Anatomy and Most Common Diseases of the Rectum and Anal Canal

Rectum (in Latin: Rectum, in Greek: Proktos) and anal canal (in Latin: Canalis analis) form the straight intestine. They form a functional unit and are part of the digestive system, which controls defecation. If this function is disturbed, fecal incontinence occurs. Hemorrhoids and anal fistulas are also diseases of the straight intestine that a physician will often be faced with in practice. Read a compact outline about the structure, function, and diseases of the final part of the digestive tract here.

Macroscopic Anatomy of the Rectum and Anal Canal

Location of the Rectum and Anal Canal

After the sigmoid colon, the large intestine passes at the level of sacral vertebrae II/III into the 15 cm rectum, which lies directly anterior to the sacral bone (os sacrum). As a continuation of the rectum, the 3-4 cm anal canal (canalis analis) follows. The rectum and anal canal are located in the true pelvis and form the terminal portion of the intestinal tract.
Superficies of the Rectum and Anal Canal

The rectum is part of the straight intestine and has several folds. In the sagittal plane, the rectal folds are as follows:

- **Sacral fold (flexura sacralis):** Due to proximity to the sacrum, the concave fold to ventral occurs.
- **Perineal fold (flexura perinealis):** Superior to the perineum, the convex fold to ventral occurs due to the caudodorsal fold of the rectum in continuation with the anal canal.

In the coronal plane, 3 characteristic folds (flexuræ laterales) correspond to the superior, middle, and inferior transverse rectal folds of the mucosa on the innermost aspect: **superior transverse rectal fold** (from the left side), **middle transverse rectal fold** (from the right side), and **inferior transverse rectal fold** (from the left side).

The middle transverse fold is also known as **Kohlrausch’s fold** and is the most distinct. The middle transverse fold is located approximately 6 cm superior to the anal aperture and is palpable. This association renders rectal carcinomas, which lie inferior to Kohlrausch’s fold, detectable during digital rectal examination. Inferior to Kohlrausch’s fold, the ampulla (ampulla recti) begins.

**Note:** The rectum is not straight, but rather S-shaped and bent due to 2 folds.

Organization of the Rectum and Anal Canal

![Image: Rectum Anatomy. By Armin Kubelbeck, License: CC BY 3.0](image)
The inferior part of the rectum is called the **anorectum** and consists of the dilatable **rectal ampulla** and the subsequent **anal canal**. A corrugated line palpable on the inner aspect, the **anorectal junction**, separates both segments. The mucosal surface has several features:

- **Anal columns**: length-oriented mucosal folds; 8–10 pieces
- **Anal valves**: small transverse folds at the inferior end of the anal columns
- **Anal sinuses**: recesses behind the valves with the ports of the proctodeal glands (glandulae anales); also known as Morgagni’s columns
- **Hemorrhoidal plexus**: submucosal; cavernous body located in the wall in the area of the anal columns
- **Anal pecten**: follows the anal columns; is 1 cm wide and sensitive to touch and pain; small tears in this area (anal fissures) are very painful; border to the outer skin is the anocutaneous line

**Blood Supply and Innervation of the Rectum and Anal Canal**

![Image: The lower rectal arteries surrounding the anus. By Henry Gray, License: Public domain](image)

The arterial blood supply of the rectum and anal canal is provided by 5 arteries with different origins. The largest part of the rectum and the cavernous body are supplied by the unpaired **superior rectal artery**. The superior rectal artery descends from the inferior mesenteric artery, reaches the rectum dorsally, and divides into 2 smaller branches that branch several times again in their course.
Of the 2 internal iliac arteries, the **middle rectal artery** reaches the rectum superior to the levator ani and supplies the inferior part of the ampulla.

The **inferior rectal artery**, which descends from the pudendal artery, is also paired. The **inferior rectal artery** reaches the anal canal inferior to the levator ani and supplies the anal canal, as well as the sphincter muscles. The arteries form anastomoses with each other to compensate for deficiencies.

The veins correspond with the arteries, bear their names, and follow their courses. The **superior rectal vein** drains into the portal vein via the inferior mesenteric vein, whereas the **middle and inferior rectal veins** drain into the vena cava via the iliac veins.

Rectally administered medications (i.e., suppositories) must not be inserted too deeply because the medications would be resorbed by the superior rectal vein and reach the liver first, instead of the systemic circulation; this would lead to an adverse **first-pass effect** and diminish or even eliminate the pharmaceutical benefit.
Furthermore, rectal carcinomas in the superior rectum metastasize to the liver, whereas rectal carcinomas in the inferior rectum lead to metastases in the lungs. The 2 different drainages are connected by the rectal venous plexus. Portocaval anastomoses can be formed due to portal vein hypertension.

**Tip:** Venous drainage of the different parts of the rectum is a popular exam topic.

The sympathetic innervation is supplied via the inferior mesenteric nerve plexus for the superior part of the rectum and via the inferior hypogastric plexus for the inferior part of the rectum. Parasympathetic innervation of the rectum, the rectum, and anal canal are supplied by the pelvic splanchnic nerves from the S2–S4 segments.

The somatic innervation for motor and sensory function is carried by the pudendal nerve.

**Peritoneal Relationships and Neighboring Organs**

Ventral to the rectum lies the vagina and uterus in females or the prostate, seminal glands, and urinary bladder in males. Whereas the superior part of the rectum is located retroperitoneal and sometimes a small part is intraperitoneal, the larger inferior part with the rectal ampulla and the anal canal is extraperitoneal.

This association arises because the turnover of the peritoneum from the rectum to the uterus (in females) or to the urinary bladder (in males) occurs at the perineal flexure. A peritoneal recess is formed at the lowest point of the peritoneal cavity (the rectouterine pouch of Douglas in females and the rectovesical pouch in males). In females, the vesicouterine pouch is formed due to the turnover of the peritoneum from the urinary bladder to the uterus.

According to the different peritoneal location of the rectum, a mobile rectum (retro- or
intraperitoneal) and a fixed rectum (extraperitoneal) can be differentiated clinically. The rectum is surrounded by the paraproctium.

<table>
<thead>
<tr>
<th>Female</th>
<th>Male</th>
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<tr>
<td>Ventral to the rectum lies the ...</td>
<td>Vagina, uterus</td>
</tr>
<tr>
<td>Turnover of the peritoneum from the rectum to ...</td>
<td>Uterus → rectouterine pouch is formed</td>
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**Microscopic Anatomy of the Rectum and Anal Canal**

**Microscopic Anatomy of the Rectum and Anal Canal**

The structure of the rectal wall corresponds to the rest of the digestive tract, with mucosa, muscularis, and adventitia. But what the colon taenia lack, the rectum has a continuous longitudinal layer instead. Furthermore, there are no hastra or epiploic appendices. The transverse rectal folds correspond to the semilunar folds.

In the rectum, the whole colon is lined by a simple columnar epithelium with crypts and goblet cells; this area is called the colorectal zone. At the supratanasional line, the rectal epithelium changes into the mucosal epithelium of the anal canal. This can be divided into 3 zones:

- **Transitional zone:** on the level of the anal columns between the supratanasional line and the dentate line; changes from columnar to stratified non-keratinized squamous epithelium
- **Squamous zone (white zone):** between the dentate line and the anodermal line with stratified keratinized squamous epithelium; firmly grown together with the internal anal sphincter
- **Cutaneous zone (perianal skin):** inferior to the anodermal line with stratified keratinized squamous epithelium; strong pigmentation of the skin, sweat and sebaceous glands, and hair follicles

**Function of the Rectum and Anal Canal**

**Continence**

Closure of the anus is provided by different structures, which are called the continence organ in their entirety. Closure of the anus seals the straight intestine, so solid, liquid, or gassy intestinal content is not expelled. The following structures aid the continence organ:

**Rectum and Anal Canal**

Due to the S-shaped course of the rectum, the column of feces weighs on the pelvic diaphragm instead of the anal canal. Furthermore, mechanoreceptors that register an incoming column of feces are located in the rectal ampulla. The skin of the anal canal can also dilate.

**Sphincter System**

Three muscles (smooth or striated) participate in the closure of the rectum and anal canal.
**Internal anal sphincter muscle**: smooth muscles (involuntary); continuation of the circular layer, innervated by sympathetic; permanently contracted due to missing parasympathetic ganglion cells

**External anal sphincter muscle**: striated muscles (voluntary); subdivided into deep, superficial, and subcutaneous parts; innervation by the pudendal nerve; surrounds the anal canal like a clamp and consequently leaves open only a longitudinal gap

**Puborectalis muscle**: striated muscles; part of the levator ani; origin at the pubis; moves around the rectum from there, at the level of the anorectal junction, and forms a muscle sling that strengthens the perineal flexure and constricts the rectum to a transversal gap; together with the longitudinal gap of the external anal sphincter, the anal canal is closed crosswise.

**Cavernous Body**

The **hemorrhoidal plexus**, an arterially fed cavernous body, is located on the level of the **anal columns** in the submucosa. The hemorrhoidal plexus is supplied by the **superior rectal artery**. The drainage occurs by **arteriovenous anastomoses** via veins that partly run through the sphincter muscles. During contraction of those muscles, drainage of the cavernous body is obstructed; it swells, and the anal columns are joined. This provides a gas-proof closure and therefore continence.

**Nervous Control**

The **viscera** in the **somatic** nervous system participate in incontinence.


When a bolus of feces arrives in the ampulla, the state of filling activates
mechanoreceptors and the signal is transmitted to the sensory cortex via the sacral cord, which signals an urge to defecate. Due to the increasing pressure in the ampulla, the internal anal sphincter releases. The voluntarily innervated external anal sphincter and puborectalis muscles relax.

Due to the relaxation of the sphincter muscles, the cavernous body is emptied. For the expulsion of the column of feces, the parasympathetic peristaltic movements of the colon are assisted by abdominal pressure, the elevation of the pelvic diaphragm, and contraction of the diaphragm. The feces is sensed according to consistency and volume in the white zone.

**Diseases of the Rectum and Anal Canal**

**Anal Abscesses and Fistulas**

Anal abscesses and fistulas occur due to inflammation of the proctodeal glands, which arise from blockage of the anal gland drainage system by fecal matter. Anal abscesses can be classified as perianal, ischioanal, intersphincteric, or supralelevator.

An anal abscess is an acute form, whereas an anal fistula is a chronic form; the latter occurs in up to 50% of patients with anal abscesses. Anal fistulas can spread along the excretory ducts and connect to the outer skin and anal canal, unlike abscesses. Anal fistulas can be classified based on their relationship with various components of the anal sphincter as superficial, intersphincteric, transphincteric, suprasphincteric, or extrasphincteric. The symptoms of anal fistulas manifest as pruritus, weeping, or discharge of pus, mild to severe pain with fever, and leukocytosis (similar to anal abscesses).

Therapy is surgical for anal abscesses and fistulas.

**Hemorrhoids**
Hemorrhoids occur due to asymptomatic hyperplasia of the hemorrhoidal plexus. Symptoms include pruritus, stinging, pain, or hemorrhage. Possible causes of hemorrhoids include continuous pushing due to obstipation, pregnancy, alcohol, and long periods of sitting. The knotty transformations of the hemorrhoidal plexus are most often found at 3, 7, and 11 o’clock in the lithotomy position. Hemorrhoidal disease can be classified into four grades, as follows:

- **Grade I:** non-painful submucous cushions lying superior to the dentate line; only visible by a proctoscope; conspicuous due to bright red blood in the feces
- **Grade II:** While pushing, the hyperplastic vascular cushions prolapse into the anal canal or outward, leading to pain; spontaneous retraction may occur.
- **Grade III:** prolapsed hemorrhoids, which have to be replaced manually
- **Grade IV:** permanent prolapse (non-reducible)

With all 4 grades, there is a danger of complications in the form of massive hemorrhage. Furthermore, there can be obstruction of draining vessels (hemorrhoidal vein thrombosis), inflammation, prolapse of the rectum, and fecal incontinence due to sphincter muscle weakness. To ease the symptoms, treatment with ointments and
suppositories is a possibility. Furthermore, patients should make dietary changes, such as high-fiber and low-fat diets.

For grade I and II disease, semi-operative methods of sclerotization or rubber band ligation are used, whereas grade III and IV must be treated surgically (hemorrhoidectomy).

**Rectal Prolapse**

Rectal prolapse is a condition in which the rectum loses its attachment and protrudes out of the anal aperture with all its wall layers, spontaneously or after defecation. The reason for rectal prolapse is often is an insufficiency of the pelvic diaphragm, which occurs particularly in older people. The condition is more common among women 60 years of age or older. Other promoting factors are obstipation and an elongated colon.

Rectal prolapse is rarely associated with pain but is often associated with fecal incontinence. Therapy is determined by the dimensions of the prolapse and ranges from rubber band ligation to operative fixation of the rectum with the sacrum (rectopexy).
**Rectal Carcinoma**

**Colorectal** carcinoma is the second most common cause of cancer mortality in men and women. In contrast to **colon carcinoma**, **rectal carcinoma** is digitally palpable in many cases and therefore is often detected during preventive checkups. Such carcinoma often develops from **adenomas (polyps)**, which signify a benign pre-stage. Risk factors for rectal carcinoma include advanced age, a history of smoking, a family history of the disease, and inflammatory bowel disease.

The symptoms (loss of efficiency, weight loss, and fever) are non-specific, which makes diagnosis difficult. Most often, patients consult a physician due to blood on toilet paper, blood in the toilet, or blood in the feces. A **digital rectal** examination should be performed immediately, followed by **colposcopy**.

**Memorize:** Blood in the feces can arise from **hemorrhoidal disease**, but blood in the feces can also be a sign of **rectal carcinoma**.

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**Exogenous** risk factors include a high intake of meats and fats, alcohol abuse, long-term smoking of cigarettes, and age greater than 40 years. **Endogenous** risk factors are chronic inflammatory bowel disease (Crohn’s disease or ulcerative colitis), a family history of colorectal carcinoma, and **adenomatous rectal polyps**. **Familial adenomatous polyposis**, for example, presents **obligatory precancerosis**.

A cure can be achieved only by surgery. For the infestation of the superior or middle rectal third, the rectum is partially removed (**rectum resection**). For the infestation of
the inferior third (tumor is less than 6 cm from the anus), the entire rectum must be removed (rectum extirpation) and an artificial anus created (anus praeter).

Examination of the Rectum and Anal Canal

Digital Rectal Examination

Educating patients about the importance of rectal examination and the procedure should be mandatory. There are different possibilities for a patient’s position:

- **Lateral position**: provides maximal flexion of the hip joints; rectangular flexion of the knee joints
- **Lithotomy position**: supine position; knees tucked up; legs spread
- **Knee-elbow position**: kneeling position; hands and lower arms resting
The examiner should wear gloves and use a lubricant. The examiner gently inserts a finger and leads forward toward the abdominal wall. At the same time, the examiner heeds the **tone** of the sphincter muscles and the condition of the mucosa. In males, the **prostate** can be grouped and evaluated. After withdrawing the gloved finger, the examiner should heed potential blood trails. Furthermore, stool residue can be evaluated based on color and consistency.

![Image: The patient was placed in an exaggerated lithotomy position. By Open-i, License: CC BY 2.5](image)

**Rectoscopy**

For preparation, the intestine must be emptied with an enema or suppository, preceded by a progressively light diet for 3 days. Prior to the procedure, a healthcare practitioner should explain the procedure and obtain consent. During the examination, the patient should be in a knee-elbow or lateral position. The rectoscope is inserted under visual control and advanced. For better evaluation of the rectum and mucosa, the air is insufflated to dilate the intestine.

**References**


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