Introduction

Acceptance of laparoscopic surgery for rectal cancer has met with some resistance, even though conventional surgery is associated with a high rate of local recurrence unless total mesorectal excision is performed. It was found that the magnified view of the deep pelvis provided by the laparoscope allows total mesorectal excision to be achieved with less blood loss than the open procedure. Some recent reports have supported laparoscopic total mesorectal excision in terms of short-term outcome. Even for patients with lower rectal cancer, the laparoscopic procedure may have advantages over conventional open surgery, although there is some controversy concerning lateral lymph node dissection ***(Morino et al., 2003).***

It has been also reported on the benefits of this laparoscopic procedure, along with the details of our operative technique. Another difficulty with performing laparoscopic resection for low rectal cancer involves the method of reconstruction, transection of the distal rectum and complete irrigation of the residual rectum after tumor resection. When an endoscopic stapling device is used for transection of the rectum, the number of staples required and the angle at which the device is introduced should be considered to ensure a safe procedure that may decrease anastomotic complications ***(Fukunaga et al., 2008).***

The role of laparoscopic surgery for rectal cancer has been perceived as controversial, with some studies (multicentre) showing relatively high rates of positive circumferential margins and local recurrence. Other studies have shown better results; however, many of these reported only short-term outcomes. Without doubt the main tenets of the advantages of laparoscopic surgery for colorectal neoplasia include reduced post-operative pain, quicker recovery of intestinal function, equivalent oncological outcomes and shorter length of hospital stay compared with open surgery ***(Aly, 2009).***

Because of the limiting pelvic anatomy, the available endostaplers only occasionally allow a clear transverse transection of the organ. Stapler placement is frequently difficult, even hazardous, and usually two or even three stapler loads are needed to cut the rectum. This is a potentially more expensive approach that eventually increases the risk of complications, namely, anastomotic dehiscence ***(Ito et al., 2008).***

Laparoscopic anterior resection with total mesorectal excision for lower third rectal cancer remains a difficult operation, in particular, in male patients with a narrow pelvis and bulky mesentery. In this type of patient, the available staplers do not allow an easy transection of the rectum close to the pelvic floor. A new approach that uses instruments (dilator, obturator, and purse-string anoscope) specifically designed for the technique of stapled hemorrhoidopexy and a common circular stapler can overcome all these issues ***(Limbert and De Almeida, 2009).***

Aim of the Work

The aim of this work is to compare ultra-low laparoscopic anterior resection for lower rectal cancer reconstructed by trans-anal purse-string technique and conventional ultra-low laparoscopic anterior resection.

Chapter (I): Anatomy of the Rectum & Anal canal

Rectum

The rectum is the terminal portion of the digestive tract. The rectum has the shape of a cylindrical reservoir, from 12 cm to 15 cm long, and extends from the sacral promontory posteriorly against the anterior surface of the sacral concavity as a continuation of the sigmoid colon. Proximally and distally it is 3 to 4 cm in diameter, and its middle portion is from 6 to 8 cm in diameter, although it may be much wider (Rectal Ampulla) ***(Bannister, 1995).***

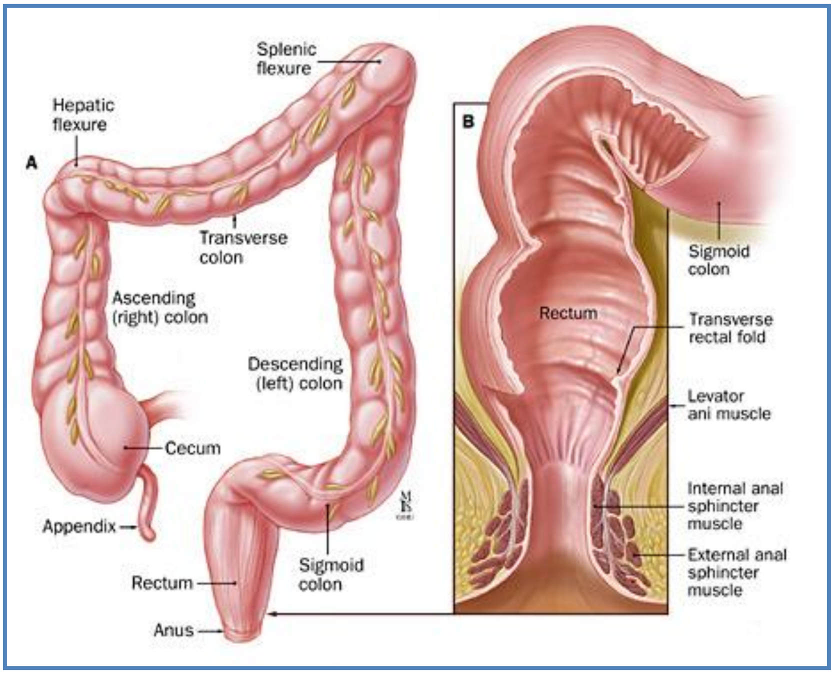

Fig. (1): Illustration of colon and interior of rectum ***(Bannister, 1995).***

The rectum differs from the sigmoid colon in having no sacculations, appendices epiploicae or mesentery; the taeniae blend about 5 cm above the rectosigmoid junction following two wide muscular bands which descend, anterior and posterior, in the rectal wall ***(Bannister, 1995).***

The rectum contains three distinct curves: the proximal and distal curves are convex to the right, whereas the middle curve is convex to the left within these curves, mucosal folds project into the lumen as *the valves of Houston*. These mucosal infoldings present some difficulty for proctoscopic examination, but are excellent targets for mucosal biopsy because they do not contain all layers of the muscular rectal wall and the risk of perforation is therefore diminished ***(Kodner et al., 1999).***

Although the rectum has no mesentery, the visceral pelvic fascia around the rectum is referred to by surgeons as the mesorectum. The pararectal lymph nodes are in the mesorectum, which is removed together with the rectum as a package during rectal excision for carcinoma ***(Sinnatamby, 1999).***

The rectum is surrounded by a fascia (fascia propria) which defines the limits of the mesorectum from behind. Peritoneum covers the upper third of the rectum at the front and sides, and the middle third only at the front; the lower third is below the level of the peritoneum which is reflected forwards on to the upper surface of the bladder (in the male) or upper vagina (in the female) to form the rectovesical or rectouterine pouch (pouch of Douglas) respectively. These pouches form the lowest parts of the peritoneal cavity, and being 7.5 and 5.5 cm from the anal margins in the male and female respectively are within reach of the fingertip on rectal examination. They are normally occupied by coils of small intestine or sigmoid colon ***(Bannister, 1995)*.**

In front of the rectovesical pouch is the uppermost part of the base of the bladder and the tops of the seminal vesicles. Below the level of pouch are the rest of the bladder base and seminal vesicles, the prostate, and the ends of each ureter and ductus deferens. A condensation of connective tissue, the rectovesical fasciae (of Denonviller) intervenes between this part of the rectum and the structures in front of it. It is connected to the floor of rectovesical pouch above and to the apex of the prostate and the perineal body below ***(Sinnatamby, 1999).***

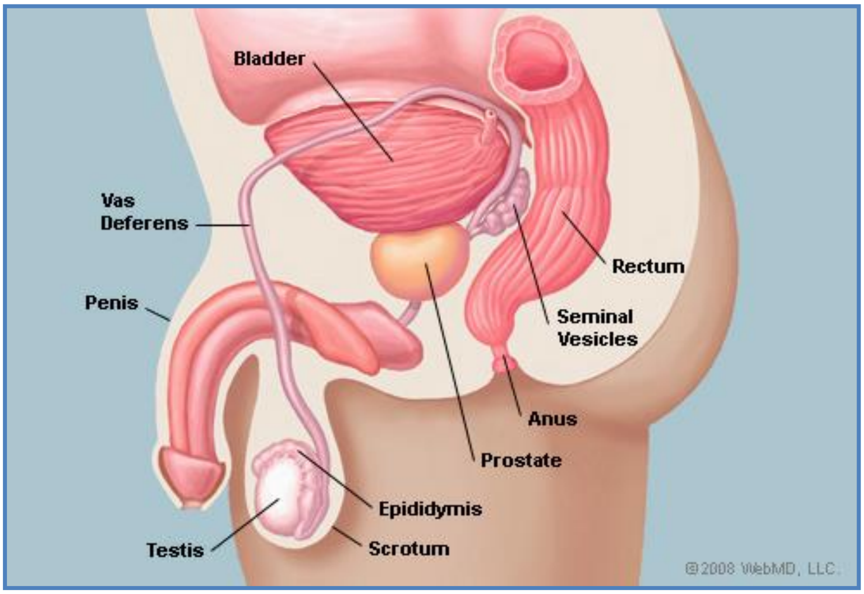

Fig. (2): A diagram showing relations of rectum to surrounding structures ***(Bannister, 1995).***

In front of the rectouterine pouch is the uppermost part of the vagina (the fornix, with the cervix of the uterus projecting into it), while below the peritoneal reflection is more of the vagina, with the thin rectovaginal fascia intervening ***(Bannister, 1995).***

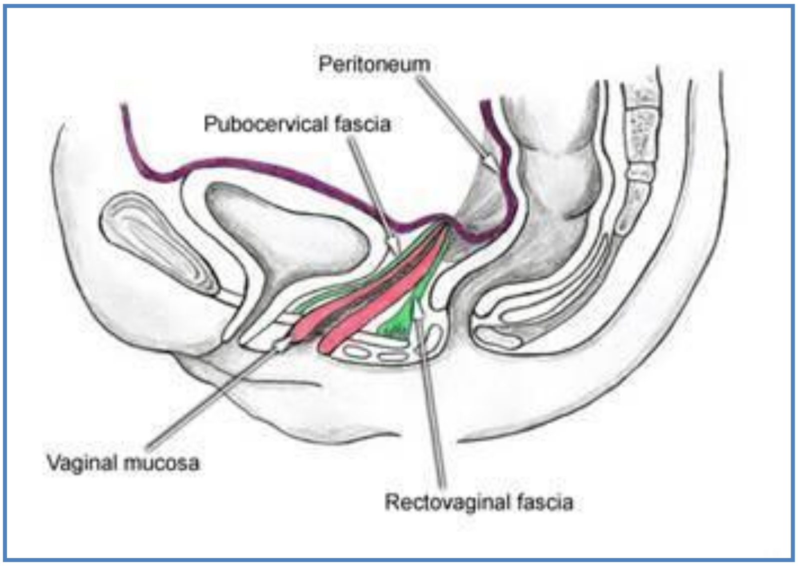

Fig. (3): A diagram showing fascial relations of rectum ***(Sinnatamby, 1999)***

On each side, the posterolateral relations of the rectum include the lower pieces of the sacrum and coccyx, the piriformis, levator ani and coccygeus muscles, the anterior rami of the lower three sacral and coccygeal nerves, the end branches of rectal vessels ***(Sinnatamby, 1999)***. From the front of the lower sacrum a strong condensation of connective tissue, the presacral or Waldeyer's fascia passes down to the anorectal junction ***(Kodner et al., 1999).***

The anal canal starts at the pelvic diaphragm (the levator ani) and ends at the anal verge. It is approximately 4 cm long and normally exists as a collapsed anteroposterior slit that extends from the anal verge to the dentate line. For practical purposes, however, surgeons usually define the surgical anal canal as extending from the anal verge to the anorectal ring, that is palpable by digital rectal examination. The anorectal ring is 1 to 1.5 cm above the dentate line ***(Kodner et al., 1999)***.

Fascial structures around the rectum

Fascia propria of the rectum

The fascia propria of the rectum is a thin visceral fascia covering the rectum and mesorectum. The mesorectum is a distinct compartment that contains the superior rectal arteries and veins, mesorectal fat, lymphatic vessels and nodes. This fascia is also called the perirectal fascia, rectal fascia, and visceral fascia ***(Church et al., 1987)***.

Denonvilliers' fascia

Denonvilliers' fascia is clearly identifiable in males between the fascia propria of the rectum and the seminal vesicles or prostate. The rectovaginal septum in females corresponds to Denonvilliers' fascia. The consistency of Denonvilliers' fascia varies between individuals, from a fragile translucent layer to a tough leathery membrane. The rectovaginal septum is less prominent in females than

Denonvilliers' fascia is in males. The fascia is thicker in younger individuals and then thins out with age, and it may be more obvious in patients with preoperative radiotherapy to the pelvis or with transmural inflammation of the rectum (i.e. Crohn's disease) ***(Church et al., 1987)***.

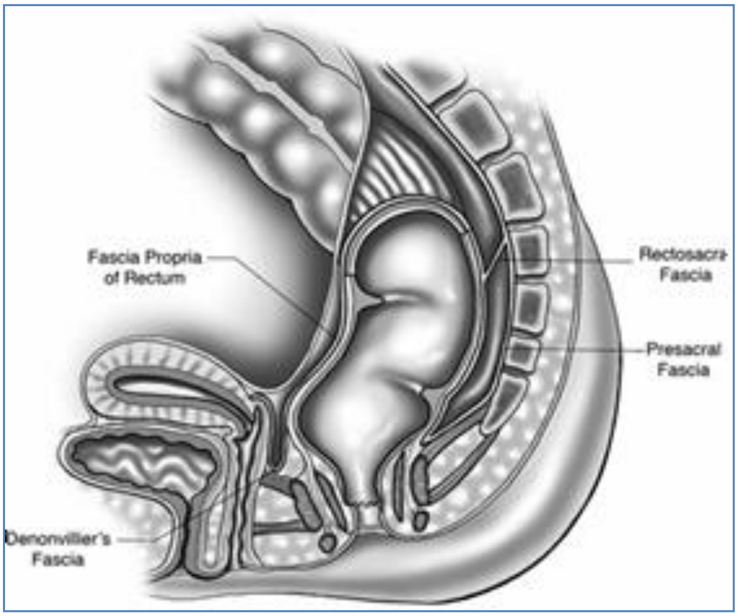

Fig. (4): Fascia around the rectum ***(Church et al., 1987)***.

Laterally, Denonvilliers' fascia divides into several thin laminae, and one of the lateral continuations extends dorsolaterally and separates the mesorectum from the pelvic plexus and urogenital neurovascular bundle. The caudal part of the Denonvilliers' fascia joins the prostate or rectourethral muscle, and for that reason, it is more easily separated from the rectum than from the Prostate ***(Kinugasa et al., 2006).***

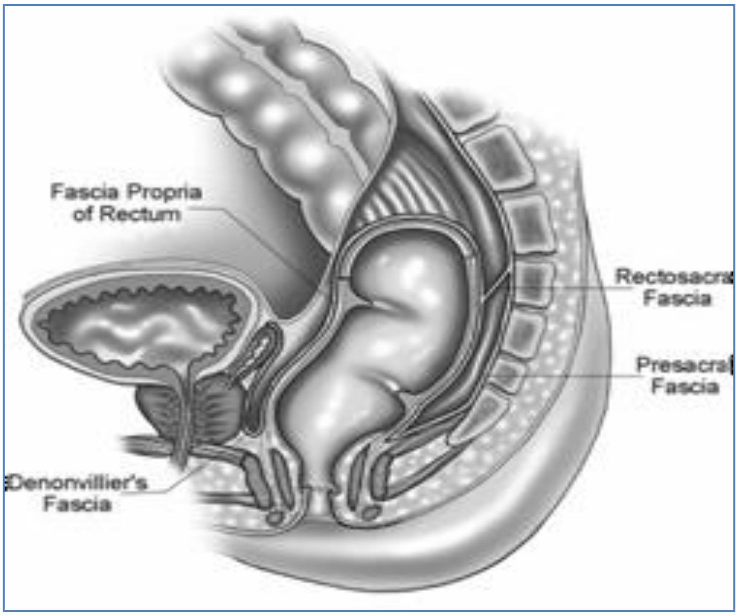

Fig. (5): A diagram showing fascia around rectum.
(Bannister, 1995)

Pre-hypogastric nerve fascia

The pre-hypogastric nerve fascia is variously known as the urogenital fascia, hypogastric nerve sheath, or ureterohypogastric fascia. This fascia is located immediately behind the fascia propria of the rectum, covering the right and left hypogastric nerves and also the pelvic plexus, and connecting with the lateral continuations of Denonvilliers' fascia at the level of the pelvic plexus. The left ureter runs dorsal to the pre-hypogastric fascia, while the right ureter runs ventral to the fascia ***(Yabuki et al., 2005).***

Parietal presacral fascia

The parietal layer of the presacral fascia (synonym, Waldeyer's fascia) is located dorsal to the hypogastric nerves and ventral to the sacral veins and iliac vessels, and divides into several parietal pelvic fasciae extending ventro-laterally, including: the fasciae lining or enclosing the pelvic plexus; the fasciae providing a posterior attachment for the levator ani muscle and lining the medial or superior surface of the muscle sheet; and the fasciae enclosing the pudendal nerve and associated inferior gluteal and internal pudendal vessels. The most medial fascia covers the pelvic splanchnic nerves and fuses with the pre-hypogastric nerve fascia at the pelvic plexus ***(Schiessel et al., 1994).***

Rectosacral fascia

The rectosacral fascia is not a true fascial structure, but it represents part of any thickened pelvic fascia or adhesion of connections between the layers of fasciae existing posterior to the rectum, including the fascia propria of the rectum, the pre-hypogastric nerve fascia, or the parietal pelvic fascia. Clinically, however, a band is apparent between the posterior wall of the rectum and the sacrum at 3–5 cm above the anorectal junction, or higher, as described by Havenga et al., This fascia should not be confused with Waldeyer's fascia, which only refers to the most distal portion of the presacral fasciae joining the anorectal junction ***(Diop et al., 2003).***

Muscles and structures around the anal canal

Anal canal

The anal canal begins at the anorectal junction and ends at the anal verge. It is angulated in relation to the rectum because the pull of the sling-like puborectalis produces the anorectal angle. It lies 2–3 cm in front of, and slightly below, the tip of the coccyx. The pigmentation of the skin around the anal verge approximately corresponds to the extent of the external anal sphincter. Identification of the anal verge may sometimes be difficult. The functional anal canal is represented by a zone of high pressure which roughly equates to the anatomical canal ***(Borley, 2008).***

The anal canal consists of an inner epithelial lining, a vascular subepithelium, the internal and external anal sphincters and fibromuscular supporting tissue, as well as dense neuronal networks of both autonomic and somatic origin. It ranges from 2.5 and 5 cm in length in adults, although the anterior wall is slightly shorter than the posterior. It is usually shorter in females ***(Borley, 2008).***

The upper portion of the anal canal is lined by columnar epithelium similar to those of the rectum. It contains secretory and absorptive cells with numerous tubular glands or crypts. Terminal branches of the superior rectal vessels pass downwards towards the anal columns. The submucosal veins drain into the submucosal rectal venous plexus and also through the fibers of the upper internal anal sphincter into an intermuscular venous plexus. Each column contains a terminal radicle of the superior rectal artery and vein. The vessels are largest in the left-lateral, right-posterior and right-anterior quadrants of the wall of the canal where the subepithelial tissues expand into three 'anal cushions'. The cushions help to seal the anal canal, to maintain continence to flatus and fluid, and are also important in the pathogenesis of hemorrhoids. The anal valves and sinuses together form the dentate (or pectinate) line at the lower ends of the columns ***(Borley, 2008).***

Levator ani muscle

The levator ani muscle is a muscular sheet which is attached to the internal surface of the pelvis and it forms a large portion of the pelvic floor. The muscle is subdivided into named portions according to their attachments and the pelvic viscera to which they are related. The separate parts are referred to as the iliococcygeus, pubococcygeus and puborectalis. These parts are often referred to as separate muscles, but the boundaries between each part cannot be easily distinguished, and they perform many similar physiological functions ***(Borley, 2008).***

The levator ani arises from each side of the walls of the pelvis along the condensation of the obturator fascia (the tendinous arch of the levator ani). Closer to the anorectal junction and elsewhere in the pelvic floor, the fibers are more nearly continuous with those of the opposite side, and the muscle forms a sling (puborectalis) ***(Borley, 2008).***

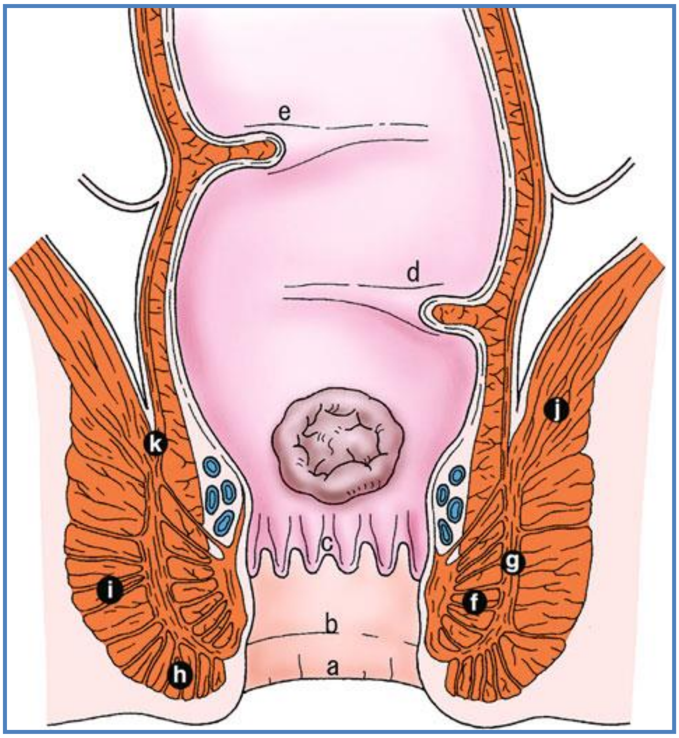

Fig. (6): Anatomy of anal canal; (a) anal verge (AV); (b) intersphincteric groove; (c) dentate line (DL); (d) lowerHouston valve; (e) middle Houston valve; (f) internal sphincter muscle; (g) conjoined longitudinal muscle; (h) subcutaneous external sphincter muscle; (i) deep external sphincter muscle; (j) puborectalis muscle; (k) anorectal ring; from a to k: length of the surgical anal canal ***(Borley, 2008).***

Rectourethralis muscle

In males, the rectourethralis muscle, which is a mass of smooth muscle, occupies a space encircled by the urethra, rhabdosphincter (external urethral sphincter), external rectal muscularis propria and bilateral levator ani slings. The external anal sphincter is likely to be tightly connected to the rectourethralis muscle, and the rectal muscularis propria communicates with the rectourethralis muscle. The rectourethralis muscle provides posterior attachment for the rhabdosphincter ***(Uchimoto et al., 2007).***

Denonvilliers' fascia ends at the rectourethralis muscle. The anorectal veins take a tortuous course across the rectourethralis muscle. Moreover, the cavernous nerve has been reported to penetrate the rectourethralis muscle. Therefore, careful treatment of this muscle seems to be necessary to avoid inducing male sexual dysfunction ***(Uchimoto et al., 2007).***

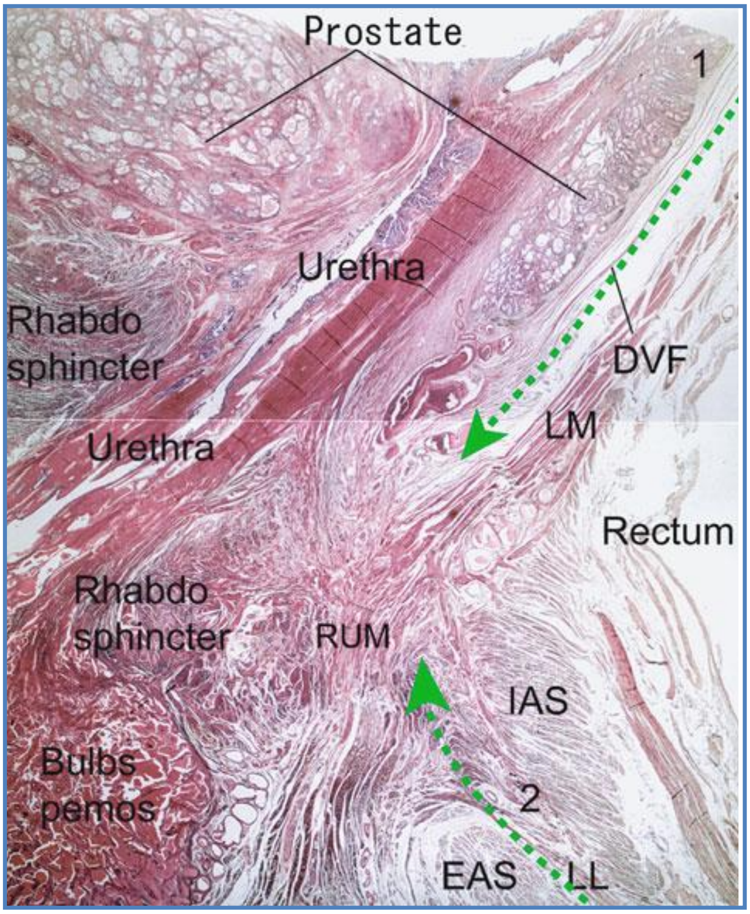

Fig. (7): Histological observation of the rectourethralis muscle (Sagittal section). Surgical planes are shown as dotted lines. (1) Surgical plane by abdominal approach; (2) Intersphincteric resection (by peranal approach); DVF Denonvilliers' fascia; EAS external anal sphincter; LL Longitudinal layer; IAS internal anal sphincter; RUM rectourethralis muscle ***(Uchimoto et al., 2007).***