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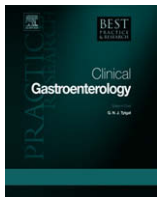

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Anorectal and pelvic floor anatomy

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The anorectum and pelvic floor are crucial in maintaining continence, facilitating evacuation, providing pelvic organ support while in females the pelvic floor is part of the birth canal. The anal sphincter is a multilayered cylindrical structure, including the smooth muscle internal sphincter and the outer striated muscle layer. The latter comprises the external sphincter as lower outer half and puborectalis as upper outer half of the sphincter. The external sphincter is continuous with the rectum at the anorectal junction.

The pelvic floor constitutes four principal layers: endopelvic fascia, the muscular pelvic diaphragm (commonly referred to as levator plate), the perineal membrane (urogenital diaphragm) and the superficial transverse perineii. Anorectum and pelvic floor have multiple interconnections by fascia and ligaments as well as multiple indirect connections to the bony pelvis. Other structures as perineal body and a fibro-elastic network add to this support.

In this article, the anatomy of the anal sphincter and pelvic floor is described based on magnetic resonance imaging (MRI). MRI is a versatile non-invasive technique with detailed demonstration of normal anatomical structures. The emphasis is on muscles, ligaments and their inter-relationship. Fascia and neurovascular structures are more briefly discussed as these more subtle structures are often more difficult or not demonstrated at MRI. As pelvic floor dysfunction is more frequently encountered in women, primarily female anatomy will be described. For the anatomy of bladder, urethra, vagina and uterus and their support structures, readers are referred to the literature [1]. After a brief technical description of MRI, the anatomy of anal sphincter, rectum and pelvic floor is described.

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MRI technique

The anatomy of the anorectum and pelvic floor is well demonstrated at T2 weighted turbo spin–echo sequences and all figures in this article concern this type of MRI sequence.

Contrast in MRI is described as signal intensity relative to other structures. Fascia, tendons and striated muscles have a relatively hypointense signal intensity (i.e., dark grey or black tones). Smooth muscles (e.g., internal anal sphincter) and fat are relatively hyperintense (i.e., light grey or white tones).

External coils give a full overview of the anal sphincter and pelvic floor without disturbing the anatomy at rest. Endoanal MRI has the advantage that the local anatomy is more detailed, which can be beneficial for demonstrating pathology as well as detailed anal anatomy. For the purpose of this article – describing anatomy – both endoanal and external coil MRI images are used.

Sagittal images are non-angulated, while axial and coronal images are obtained with sequences which are, respectively, orthogonal and parallel to the anal canal axis or rectum to reduce partial volume effects. For more details on the technique, readers are referred to the literature [2].

Anal sphincter

The anus is the most distal part of the alimentary tract. The anal sphincter envelops the anal canal, closing the anal canal until an appropriate moment and place when the sphincter relaxes for evacuation of stool.

The anal sphincter is tilted anteriorly in the sagittal plane with the cranial part forward. The canal is 4–6 cm (average 5 cm) in length [3,4]. The anal sphincter can be considered as a multilayered cylindrical structure, with the innermost layer being the anal lining, with the subsequent layers: internal sphincter, the fat-containing inter-sphincteric space with the longitudinal layer, and subsequently the outer striated muscle layer. The latter constitutes the sling-like puborectalis muscle for the upper half and the cylindrical external sphincter for the lower half. These layers are discussed in more detail. The neurovascular supply to the anal sphincter is relatively complex and here only a general description of the nerve supply is presented in the paragraphs on the sphincter muscles.

Anal mucosal lining

The lining of the anal canal changes along the length of the canal. In the upper part is colonic-type mucosa arranged into 6–10 vertical folds, called the anal columns, which are separated by grooves. The mucosa has muscularis mucosae at this level (Fig. 1). At the caudal end of each anal column is a fold ('anal valve'), with the opening of submucosal anal glands just above. This is adjacent to the dentate line (smooth hairless skin) with above autonomic nerve supply and below somatic nerve supply (inferior rectal nerve) as well as portosystemic venous connection. Important for proper function of the anal sphincter is the rich supply of sensory endings at the dentate line and proprioceptive fibres. Motor control and sensory input are processed at several levels of the central nervous system. The anal cushions are three specialised vascular engorgements of the submucosa that act as seals for the anal canal [5]. The lowest part of the anal canal has a lining as the perianal skin (keratinised stratified squamous epithelium).

Internal sphincter

The internal sphincter is a smooth muscle sphincter which is the continuation of the circular layer of the muscularis propria of the rectum. The internal sphincter is important in maintaining anal sphincter rest pressure. The internal sphincter is approximately 2–3 mm thick on endoluminal imaging [3] (Figs. 1–3). With age, the internal sphincter increases in thickness in both sexes [3]. The internal sphincter does not extend to the lower edge of the anal sphincter but ends approximately 1 cm above this level. The lower muscular part of the anal sphincter therefore only constitutes external sphincter. The autonomic nerve supply of the internal sphincter is by sympathetic fibres from the inferior pelvic plexus and parasympathetic (inhibitory) fibres through the inferior pelvic