

# Rectum and Anal Canal

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## 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.

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## 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.

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## 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**.

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## 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**.
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## 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).
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## 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.
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## 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.
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- 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**.
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## 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

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### 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**

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### **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

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## 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**

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### 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.
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## 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

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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.

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### 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.
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### 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**.
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### 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.
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### Development of the Anal Canal

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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**.
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## 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**.
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## 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

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- 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

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### 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**.

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**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)**

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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)**

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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**

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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**

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**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**

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**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**

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**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**

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**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**

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**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**

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**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)**

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**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**

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**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**

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**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**

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**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**

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**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**

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**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**

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**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**

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**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**

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**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**

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**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**

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

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

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**Q2.** What is the direction of the anal canal?

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

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**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.

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**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**.

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**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.
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**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**.

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

**A.**

- **Internal sphincter** – involuntary, smooth muscle (circular coat).
  - **External sphincter** – voluntary, skeletal muscle (striated).
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**Q10.** What forms the anorectal ring?

**A.** Formed by the **puborectalis**, **deep part of the external sphincter**, and **internal sphincter**.

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**Q11.** What is the function of the puborectalis muscle?

**A.** Acts as a **sling at the anorectal junction**, maintaining **fecal continence**.

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**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.
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**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).

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**Q15.** What are the common sites of internal hemorrhoids?

**A.** At **3, 7, and 11 o'clock positions** (in lithotomy position).

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**Q16.** Why are internal hemorrhoids painless?

**A.** Because the mucosa above the pectinate line is **supplied by autonomic nerves**.

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**Q17.** Why are external hemorrhoids painful?

**A.** Because the skin below the pectinate line is **somatically innervated by the pudendal nerve**.

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

**A.**

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

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**Q20.** What happens if the anorectal ring is damaged?

**A.** It leads to **fecal incontinence** due to loss of sphincteric control.

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**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.
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**Q23.** Which nerve supplies the external anal sphincter?

**A. Inferior rectal nerve** (branch of pudendal nerve) and **perineal branch of S4**.

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**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.

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**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**.

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**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**.

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**Q27.** What is the function of the conjoint longitudinal coat?

**A.** Connects the **internal and external sphincters**, supports mucosa, and maintains **anal canal integrity**.

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**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**.

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**Q30.** What is the histological hallmark of the anal columns?

**A.** Presence of **venous channels** of the **superior rectal vein** within the mucosal folds.