to perineal body & anococcygeal raphe.

II) Superficial Part:

Surrounds lower part of internal sphincter above subcutaneous part.

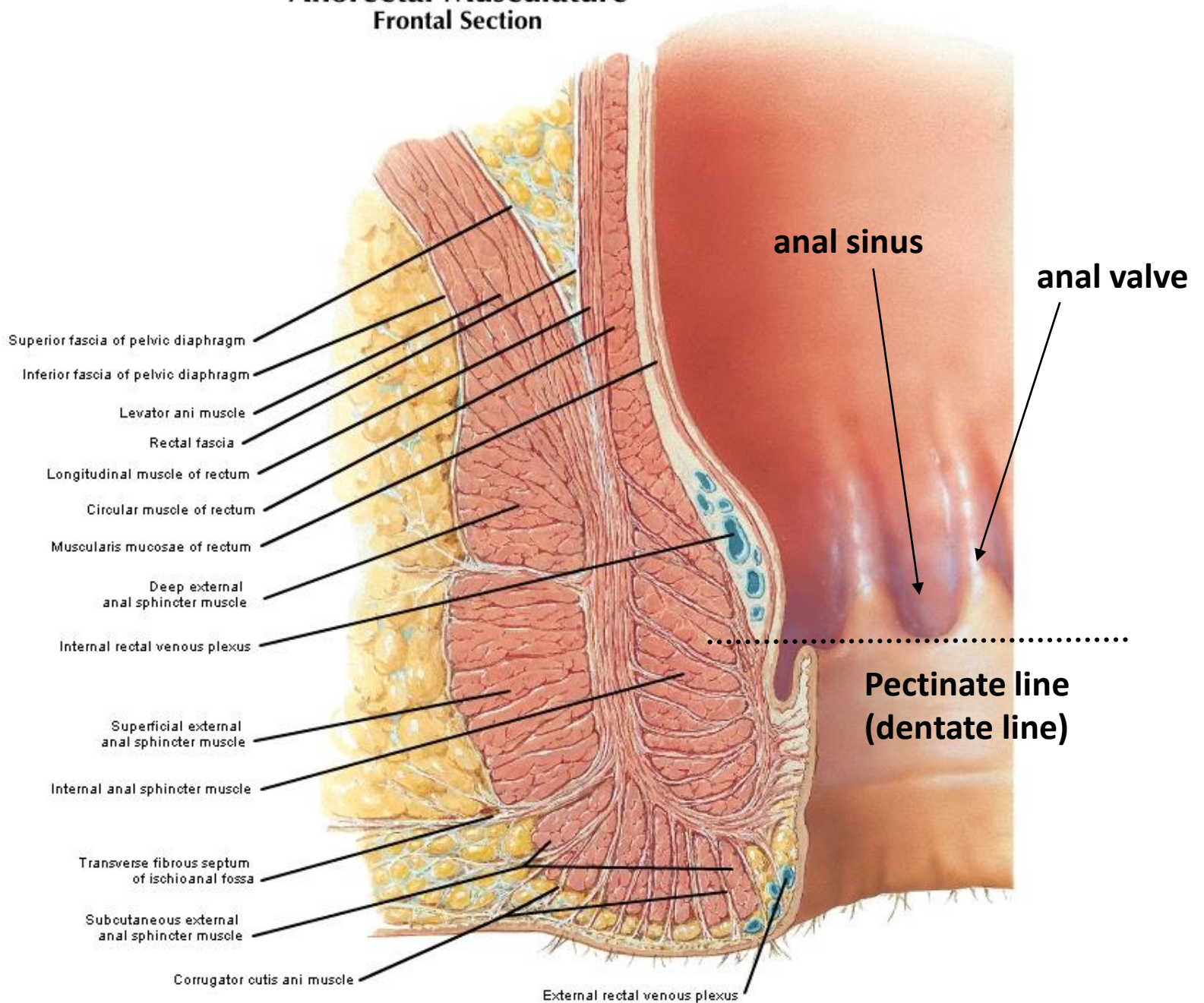
III) Deep Part – surrounds anorectal junction

Hilton's line

- A colour contrast b/w bluish pink area above and dark black skin below
- **Anal intersphincteric groove** at lower end of internal sphincter muscle
- Indicates lower margin of internal sphincter
- Anal fascia and lunatic fascia extend up to Hilton's line

Anorectal Musculature

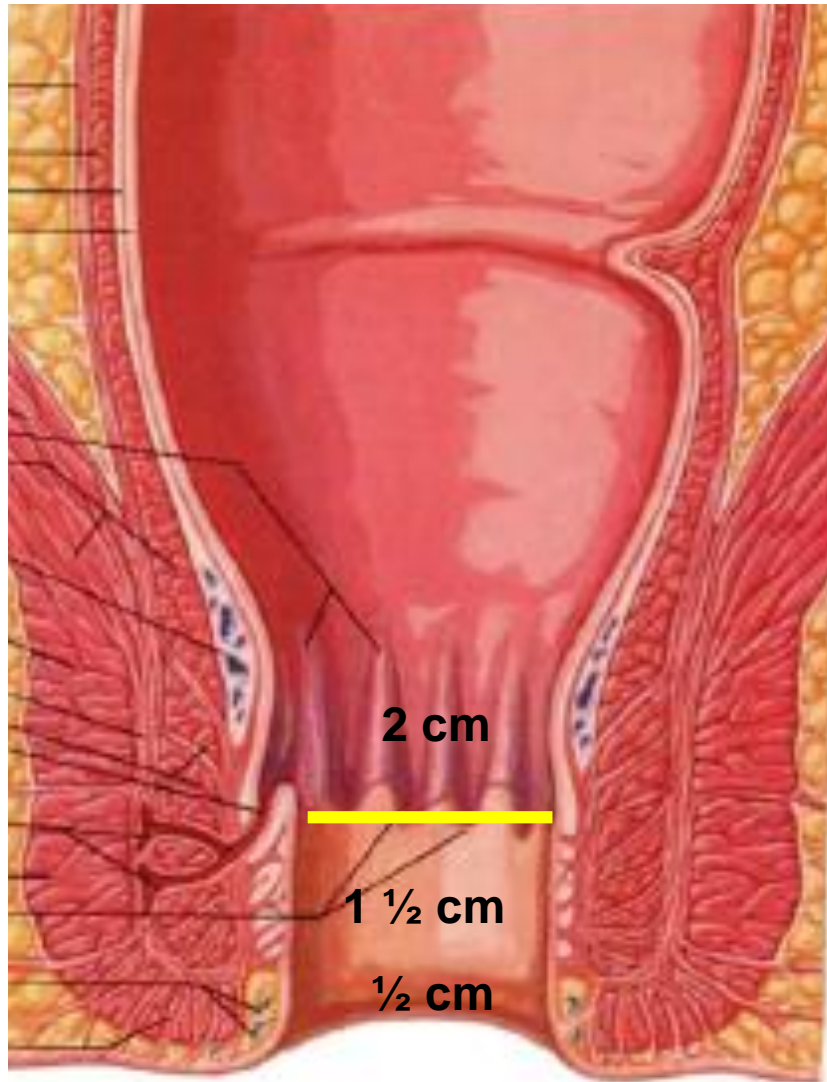
Frontal Section



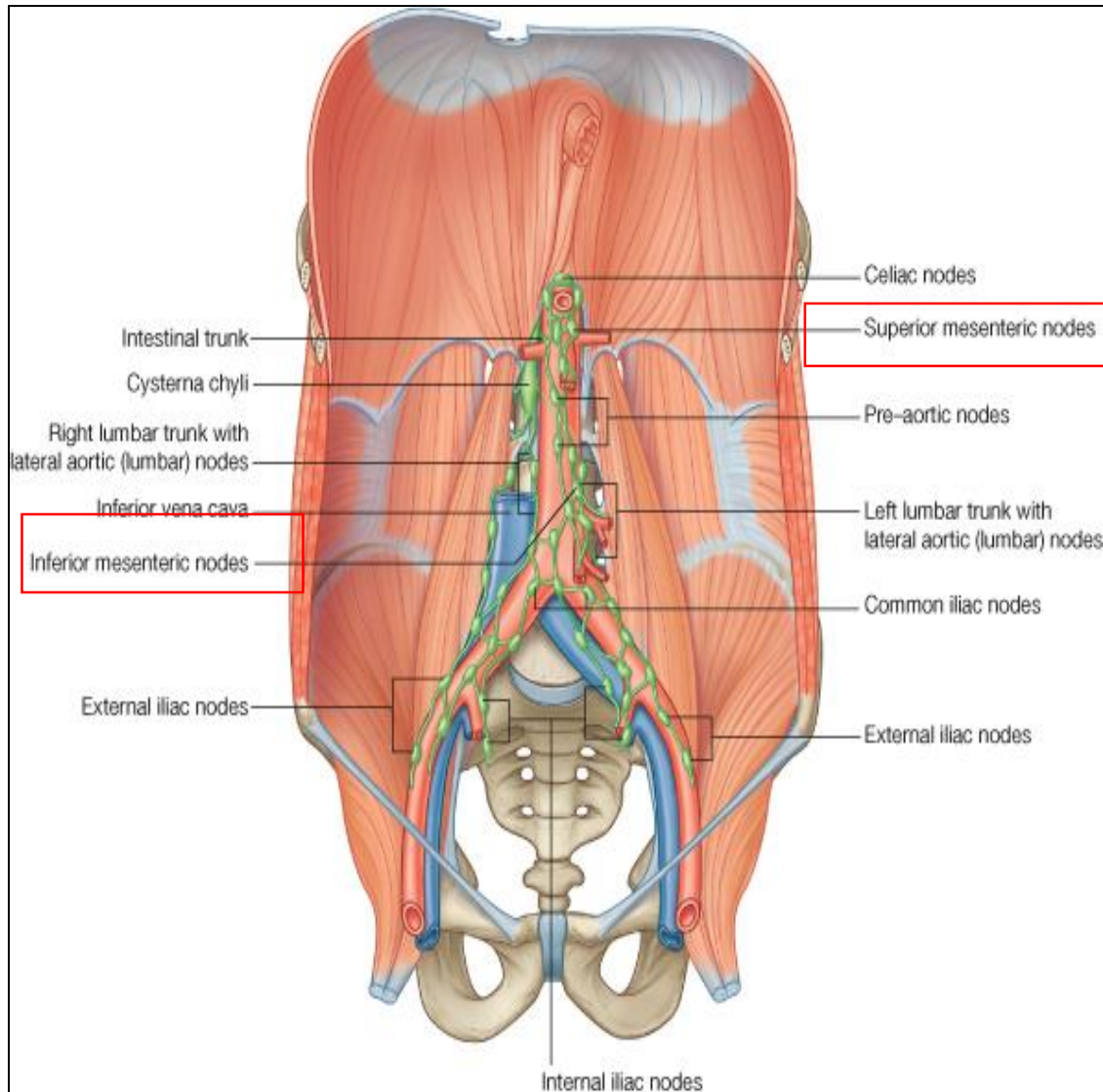
Anal Canal

- Anal canal is related:
- **Posteriorly** - fibrous tissue between it and coccyx (**anococcygeal body**),
- **Laterally** - *containing* fat, **ischioanal /ischiorectal fossae**
- **Anteriorly** - **perineal body** separating it from bulb of penis of urethra in male or lower part of vagina in female.

Anal canal - Vessels and nerves



Lymph drainage of Gut



- lymph vessels follow arteries.
- Ultimately,
- **Pre-aortic lymph nodes** (Superior & Inferior mesenteric).

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- Nerve supply: (Autonomic): Sympathetic Greater Splanchnic T5-T9 + Vagus – Coeliac trunk T12

- Origin: Midgut (endoderm)
- Nerve supply: (Autonomic): Sympathetic Lesser Splanchnic T10 T11 + Vagus – Sup Mesenteric artery L1

- Origin: Hindgut (endoderm)
- Nerve supply: (Autonomic): Sympathetic Least Splanchnic T12 L1 + Hypogastric S2S3S4 – Inferior Mesenteric Artery L3

- Origin :lower 1/3 of anal canal – ectoderm
- Nerve Supply: Somatic (inferior rectal Nerves)