# Anatomy and Neurophysiology of Defecation

| Article Details | Relevant Anatomic Structures and Background Information | Neuronal Innervation | Process of Defecation | Process of Fecal Incontinence and Complications |
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| **Title:** Neurogenic Bladder, Neurogenic Bowel, and Sexual Dysfunction in People with Spinal Cord Injury[1]<br><br>**Year:** 2002<br><br>**Authors:** Barbara T Benevento, Marca L Sipski<br><br>**Article Type:** Narrative Review | **Neurogenic Bowel**[1]:<br>- External anal sphincter (EAS), internal anal sphincter (IAS), and puborectalis muscle act together to maintain fecal continence.<br>- Prolonged bed rest influences bowel motility. Seated position is preferred as it facilitates defecation. | - Vagus nerve supplies parasympathetic innervation from esophagus to colon.[1]<br>- Pelvic nerve carries parasympathetic fibers (S2-S4) to descending colon and rectum.[1]<br>- Sympathetic innervation from superior and inferior mesenteric (T9-T12) and hypogastric (T12-L2) nerves.[1]<br>- Somatic innervation via pudendal nerve (S2-S4) to pelvic floor.[1] | - At rest, tone of IAS maintains continence.[1]<br>- During Valsalva or cough to prevent incontinence, EAS and puborectalis contract.[1]<br>- IAS maintains continence of liquid and gas.[1]<br>- EAS maintains continence of solids.[1]<br>- Defecation occurs when puborectalis muscle and EAS relax due to involuntary advancement of stool into rectum (aided by peristalsis and increased intra-abdominal pressure)[1]<br>- Enteric system is intact after SCI.[1] | - Influences morbidity and can severely disrupt quality of life[1]<br>- Gastrointestinal (GI) complications include bowel dysfunction, reflux, autonomic dysreflexia, pain, distension, diverticulosis, hemorrhoids, nausea, loss of appetite, impaction, constipation, diarrhea, and delayed or unplanned evacuation[1]<br>- Lesions to parasympathetic cell bodies in pelvic nerve, cauda equina, or conus medullaris can cause lower motor neuron (LMN) bowel syndrome or areflexic bowel (causes constipation and risk for |

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| | | | | incontinence from a lax EAS) [1]<br>- A lesion above the conus medullaris can cause an upper motor neuron (UMN) bowel syndrome or hyperreflexic bowel (causing constipation and fecal retention due to activity of EAS) [1]<br>- Factors to consider when creating a bowel program include type of bowel dysfunction, history of GI problems or other medical conditions, medications, diet, fluid intake [1]<br>- Also, important to consider upper and lower extremity strength, sitting balance, ability to transfer, length of extremities, and weight.[1] These factors will influence if a patient can be independent or will require assistance in |

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| | | | | their bowel program.[1] |
| **Title:** Gastrointestinal Function and Disorders[2]<br><br>**Year:** 2004<br><br>**Authors**: Poul-Erik Paulev, Gustavo Zubieta-Calleja<br><br>**Article Type**: Book | **Internal anal sphincter (IAS)** [2]**:** maintain tonic contraction during continence<br><br>**External anal sphincter (EAS)** [2]**:** innervated by pudendal nerve<br><br>**Levator ani**[2]**:** helps with anal closure<br><br>**Lower sacral medulla**[2]**:** defecation center | Internal anal sphincter innervated by lumbar medulla via hypogastric nerve and inferior mesenteric ganglion.[2]<br><br>Parasympathetic fibers (cholinergic fibers) in pelvic nerve (S2-S4) relaxes internal anal sphincter.[2] | Colonic transport occurs over days.[2]<br><br>Slow waves of contractions move contents in oral direction to delay population and help with absorption of water and electrolytes.[2]<br><br>Defecation involves voluntary and reflex actions in the colon, rectum, anal sphincters, and striated muscles (diaphragm, abdominal, and pelvic muscles).[2]<br><br>It's a temporal release of anal continence via reflex.[2]<br><br>Distension of rectum with fecal matter causes awareness of urge to defecation (intrinsic defecation reflex and spinal reflex).[2]<br><br>Strong spinal reflex involves relaxation of smooth muscle in internal sphincter and contraction of striated muscle in external anal | Damage to lower sacral medulla (defecation center) destroys spinal reflex and inhibits normal defecation.[2]<br><br>Higher spinal lesions destroy voluntary control, but defecation reflex persists.[2] |

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| | | | sphincter causing receptive relaxation.[2]<br><br>Parasympathetic:<br>Pelvic nerve releases Acetylcholine (Ach) at distal large intestine and rectal receptors which allows for contraction.[2]<br><br>Sympathetic: IAS maintain resting tone, hypogastric n. releases norepinephrine (NE) at rectal receptors causing relaxation, hypogastric n. also releases NE at IAS receptors causing contraction[2]<br><br>**Defecation Control[2]:**<br>Somatic nervous system:<br>- Puborectalis maintains anorectal angle and innervated by sacral nerve roots<br>- Pudendal n. supplies EAS<br>- Release Ach at receptors leading to voluntary contraction of pelvic floor muscles and EAS | |

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| | | | **Recto-anal Inhibitory Reflex**[2]**:**<br>Parasympathetic:<br>- Sensory portion of pelvic n send slow impulses about volume<br>- Pelvic n. reduce Ach release at upper IAS receptors leading to reflexive relaxation of IAS<br>Sympathetic:<br>- Hypogastric n. releases NE at rectal receptors = relaxation<br>- Hypogastric n. releases NE at lower IAS = IAS contraction<br>Somatic:<br>- Pudendal n. release Ach at receptors of puborectalis and EAS = reflex or voluntary PFM and EAS contraction<br>**Full rectum**[2]**:**<br>Parasympathetic:<br>- Sensory portion of pelvic n. sends rapid impulses about volume | |

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| | | | - Efferent pelvic n. at rectal receptors increases Ach release = rectal contraction<br>- Pelvic n. reduces release of Ach at upper IAS = IAS reflexively relax<br>Sympathetic:<br>- Hypogastric n. reduces release of NE at rectal receptors = no relaxation<br>- Hypogastric n. reduces release of NE at lower IAS = no IAS contraction<br>Somatic:<br>- Pudendal n. reduces Ach release if ready to defecate (appropriate timing) = voluntary PFM and EAS relaxation<br>- Pudendal n. increases Ach release if not ready to defecate = voluntary PFM and EAS contraction<br><br>**Defecation reflex[2]:** | |

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| | | | Parasympathetic:<br>- Sensory portion of pelvic n. at rectum continues sending rapid messages<br>- Efferent pelvic n. at rectal receptors increases Ach release – reflex loop to continue to contract rectum<br>Sympathetic:<br>- Continues inhibition<br>Somatic:<br>- Continues inhibition<br><br>**Closing Reflex[2]:**<br>Parasympathetic:<br>- Sensory pelvic n. send impulse about completion<br>Sympathetic:<br>- Resume defecation control<br>Somatic:<br>- Descending cortical reflex maintains continence following defecation<br>- Pudendal n. increase Ach release at PFM and | |

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| | | | EAS = reflexive PFM and EAS contraction<br>- IAS regain resting tone | |
| **Title:** The Physiology of continence and evacuation[3]<br><br>**Year:** 2009<br><br>**Authors:** Adeel Bajwa, Anton Emmanual<br><br>**Article Type:** Narrative Review | **Anal sphincter Complex**[3]**:** involved in the regulation fecal incontinence and defecation control<br><br>**Internal Anal Sphincter**[3]**:**<br>3 cm long and 3 mm wide (longer in males and thickens with increasing age)<br><br>Intrinsic "slow wave" activity = resting tone of anus (85% of tone and sphincter pressure)<br><br>Weakness or disruption → passive leakage of fecal contents<br><br>**External Anal Sphincter (EAS):** [3]<br>Fatigable muscle (unlike internal sphincter)<br><br>Slow twitch and fast twitch fibers<br><br>Contributes a small amount to resting anal tone<br><br>Conscious delay of defecation is achieved through EAS contraction which allows for rectal adaptation to occur which then causes decrease in rectal pressure and suppresses urge. | Rectum innervation from extrinsic autonomic nerves (enteric system) – allow for rectal compliance[3]<br><br>**Rectoanal inhibitory reflex**[3]**:**<br>Relaxation of upper internal anal sphincter during progressive rectal filling<br><br>Low internal sphincter has high resting pressures (helps maintain continence)<br><br>External sphincter has excitatory response which helps prevent loss of rectal contents as they descend into the highly innervated upper anal canal.<br><br>**Pudendal n.** supplies external anal sphincter[3]<br><br>**Closing Reflex**[3]**:** when traction (from fecal matter) is applied to EAS, there is an increase in EAS contraction that is exaggerated when traction is released = basis for anal closure at end of | Defecation occurs due to rectal sensory awareness at a certain level of filling.[3] This is relayed to cerebral cortex as an urge to defecate. Threshold depends on nature of contents and rectum itself.[3]<br><br>Sitting creates optimal straightening of rectal angle which allows for easier propulsion of fecal matter.[3]<br><br>Rectal filling causes a reflex relaxation of anal sphincters and puborectalis.[3] Someone will also perform Valsalva maneuver.[3] This increases abdominal pressure and causes muscles of abdominal wall (anterior) to tense up to increase pressure in pelvis.[3] This will cause the pelvic floor to relax which allows stool to enter lower rectum.[3] This then causes a spontaneous recto-sigmoid contraction | Constipation can be categorized as either a pelvic floor dysfunction, slow whole gut transit, or combination of the two.[3]<br><br>Inadequate EAS excitation is seen in those with incontinence and neurogenic or traumatic EAS injury.[3] |

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| | **Rectum**[3]**:** conduit and storage for stool<br><br>Distal gut distension inhibits proximal gut motor activity (allows for coordinated peristalsis).<br><br>Rectal distension leads to decreased colonic tone.<br><br>Rectal filling sensation occurs with rise in rectal pressure, after recto-anal inhibitory reflex is initiated = descension of fecal matter into upper anal canal<br><br>Once conscious awareness of filling is established, parasympathetic driven defecation reflex is initiation (can be inhibited voluntarily)<br><br>**Pelvic Diaphragm/Puborectalis/Anorectal Angle**[3]**:**<br>Striated muscular layer with ligamentous structure surrounding rectum, vagina, and urethra.<br><br>Pelvic Diaphragm consists of multiple muscles that act together. During defecation, pelvic floor muscles relax with rise in intraabdominal pressure and anterior abdominal wall contraction. | defecation (descending cortical signals)<br><br>Puborectalis innervated by nerve roots directly.[3] | to push stool through relaxed anal canal.[3]<br><br>Sensory inputs from anus maintains propulsive activity of rectum until it is empty.[3] Reflex seems to be mediated at spinal cord level due to findings that patients with spinal cord injury can void a complete stool once initiated.[3]<br><br>Once last fecal matter is passed, a "closing reflex" of external anal sphincter occurs due to decrease in stretching of sphincter.[3]<br><br>Rectal compliance = volume response to a pressure distension of the rectum[3] | |

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| | Puborectalis muscle is particularly important since it contributes to the anorectal angle (helps preserve continence). Contraction is voluntary and helps close anal canal but also increases anorectal angle (ARA).<br><br>ARA is angle between rectum and upper anal canal. | | | |

Bibliography

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