Rectum and Anal Canal

Rectum

Situation:
The rectum lies in the **posterior part of the lesser pelvis**, anterior to the **lower three pieces of the sacrum and the coccyx**.

Extent:
It begins as a **continuation of the sigmoid colon** at the **level of the third sacral vertebra** (S3).
The rectosigmoid junction is marked by the **end of the sigmoid mesocolon**.
It ends by continuing as the **anal canal** at the **anorectal junction**, which lies **2–3 cm in front of and slightly below the tip of the coccyx** — corresponding to the **apex of the prostate** in males

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.

Dimensions:
The rectum measures about **12 cm in length**.
Its upper part has a diameter of **about 4 cm**, similar to the sigmoid colon, while its lower part **dilates to form the rectal ampulla**, which acts as a temporary fecal reservoir

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.

Course and Direction:
The rectum passes **downward and backward**, then **downward**, and finally **downward and forward**.
It shows two types of curvatures:

- **Anteroposterior curves:**

- *Sacral flexure* follows the **concavity of the sacrum and coccyx**.
- *Perineal flexure* is the **backward bend** at the **anorectal junction**.

- **Lateral curves:**
  - Upper convex to the **right**
  - Middle convex to the **left (most prominent)**
  - Lower convex to the **right**

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Relations:

- **Peritoneal relations:**
  - *Upper one-third* – covered by peritoneum **in front and on both sides**
  - *Middle one-third* – covered **only in front**
  - *Lower one-third* – **no peritoneal covering**, lies **below the rectovesical pouch** (males) or **rectouterine pouch** (females)
  - Distance between anus and pouch floor: **7.5 cm in males**, **5.5 cm in females**
- **Visceral relations:**
  - *In males:* upper two-thirds relate to the **rectovesical pouch** with intestinal coils; lower one-third to **bladder base, ureters, seminal vesicles, deferent ducts, and prostate**.

- *In females:* upper two-thirds relate to the **rectouterine pouch** and intestines; lower one-third to **vagina and uterus**

Mucosal Folds

The mucosa of the rectum is **smooth and devoid of villi**. It shows **three permanent transverse folds**, called **Houston's valves** or **rectal folds**, which are **semilunar in shape** and **project into the lumen**.

- **Upper fold:** to the left, about 12 cm from the anus.
- **Middle fold:** to the right, about 8 cm from the anus — the *most prominent*, corresponding to the **Kohlrausch's fold**, marking the **junction of the upper two-thirds and lower one-third** of the rectum.
- **Lower fold:** to the left, about 5 cm from the anus.

These folds support the **fecal column** and help **retain feces** before defecation.

Arterial Supply

The rectum receives blood from **three main arteries**:

- **Superior rectal artery** ? continuation of the **inferior mesenteric artery**, supplies the **upper part of the rectum**.
- **Middle rectal arteries** ? branches of the **internal iliac arteries**, supply the **middle portion**.

- **Inferior rectal arteries** ? branches of the **internal pudendal arteries**, supply the **lower part** of the rectum and anal canal.

These arteries **anastomose freely** in the submucosa and muscular coats, forming a **continuous longitudinal arterial network** along the rectal wall.

Venous Drainage

Venous drainage follows the arterial pattern and is divided into **three sets**:

- **Superior rectal vein** ? drains into the **inferior mesenteric vein**, hence into the **portal system**.
- **Middle rectal veins** ? drain into the **internal iliac veins**, hence into the **systemic circulation**.
- **Inferior rectal veins** ? drain into the **internal pudendal veins**, also into the **systemic system**.

These connections between the **portal and systemic systems** form a **porto-systemic anastomosis**, clinically important in **portal hypertension**, leading to **hemorrhoids**.

Lymphatic Drainage

- **Upper part:** drains into the **pararectal lymph nodes**, then to **inferior mesenteric nodes** .
- **Middle part:** drains into the **internal iliac nodes**.
- **Lower part:** drains into the **superficial inguinal nodes** through the **anal canal below the pectinate line**.

Nerve Supply

The rectum is supplied by **both autonomic and somatic nerves**:

- **Sympathetic:** from the **L1–L2 spinal segments** via the **hypogastric plexus**, causing **contraction of internal anal sphincter** and **inhibition of peristalsis**.
- **Parasympathetic:** from **S2–S4 (pelvic splanchnic nerves)** via the **inferior hypogastric plexus**, responsible for **rectal peristalsis** and **relaxation of the internal sphincter**.
- **Somatic fibers:** from the **pudendal nerve**, supplying the **external anal sphincter** (voluntary control).

Supports of the Rectum

The rectum is supported by:

- **Pelvic floor (levator ani muscles):** especially the **puborectalis**, forming a sling around the anorectal junction and maintaining the **anorectal angle**.
- **Lateral ligaments of the rectum:** condensations of pelvic fascia containing **middle rectal vessels**.
- **Fascial condensations:** including **Waldeyer's fascia** (rectosacral fascia), connecting the rectum to the sacrum.
- **Pelvic peritoneal reflections** and **rectal ampulla**, which help maintain fecal continence.

Dissection

- The rectum is exposed by removing the **sigmoid colon** and reflecting the **pelvic viscera** .
- Note the **peritoneal reflections** on its upper two-thirds and identify the **three lateral mucosal folds** within.

- The **lateral ligaments** containing **middle rectal vessels** and **pelvic fasciae** (Waldeyer's fascia) can be identified posteriorly.

- In males, observe relations with **prostate, seminal vesicles, and bladder base**; in females, with **posterior vaginal wall and uterus**.

Clinical Anatomy

- **Hemorrhoids (piles):** occur due to dilation of the **rectal venous plexus**, especially at the **3, 7, and 11 o'clock positions**, representing sites of **portosystemic anastomosis**.
    - *Internal hemorrhoids* ? above pectinate line (painless).
    - *External hemorrhoids* ? below pectinate line (painful).
- **Rectal prolapse:** due to weakness of **pelvic floor (levator ani)** and **fascia**, leading to downward displacement of rectal wall through the anal canal.
- **Rectal carcinoma:** commonly develops near **Kohlrausch's fold**; spreads through **lymphatics** to **pararectal and internal iliac nodes**.
- **Rectal examination (per rectal):** essential to assess **prostate in males**, **posterior vaginal wall in females**, and **rectal wall integrity**.
- **Fistula-in-ano:** infection of **anal glands** leading to **fistulous tracts** between the anal canal and perianal skin.
- **Rectal atresia:** congenital absence or narrowing of the anal opening due to **failure of cloacal membrane rupture**.
- **Fecal incontinence:** caused by **damage to pudendal nerve** or **weakness of the external sphincter** after obstetric or neurological injury.

Anal Canal

Length, Extent, and Direction

- The **anal canal** measures about **3.8 cm in length**.
- It extends from the **anorectal junction** (where the rectal ampulla narrows to pass through the pelvic diaphragm) to the **anus**, the external opening.
- It is directed **downward and backward**, lying between the **right and left ischioanal fossae** which allow expansion during defecation.
- The **anorectal junction** lies about **2–3 cm in front of and slightly below the tip of the coccyx**, corresponding to the **apex of the prostate** in males.
- The **anus** is situated **about 4 cm below and in front of the coccyx**, surrounded by pigmented skin arranged in **radiating folds** containing **apocrine glands**

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  .

Relations of the Anal Canal

- **Anteriorly**
  - *Both sexes:* **Perineal body**
  - *Males:* **Membranous urethra** and **bulb of penis**
  - *Females:* **Lower end of the vagina**
- **Posteriorly**

- **Anococcygeal ligament** and **tip of coccyx**

- **Laterally**
  - **Ischioanal fossae** on both sides

- **All around:**
  - Enclosed by **sphincter muscles**, whose tone keeps the canal closed

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    .

Interior of the Anal Canal

The anal canal’s interior is divided into **three parts** based on epithelial lining and structure:

Upper Mucous Part (?15 mm)

- Lined by **mucous membrane** of **endodermal origin**.
- Features:
  - **6–10 vertical folds** called **anal columns (of Morgagni)** containing **radicles of superior rectal vein**.
  - **Anal valves** – short transverse mucosal folds joining adjacent columns.
  - **Anal sinuses** – small depressions above each valve, containing **anal glands** (their secretions are odoriferous in lower animals).
  - The line joining anal valves forms the **pectinate (dentate) line**, representing the **junction of endodermal and ectodermal regions**.

- Occasionally, small **anal papillae** may project from valves — remnants of the **embryonic anal membrane**

  Volume 2, BD Chaurasia's Human …

  .

Middle Part (Pecten or Transitional Zone) (?15 mm)

- Lies below the pectinate line, appears **bluish** due to dense venous plexus.
- Lined by **stratified squamous epithelium**, thin and glossy, **without sweat glands**.
- Ends at the **white line of Hilton**, which marks the lower limit of this zone and corresponds to the interval between the **subcutaneous external sphincter** and **lower edge of internal sphincter**

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  .

Lower Cutaneous Part (?8 mm)

- Lined by **true skin**, containing **sebaceous glands, sweat glands, and hair follicles**.
- Represents the **ectodermal part** of the anal canal

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  .

Musculature of the Anal Canal

Internal Anal Sphincter (Involuntary)

- Formed by the **thickened circular smooth muscle coat** of the gut.

- Surrounds the **upper three-fourths (?30 mm)** of the anal canal.
- Extends from the **upper end of the canal to the white line of Hilton**.
- Under **autonomic control** — sympathetic stimulation causes contraction; parasympathetic causes relaxation.

External Anal Sphincter (Voluntary)

- Made of **striated muscle fibers** under **somatic control** via **inferior rectal nerve** and **perineal branch of S4**.
- Surrounds the **entire anal canal** and consists of:
    - **Subcutaneous part:** encircles the anal margin.
    - **Superficial part:** attached anteriorly to **perineal body**, posteriorly to **anococcygeal ligament**.
    - **Deep part:** blends superiorly with **puborectalis fibers**.
- In males, **transverse perinei and bulbospongiosus** insert anteriorly forming a **plane of cleavage**; in females, **transverse perinei and bulbospongiosus** fuse with the sphincter in the lower perineum

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  .

Conjoint Longitudinal Coat

- Formed by the fusion of **puborectalis muscle** with the **longitudinal muscle coat** of rectum at the **anorectal junction**.

- Lies between the **external and internal sphincters**.
- Descends as **fibroelastic septa** that insert into the **skin around the anus** (forming *corrugator cutis ani*), helping maintain anal integrity and anchoring the anal mucosa

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  .

Anorectal Ring

- A **muscular ring** at the **anorectal junction** formed by the union of:
  - **Puborectalis muscle**,
  - **Uppermost fibers of the external sphincter**, and
  - **Internal anal sphincter**.
- Palpable during digital rectal examination.
- Essential for **rectal continence** — its division results in **incontinence**.
- It is less marked **anteriorly**, where **puborectalis fibers** are absent

Surgical Spaces Related to the Anal Canal

1. **Ischioanal (Ischiorectal) Space**
   - Present on **each side of the anal canal**.
   - Triangular in coronal section and filled with **fat and loose areolar tissue**.

- Allows **distension of the anal canal during defecation** and provides space for passage of **inferior rectal vessels and nerves**.

- Pus in this space may spread widely and communicate with the opposite side through the **deep postanal space**.

2. **Perianal Space**

   - Surrounds the anal canal **below the white line**.

   - Contains:

     - **Lower fibers** of the **external sphincter**

     - **External rectal venous plexus**

     - **Terminal branches** of the **inferior rectal vessels and nerves**

   - **Pus in this space** tends to track either **upward to the white line** or **outward to the perineal skin**, rather than spreading to the ischioanal fossa

     Volume 2, BD Chaurasia's Human …

     .

3. **Submucous Space**

   - Lies **above the white line** between the **mucous membrane and internal sphincter**.

   - Contains the **internal rectal venous plexus** and **lymphatic vessels**

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     .

Arterial Supply

- **Above the pectinate line:**
  Supplied by the **superior rectal artery** (branch of the inferior mesenteric artery).

- **Below the pectinate line:**
  Supplied by the **inferior rectal arteries** (branches of the internal pudendal arteries).

- These two systems anastomose within the wall of the anal canal, ensuring continuous circulation

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  .

Venous Drainage

1. **Internal Rectal Venous Plexus** (haemorrhoidal plexus)
   - Lies in the **submucosa**.
   - Drains mainly into the **superior rectal vein**, but communicates freely with the **external plexus** and **middle and inferior rectal veins**.
   - Represents an important **portosystemic anastomosis**.
   - Veins at **3, 7, and 11 o'clock** positions (in lithotomy) are large and prone to **internal hemorrhoids**

     Volume 2, BD Chaurasia's Human …

     .
2. **External Rectal Venous Plexus**
   - Lies **outside the muscular coat** of rectum and anal canal.

- Communicates with the internal plexus.
- Drained by:
  - **Inferior rectal vein ? internal pudendal vein**
  - **Middle rectal vein ? internal iliac vein**
  - **Superior rectal vein ? inferior mesenteric vein**

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3. **Anal Veins**
   - Arranged **radially around the anal margin**.
   - Communicate with internal plexus and inferior rectal veins.
   - Rupture due to **excessive straining** may produce **perianal hematoma** (external piles)

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     .

Lymphatic Drainage

- **Above the pectinate line:** to the **internal iliac lymph nodes**.
- **Below the pectinate line:** to the **medial group of superficial inguinal nodes**.
- The **pectinate line** thus forms a **watershed** between deep and superficial lymph drainage

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Nerve Supply

1. **Above the pectinate line:**
    - Supplied by **autonomic nerves**:
        - **Sympathetic:** from **inferior hypogastric plexus (L1–L2)** ? causes **contraction of internal sphincter**.
        - **Parasympathetic:** from **pelvic splanchnic nerves (S2–S4)** ? causes **relaxation of internal sphincter** and **initiates peristalsis**.
2. **Below the pectinate line:**
    - Supplied by **somatic nerves** — **inferior rectal nerve (branch of pudendal nerve)** and **perineal branch of S4** ? control the **external sphincter**.
    - This zone is **pain-sensitive**, unlike the upper part

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      .

Dissection

- After identifying the **anal canal**, expose:
    - The **ischioanal fossae** laterally.
    - The **internal and external sphincters**.
    - The **submucous and perianal spaces**.

- Trace the **inferior rectal vessels and nerves** from the **pudendal canal** to the **anal margin**.

- Identify the **pectinate line** and note transitions in mucosal epithelium and vascular plexuses.

Clinical Anatomy

- **Internal hemorrhoids:**
  Dilatation of **internal rectal venous plexus** above pectinate line — *painless bleeding*.

- **External hemorrhoids:**
  Involve **external venous plexus** below pectinate line — *painful and tender swellings*.

- **Anal fissure:**
  Linear tear in **lower anal canal**, often due to **constipation or trauma**, producing **severe pain during defecation**.

- **Fistula-in-ano:**
  Abnormal epithelialized tract connecting anal canal to skin, often secondary to **perianal abscess**.

- **Ischioanal abscess:**
  Infection in ischioanal fossa leading to **painful swelling**; may spread contralaterally via the **deep postanal space**.

- **Incontinence:**
  Damage to **anorectal ring** or **pudendal nerve** results in **loss of control** over defecation.

- **Carcinoma:**
  Above pectinate line ? **lymph spread to internal iliac nodes**;
  Below pectinate line ? **spread to superficial inguinal nodes**.

Histology of the Anal Canal

The anal canal shows **distinct epithelial and structural changes** at different levels, corresponding to its **embryological origins**.

Upper Part (Above Pectinate Line)

- **Epithelium:** Simple columnar (like rectal mucosa).
- **Lamina propria:** Contains **mucous glands** and **dense vascular plexuses** (internal rectal venous plexus).
- **Muscularis mucosae:** Present but thin.
- **Submucosa:** Rich in **veins, lymphatics, and connective tissue**.
- **Muscular coat:**
    - *Inner circular layer* ? thickened below to form **internal anal sphincter**.
    - *Outer longitudinal layer* ? continuous with **conjoint longitudinal muscle coat** of the rectum.

Middle Zone (Pecten or Transitional Zone)

- **Epithelium:** Stratified squamous non-keratinized; smooth, bluish appearance due to venous plexus beneath.
- **No glands or hair follicles.**
- Marks the transition from endodermal to ectodermal region.

- Contains small **anal glands** that open into **anal sinuses** near the pectinate line.

Lower Part (Below White Line)

- **Epithelium:** Keratinized stratified squamous (true skin type).
- Contains **sebaceous and sweat glands**, and **hair follicles**.
- Beneath lies **dense connective tissue**, **external venous plexus**, and **skeletal muscle fibers** of the **external sphincter**.

Key Histological Structures

- **Anal columns:** Longitudinal mucosal folds with branches of the **superior rectal vein**.
- **Anal valves and sinuses:** Sites of potential infection or abscess formation.
- **Internal and external venous plexuses:** Represent the anatomical basis for hemorrhoids.

Development of the Anal Canal

The anal canal develops from **two embryological sources**:

1. **Endodermal (Hindgut) Part**
    - Derived from the **terminal part of the hindgut**, which forms the **rectum and upper two-thirds of the anal canal**.
    - Lined by **columnar epithelium**.

- Blood supply from **superior rectal artery** (inferior mesenteric artery).
- Lymph drains to **internal iliac nodes**.
- Nerve supply is **autonomic (visceral)** and **insensitive to pain**.

2. **Ectodermal (Proctodeal) Part**
   - Derived from the **proctodeum** (ectodermal depression on the embryo's surface).
   - Forms the **lower one-third** of the anal canal.
   - Lined by **stratified squamous epithelium** (skin type).
   - Supplied by **inferior rectal artery** (from internal pudendal artery).
   - Lymph drains to **superficial inguinal nodes**.
   - Nerve supply is **somatic (pudendal nerve)** and **pain-sensitive**.

Cloacal Membrane and Pectinate Line

- The **cloacal membrane** initially separates the **endodermal hindgut** from the **ectodermal proctodeum**.
- Its rupture at **7th week of development** establishes continuity between the two parts.
- The line of fusion is marked in adults by the **pectinate (dentate) line**.

Clinical Embryology

- **Imperforate anus:** Failure of cloacal membrane to rupture.

- **Anal stenosis:** Narrowing due to incomplete absorption of epithelial plug.
- **Ectopic anus:** Abnormal migration of the anal opening.
- **Fistula-in-ano:** Persistence of embryonic connections between the anal canal and perineal skin.
- **Anorectal agenesis:** Failure of development of the hindgut part of the canal.

Facts to Remember

- The **middle lateral curvature** of the rectum is the **most prominent**, and it is **convex to the left side**.
- The **chief vessels** of the rectum are the **superior rectal artery** and **superior rectal vein** .
- The **perineal body** and **levator ani muscles** form the **main supports** of the rectum.
- The **anal canal** is surrounded by both **internal (involuntary)** and **external (voluntary)** sphincters which maintain continence.
- Only the **middle fibers** of the **external anal sphincter** have a **bony attachment**.
- The **proximal 15 mm** of the anal canal develops from the **anorectal canal (endoderm)**, and the **distal 23 mm** develops from the **proctodeum (ectoderm)**.
- **Primary hemorrhoids** appear at **3, 7, and 11 o’clock** positions (in the lithotomy position).

- The **rectum and anal canal** together demonstrate **dual blood, lymphatic, and nerve supply**, explained by their **dual embryological origin**.

- The **pectinate line** marks the junction between **endodermal and ectodermal regions**, distinguishing areas of **visceral vs. somatic innervation** and **different lymph drainage**.

- **Internal hemorrhoids** (above the pectinate line) are **painless**, while **external hemorrhoids** (below it) are **painful** due to somatic innervation.

- The **anorectal ring** formed by **puborectalis**, **deep external sphincter**, and **internal sphincter** is vital for **continence**.

- **Damage to the anorectal ring** or **pudendal nerve** results in **fecal incontinence**.

- The **ischioanal fossae** provide space for **anal expansion during defecation**, but infections here can spread **bilaterally through the deep postanal space**.

- **Rectal carcinoma** often occurs at the **rectosigmoid junction** or **ampulla**; lymphatic spread depends on the **level relative to the pectinate line**.

Clinicoanatomical Problem

Case:
A **40-year-old female** patient presents with **painless bleeding** and a **soft mass protruding from the anus** during defecation

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Question 1:
What is the **painless structure** that bleeds during defecation?

Answer:

The patient is suffering from **internal hemorrhoids (piles)**, which are caused by **prolapse of the mucous membrane** containing **tributaries of the internal rectal venous plexus**.

This venous plexus drains blood from the upper part of the anal canal (above the **pectinate line**) and is supplied by **autonomic nerves**, hence **painless**.

Question 2:

What are the **reasons** for this development?

Answer:

- **Varicosity** of the **internal rectal venous plexus** due to increased venous pressure.
- **Irregular bowel habits** and **chronic constipation**, leading to straining during defecation.
- **Prolonged standing** or **portal hypertension** (commonly due to **liver cirrhosis**) increases pressure in the portal circulation, resulting in venous congestion.
- The **internal venous plexus** lacks valves and is arranged in **radial columns** that bulge under pressure, forming **piles** at the classical **3, 7, and 11 o'clock positions** in the lithotomy position

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  .

Clinical Correlation:

- These piles **bleed bright red blood** during defecation because of rupture of **varicose venous radicles**.
- The absence of pain distinguishes **internal piles** (autonomic innervation) from **external piles** (somatic innervation by pudendal nerve).

- **Chronic cases** may lead to **anemia** and **prolapse** of the mucosa.

- **Management** involves dietary fiber, avoiding straining, and in advanced cases, **ligation** or **hemorrhoidectomy**.

Multiple Choice Questions

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1. The upper part of the anal canal develops from:
A. Cloacal membrane
B. Ectodermal proctodeum
C. Endodermal hindgut (anorectal canal)
D. Mesoderm of urorectal septum
? Answer: C. Endodermal hindgut (anorectal canal)

---

2. The lower part of the anal canal develops from:
A. Cloaca
B. Proctodeum (ectodermal invagination)
C. Hindgut endoderm
D. Allantois
? Answer: B. Proctodeum (ectodermal invagination)

---

3. The line that marks the junction between endodermal and ectodermal parts of the anal canal is:
A. White line of Hilton
B. Pectinate (dentate) line
C. Anal verge
D. Anocutaneous line
? Answer: B. Pectinate (dentate) line

---

4. Above the pectinate line, the epithelium is:
A. Stratified squamous keratinized
B. Stratified squamous non-keratinized

C. Simple columnar

D. Cuboidal

? Answer: C. Simple columnar

---

5. Below the pectinate line, the epithelium is:

A. Simple columnar

B. Stratified squamous keratinized

C. Pseudostratified ciliated columnar

D. Transitional

? Answer: B. Stratified squamous keratinized

---

6. The artery supplying the anal canal above the pectinate line is:

A. Middle rectal artery

B. Inferior rectal artery

C. Superior rectal artery

D. Median sacral artery

? Answer: C. Superior rectal artery

---

7. The artery supplying the anal canal below the pectinate line is:

A. Superior rectal artery

B. Middle rectal artery

C. Inferior rectal artery

D. Inferior mesenteric artery

? Answer: C. Inferior rectal artery

---

8. The vein involved in the development of internal hemorrhoids is:

A. Inferior rectal vein

B. Middle rectal vein

C. Superior rectal vein

D. External pudendal vein

? Answer: C. Superior rectal vein

---

9. Internal hemorrhoids are painless because:

A. The mucosa is thick

B. It is supplied by autonomic nerves

C. It occurs below the pectinate line

D. The area lacks nerve endings

? Answer: B. It is supplied by autonomic nerves

---

10. External hemorrhoids are painful because:

A. They occur above pectinate line

B. They involve internal rectal venous plexus

C. They are supplied by pudendal nerve (somatic)

D. They are small in size

? Answer: C. They are supplied by pudendal nerve (somatic)

---

11. Which of the following marks the lower limit of the pecten?

A. Pectinate line

B. White line of Hilton

C. Anal verge

D. Anal sinus

? Answer: B. White line of Hilton

---

12. The venous drainage below the pectinate line is mainly into:

A. Inferior rectal veins ? internal pudendal vein

B. Middle rectal veins ? internal iliac vein

C. Superior rectal vein ? inferior mesenteric vein

D. Lumbar veins ? azygos vein

? Answer: A. Inferior rectal veins ? internal pudendal vein

---

13. The lymph from the anal canal below the pectinate line drains into:

A. Pararectal nodes

B. Internal iliac nodes

C. Superficial inguinal nodes

D. Inferior mesenteric nodes

? Answer: C. Superficial inguinal nodes

---

14. The nerve supply to the anal canal below the pectinate line is:

A. Inferior hypogastric plexus

B. Pelvic splanchnic nerves

C. Inferior rectal branch of pudendal nerve

D. Pelvic sympathetic chain

? Answer: C. Inferior rectal branch of pudendal nerve

---

15. Which structure forms the internal anal sphincter?

A. Longitudinal muscle coat of rectum

B. Thickened circular smooth muscle of rectum

C. Levator ani

D. Puborectalis

? Answer: B. Thickened circular smooth muscle of rectum

---

16. The external anal sphincter is supplied by:

A. Autonomic nerves

B. Inferior rectal nerve and perineal branch of S4

C. Pelvic splanchnic nerves

D. Hypogastric plexus

? Answer: B. Inferior rectal nerve and perineal branch of S4

---

17. Which muscle forms the main sling for fecal continence at the anorectal junction?

A. Puborectalis

B. Ischiococcygeus

C. Superficial external sphincter

D. Bulbospongiosus

? Answer: A. Puborectalis

---

18. The anorectal ring is formed by:

A. Pubococcygeus

B. Internal sphincter only

C. Puborectalis, deep external sphincter, and internal sphincter

D. Superficial external sphincter

? Answer: C. Puborectalis, deep external sphincter, and internal sphincter

19. Which of the following represents the portosystemic anastomosis in the anal canal?

A. Superior and inferior rectal veins

B. Inferior rectal and external pudendal veins

C. Superior and middle rectal arteries

D. Internal pudendal and obturator veins

? Answer: A. Superior and inferior rectal veins

---

20. A defect in partitioning of the cloaca by the urorectal septum leads to:

A. Rectal atresia

B. Anorectal agenesis with or without fistula

C. Anal fissure

D. Rectal prolapse

? Answer: B. Anorectal agenesis with or without fistula

Viva Voce

Q1. What is the total length of the anal canal?

A. Approximately **3.8 cm (1½ inches)**.

Q2. What is the direction of the anal canal?

A. It is directed **downward and backward**, following the axis of the pelvic outlet.

Q3. What are the parts of the anal canal?

A.

- **Upper part** – mucous (endodermal).
- **Middle part** – transitional zone (pecten).
- **Lower part** – cutaneous (ectodermal).

Q4. What is the pectinate line?
A. A **serrated line** formed by the anal valves joining adjacent anal columns; it marks the **junction of endodermal and ectodermal parts** of the anal canal.

Q5. What is the significance of the pectinate line?
A. It marks differences in:

- **Epithelium** – columnar above, squamous below.
- **Blood supply** – superior rectal artery above, inferior rectal below.
- **Venous drainage** – portal above, systemic below.
- **Lymph drainage** – internal iliac above, superficial inguinal below.
- **Nerve supply** – autonomic above (painless), somatic below (painful).

Q6. What are anal columns (of Morgagni)?
A. Longitudinal mucosal folds in the upper anal canal containing **superior rectal vein tributaries**.

Q7. What are anal valves and anal sinuses?
A.

- **Valves:** Small transverse folds joining adjacent columns.
- **Sinuses:** Small depressions above valves; may collect debris and become infected.

Q8. What is the white line of Hilton?
A. A line at the **junction of the transitional and cutaneous zones**, corresponding to the lower limit of the **internal sphincter** and upper limit of the **subcutaneous external sphincter**.

Q9. What are the sphincters of the anal canal?
A.

- **Internal sphincter** – involuntary, smooth muscle (circular coat).
- **External sphincter** – voluntary, skeletal muscle (striated).

Q10. What forms the anorectal ring?
A. Formed by the **puborectalis**, **deep part of the external sphincter**, and **internal sphincter**.

Q11. What is the function of the puborectalis muscle?
A. Acts as a **sling at the anorectal junction**, maintaining **fecal continence**.

Q12. What are the supports of the rectum?
A.

- **Pelvic diaphragm (levator ani)**
- **Perineal body**
- **Endopelvic fascia**
- **Anal sphincters**

Q13. Which arteries supply the anal canal?
A.

- **Above pectinate line:** Superior rectal artery.
- **Below pectinate line:** Inferior rectal artery.

Q14. Which veins form the portosystemic anastomosis in the anal canal?
A. Between **superior rectal vein** (portal system) and **middle/inferior rectal veins** (systemic circulation).

Q15. What are the common sites of internal hemorrhoids?
A. At **3, 7, and 11 o'clock positions** (in lithotomy position).

Q16. Why are internal hemorrhoids painless?
A. Because the mucosa above the pectinate line is **supplied by autonomic nerves**.

Q17. Why are external hemorrhoids painful?
A. Because the skin below the pectinate line is **somatically innervated by the pudendal nerve**.

Q18. Where does lymph from the anal canal drain?
A.

- **Above pectinate line:** Internal iliac lymph nodes.
- **Below pectinate line:** Superficial inguinal lymph nodes.

Q19. What is the clinical importance of the ischioanal fossa?
A. It allows **distension of the anal canal** during defecation and can be a **site of abscess or fistula formation**.

Q20. What happens if the anorectal ring is damaged?
A. It leads to **fecal incontinence** due to loss of sphincteric control.

Q21. What are the common congenital anomalies of the anal canal?
A.

- **Imperforate anus**

- **Anal stenosis**
- **Anorectal agenesis with fistula**
- **Rectovaginal or rectourethral fistula**

Q22. What is the histological difference above and below the pectinate line?
A.

- **Above:** Simple columnar epithelium.
- **Below:** Stratified squamous keratinized epithelium.

Q23. Which nerve supplies the external anal sphincter?
A. Inferior rectal nerve (branch of pudendal nerve) and **perineal branch of S4**.

Q24. Which muscle forms the corrugator cutis ani?
A. Fibers of the **longitudinal coat of rectum** that extend to the skin around the anus, helping to wrinkle it.

Q25. What embryological event leads to formation of the anal canal?
A. Fusion of endodermal hindgut and ectodermal proctodeum after rupture of the **cloacal membrane** during the **7th week of development**.

Q26. What is the cause of backflow of portal blood through rectal veins?
A. Portal hypertension, leading to dilatation of **internal rectal veins** and formation of **piles**.

Q27. What is the function of the conjoint longitudinal coat?
A. Connects the **internal and external sphincters**, supports mucosa, and maintains **anal canal integrity**.

Q28. What is the difference between upper and lower anal canal regarding pain?
A.

- **Upper part:** Painless (autonomic innervation).
- **Lower part:** Painful (somatic innervation).

Q29. What is the function of the perineal body in relation to the anal canal?
A. Acts as an **anchoring structure** for sphincters and maintains **pelvic floor integrity**.

Q30. What is the histological hallmark of the anal columns?
A. Presence of **venous channels** of the **superior rectal vein** within the mucosal folds.