Original Paper

The Rectal Wings-Highlighting by Dissection, Contents and Clarifications Regarding the Terminology

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ABSTRACT: Background: The rectum is stabilized within the pelvis by connective condensations traditionally termed rectal wings or ligaments, classically divided into lateral and posterior components. Their anatomical definition, composition, and relationship with the mesorectum and pelvic fasciae remain controversial, despite their surgical significance during total mesorectal excision (TME). This study aims to clarify the structure, contents, and topographical relationships of the rectal wings through cadaveric dissection. Methodology: A descriptive anatomical dissection was conducted on four formalin-fixed adult cadavers at the Anatomy Laboratory of "Carol Davila" University of Medicine and Pharmacy, Bucharest. The rectum and mesorectum were mobilized according to the TME standard. Dissections were performed under direct vision, preserving the pelvic autonomic nerves. Macroscopic findings were photographed and analyzed to determine the composition and limits of the lateral and posterior rectal wings. Results: The lateral rectal wings were identified as subperitoneal condensations of pelvic connective tissue connecting the mesorectal fascia with the presacral fascia. They enclosed branches of the inferior hypogastric plexus and, occasionally, the middle rectal vessels (absent in all four cases). The posterior rectal wings appeared as sagittal condensations surrounding branches of the middle sacral vessels. Both types of wings merged with the mesorectal fascia at sites where neurovascular elements traversed toward the rectal wall, representing extensions of the sacro-recto-genito-pubic laminae. Conclusions: Both lateral and posterior rectal wings represent regional specializations of the pelvic subperitoneal connective tissue. Their recognition harmonizes anatomical terminology with surgical reality, refining the understanding of pelvic fascial planes critical for nerve-sparing TME.

KEYWORDS: *Rectal wings, lateral rectal ligament, posterior rectal ligament, mesorectal fascia, inferior hypogastric plexus, total mesorectal excision.*

Introduction

The rectum is anchored within the pelvis by distinct connective tissue condensations, referred to as rectal wings, which are classically divided into lateral (posterolateral) and posterior wings [1,2,3].

The lateral rectal wings - also termed the 'lateral rectal ligaments' - extend from the rectal wall toward the pelvic sidewall.

They represent condensations of the endopelvic fascia which may enclose the middle rectal vessels (when present) together with branches of the inferior hypogastric plexus directed to the rectum [4].

By contrast, the posterior rectal wings are firm midline condensations that anchor the dorsal aspect of the rectum to the sacrum, typically at the S_3-S_4 level [5,6,7,8].

These attachments have long been considered important for rectal support; however, their precise composition - and even their very existence - has remained a matter of debate.

Objective

Over time, anatomists have variably described the lateral rectal wings either as substantial supportive condensations or as peritoneal folds, reflecting the evolving understanding of their true nature.

Recognition of these rectal wings is not merely academic but has direct implications for surgical practice.

During total mesorectal excision (TME) for rectal cancer, surgeons routinely transect the lateral rectal wings to mobilize the rectum, while carefully controlling any middle rectal vessels and preserving adjacent autonomic

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nerves that are essential for bladder and sexual function [9,10].

Even in radical pelvic exenteration, detailed knowledge of the lateral and posterior rectal attachments assists in achieving clear resection margins while minimizing injury to surrounding organs and nerves [11,12].

Thus, a thorough understanding of the rectal wings - grounded in both anatomical detail and historical context - supports safer surgical technique and advances our knowledge of pelvic support structures.

Methods

The present work is a descriptive anatomical cadaveric dissection study, conducted in the Anatomy laboratories of „Carol Davila" University of Medicine and Pharmacy, Bucharest, on adult human cadavers.

Dissections were performed on four adult cadavers (two male, two female), using standard dissection instruments - scalpel, scissors, and forceps.

All cadavers had been fixed in a 10% formaldehyde solution.

Photographs were obtained using a Samsung Galaxy Z Fold 5 smartphone camera.

All procedures were carried out in the Anatomy Laboratory of the University.

Results

Several fundamental issues arise regarding the lateral rectal wings, the most important being the need for a precise definition.

The lateral rectal wings (ligaments) are generally described as condensations of connective tissue situated around the middle rectal vessels and the middle rectal nerves (branches of the inferior hypogastric plexus).

This definition is, however, imperfect, since the middle rectal arteries are present in only about 20% of cases.

Therefore, the definition requires modifications.

In our dissection, we identified the lateral rectal ligaments at the junction between the pelvic peritoneum and the subperitoneal space.

The adult pelves were first transected at the L_2-L_3 level and below the upper third of the thighs.

Subsequently, we mobilized the rectum together with the surrounding mesorectal tissue and mesorectal fascia, performing the dissection according to the surgical standard of total mesorectal excision.

During dissection, particular care was taken to preserve the pelvic nervous elements, namely the inferior hypogastric plexus and its afferent branches.

A posterior dissection of the rectal-mesorectal complex was performed by entering the 'holy plane', thereby mobilizing these structures anteriorly.

Our dissections demonstrated that the lateral rectal wings connect the lateral rectal wall to the posterolateral pelvic wall.

Accordingly, these ligaments appear to connect the presacral fascia with the mesorectal fascia.

In terms of content, the posterior portion of the lateral wings contains afferent fibers of the inferior hypogastric plexus, represented by the pelvic splanchnic nerves arising from the S_2-S_4 spinal segments, as shown in our dissection (Figure 1).

Dissecting into the 'holy plane' involves entering the loose connective tissue located between the posterior mesorectal fascia and the presacral fascia, thereby preserving the middle sacral vessels.

The lateral rectal wings seem to represent extensions of the mesorectal connective tissue.

The right hypogastric nerve was observed descending into the pelvis in a laterorectal position.

Its fibers, together with the pelvic splanchnic nerves, contribute to the formation of the inferior hypogastric plexus.

Medially, the contents of the lateral rectal wings include the middle rectal nerves, which are efferent branches of the inferior hypogastric plexus (Figure 2).

A dissection of the left laterorectal space was performed to demonstrate the left inferior hypogastric plexus and its branches: an anterior bundle (vesicourethral branches), an intermediate bundle (to the uterus, vagina and clitoris in females or to the prostate, seminal vesicles, deferent ducts and penis in males), and a posterior bundle (middle rectal nerves).

At this stage, a distinction must be made between the sacro-recto-genito-pubic laminae and the lateral rectal ligaments.

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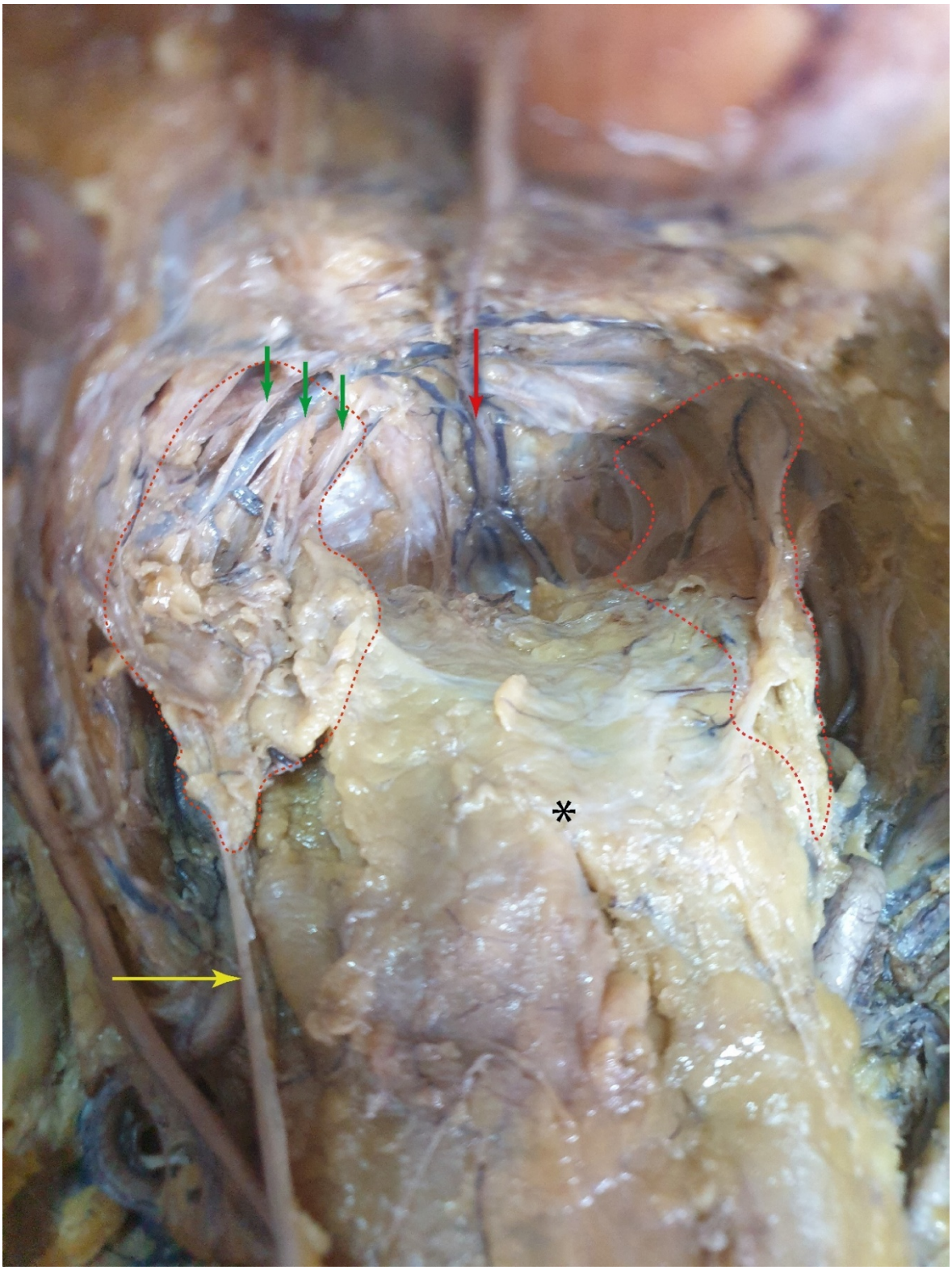

Figure 1. Anterior and superior view of a male pelvis, after mobilizing the rectal-mesorectal complex anteriorly. Red dotted lines - lateral rectal wings; yellow arrow - right hypogastric nerve; green arrows - right pelvic splanchnic nerves originating at S_2-S_4; asterisk - posterior aspect of the rectum, covered by the mesorectal fascia; red arrow - middle sacral artery and veins.

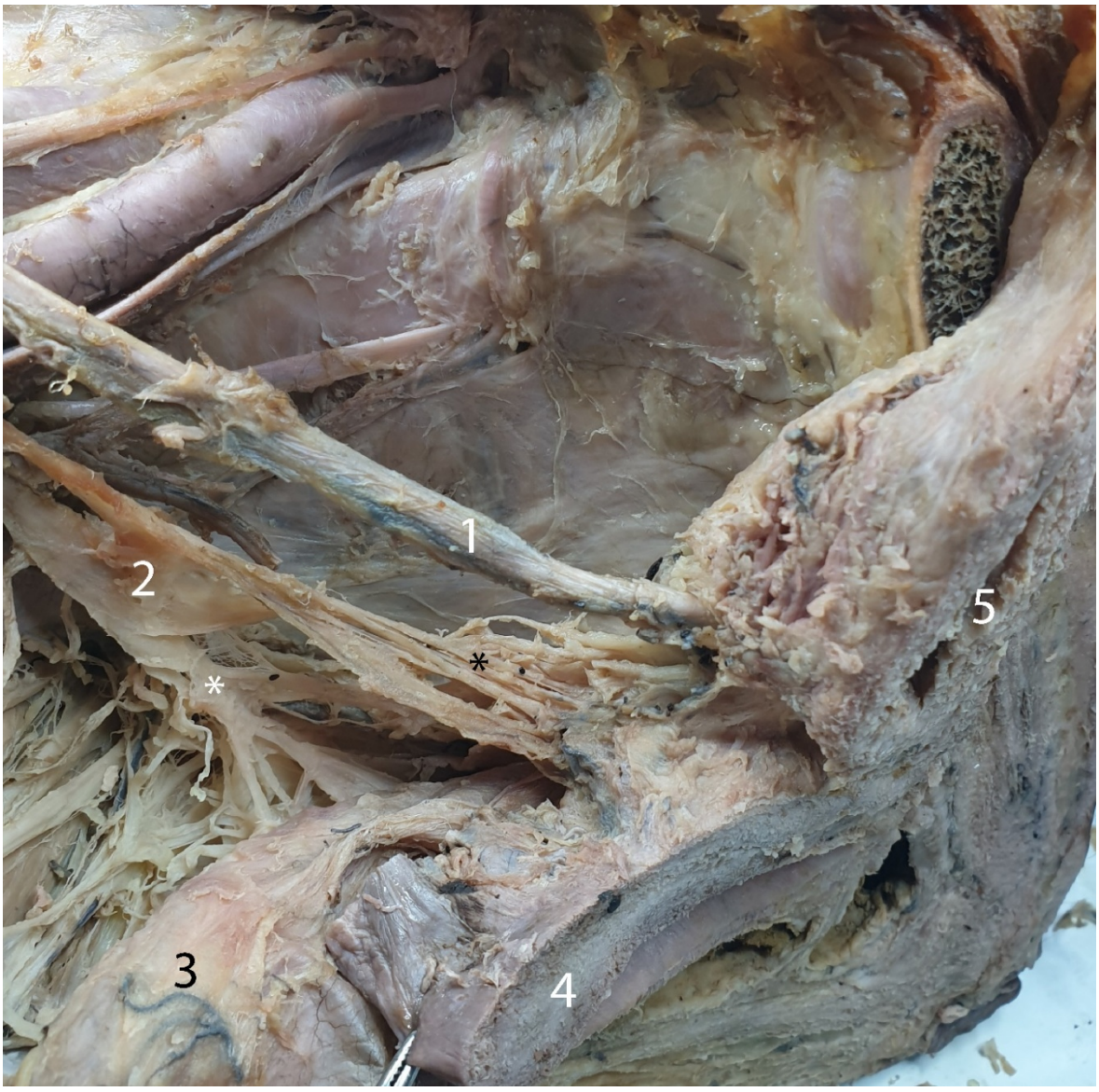

Figure 2. Superomedial view of the left hemipelvis, highlighting the middle rectal nerves. 1 - left ureter; 2 - left inferior hypogastric plexus; 3 - rectum; 4 - uterus; 5 - urinary bladder; white asterisk - rectal nerves; black asterisk - uterovaginal and vesicourethral branches from the inferior hypogastric plexus.

By definition, the laminae subperitoneal condensations of pelvic-subperitoneal connective tissue, arranged sagittally between the presacral fascia and the pubis, surrounding the median pelvic organs and traversed by nervous elements and blood vessels.

The lateral rectal ligaments are likewise located subperitoneal, at the peritoneal-subperitoneal interface, and also contain vascular and neural elements.

Rectal nerve branches from the inferior hypogastric plexus penetrate the mesorectal fascia, traverse the mesorectum, and then reach the rectal wall. In essence, both the lateral rectal wings and the sacro-recto-genito-pubic laminae represent regional expressions of the same pelvic-subperitoneal connective tissue complex.

Therefore, the lateral ligaments of the rectum may be regarded as the pararectal component of the sacro-recto-genito-pubic laminae.

This interpretation reconciles the two concepts.

10.12865/CHSJ.52.01.11

Figure 3. Superior view of the male pelvis, highlighting the posterior rectal ligaments. 1 - external iliac arteries; 2 - external iliac veins; 3 - urinary bladder; 4 - deferent ducts; 5 - seminal vesicles; 6 - rectum; 7 - sacrum; blue dotted lines - posterior rectal wings; blue arrow - presacral fascia; red arrow - middle sacral vessels.

The posterior rectal wings (ligaments) correspond to the posterior extension of the sacro-recto-genito-pubic laminae and are seldom mentioned in the literature.

In our dissection (Figure 3), the posterior rectal ligaments were observed to be structured around the branches of the middle sacral vessels, which - similar to the lateral ligaments - perforate the posterior mesorectal fascia and organize it into two sagittal recto-sacral extensions.

The posterior rectal ligaments likewise represent pelvic-subperitoneal connective structures.

Discussion

It is essential that anatomical descriptions remain clear, objective, and concise.

Numerous connective structures are located in the peri- and pararectal regions, and the complex terminology surrounding them often generates confusion [13].

A comprehensive and unified definition is therefore required to achieve clarity regarding these structures.

A first example is the Denonvilliers fascia (in males) and the rectovaginal fascia (in females), which separate the rectum from the prostate and the vagina, respectively [14,15].

The sacro-recto-genito-pubic laminae are condensations of pelvic-subperitoneal connective tissue, oriented mainly in the sagittal plane and organized around the subperitoneal neurovascular elements.

They are generally regarded as playing only a minor role in maintaining rectal position [16].

The lateral rectal wings are pelvic-subperitoneal connective tissue condensations located around the middle rectal artery and branches of the inferior hypogastric plexus, connecting the subperitoneal portion of the rectum to the posterolateral pelvic wall.

Their variability is due primarily to the inconsistent presence of the middle rectal

artery, which is reported in the literature in approximately 20% of cases [17,18,19].

The posterior rectal wings represent more of a historical concept, referring to condensations of connective tissue organized around branches of the middle sacral artery and extending subperitoneally between the mesorectal fascia and the presacral fascia.

They can in fact be regarded as the posterior, rectosacral continuation of the sacro-recto-genito-pubic laminae [5].

As we demonstrated in our study, at the level of both types of rectal wings, the vasculoneural structures extend into the mesorectal fascia, traverse the mesorectum, and ultimately penetrate the rectal wall [4,20].

Another regional connective structure described more recently is the rectosacral fascia, considered a continuation between the presacral fascia and the mesorectal fascia.

This definition places the rectosacral fascia in an almost frontal orientation [7].

It also has an imaging correlate, which has been emphasized in recent studies of pelvic MRI anatomy.

This fascia may sometimes be mistaken for the posterior rectal ligaments; however, while both the posterior wings and the rectosacral fascia occupy the presacral region, their orientations differ: the posterior rectal wings are sagittal condensations, whereas the rectosacral fascia is oriented more frontally [8].

The anatomical description of the lateral rectal wings has evolved considerably alongside advances in both anatomical knowledge and surgical technique.

Classical anatomical treatises defined them as condensations of the endopelvic parietal fascia that connect the lateral rectal wall to the pelvic sidewall [10,21].

Subsequently, their definition was broadened to include the passage of the middle rectal artery and branches of the inferior hypogastric plexus, thereby conferring a clear neurovascular significance to these structures [1].

However, the gold standard for oncological safety in rectal resections -total mesorectal excision, first proposed by Heald - contains no reference to these structures when describing the resection plane, known as the ‘holy plane’ [9].

Given these aspects, the modern surgical concept of total mesorectal excision must integrate both the preservation of the mesorectal fascia integrity and the safe, effective identification and division of the lateral rectal wings, while at the same time protecting the critical regional nervous structures-the bilateral inferior hypogastric plexuses [22].

Our dissection demonstrated that during total mesorectal excision, the lateral rectal wings are encountered as condensations of the pelvic subperitoneal connective tissue along the rectal branches of the inferior hypogastric plexus and, when present, the middle rectal artery [23].

Notably, we did not identify a middle rectal artery in any of our cases.

From a superior view of the intact pelvis, only the pararectal recesses are visible lateral to the rectum; thus, one could argue that no lateral wings exist in the peritoneal segment of the rectum.

This observation is fundamentally different from earlier attempts to define lateral rectal ligaments as peritoneal folds situated lateral to the rectum that can be tractioned with a finger [1].

This interpretation is anatomically logical: the subperitoneal segment of the rectum is approached by the middle rectal artery (in roughly 20% of cases) and the middle rectal branches of the inferior hypogastric plexus, both with subperitoneal localisation.

By contrast, the posterior rectal ligaments represent an even more loosely defined element, described as connective tissue bands extending from the presacral fascia to the rectum, tethering it to the sacrum and coccyx, and potentially incorporating the presacral vessels and other autonomic neural branches.

Our findings demonstrate that the posterior rectal ligaments are condensations of pelvic subperitoneal connective tissue associated with the above-mentioned elements, corresponding directly to the posterior component of the sacro-recto-genito-pubic laminae [24,25].

Given that the ‘holy plane’ is predominantly avascular and composed of loose connective tissue, the existence of posterior rectal wings carries surgical importance, particularly due to the risk of encountering and injuring the presacral vessels during surgical dissection [10].

The main difficulty in defining the rectal ligaments lies in their overlap with the concept of the mesorectum and with the principles of total mesorectal excision.

Any definition of the rectal ligaments must not contradict the established concept of total mesorectal excision, nor create confusion, since

 10.12865/CHSJ.52.01.11

this procedure has become the gold standard in the surgical treatment of rectal cancer.

Essentially, in the case of the lateral rectal wings, the middle rectal artery and the rectal nerve branches of the inferior hypogastric plexus are located between the pelvic parietal fascia and the mesorectal fascia.

These elements perforate the mesorectal fascia, traverse the mesorectal connective tissue, and ultimately penetrate the rectal wall.

The posterior rectal wings are found as condensations of connective tissue organized around branches of the middle sacral vessels.

The mesorectum and mesorectal fascia may occasionally form small extensions along these vascular branches, which must be divided during total mesorectal excision.

Rectal resection with total mesorectal excision is the gold standard in the surgical treatment of rectal cancer.

In practice, the terminology most relevant to surgeons performing this procedure relates primarily to the mesorectal fascia.

However, the literature also describes several connective structures whose terminology sometimes overlaps with that of the mesorectal fascia, the most important anatomo-surgical landmark.

The real challenge arises from the use of the terms 'rectal ligaments' (or wings), 'mesorectum', and 'mesorectal fascia', which, if not precisely defined, may generate confusion [3,5,6,7,9].

First of all, we should highlight the appropriate meaning of the terms of 'mesorectal fascia' and 'mesorectum'.

The mesorectal fascia is a connective membrane which covers the circumference of the rectum and is situated superficial to the perirectal adipose tissue, the perirectal lymph nodes and ducts and the superior rectal vessels.

This fascia is more consistent in its posterior part and represents a crucial element for the cleavage plane found between itself and the presacral fascia [5,7].

The surgical protocol in the rectal resection with total mesorectal excision includes the dissection in this cleavage plane as a mandatory step [9,10,11].

The mesorectum represents the content of the perirectal space, which is delineated by the mesorectal fascia and the proper rectal wall.

It includes all the vascular, neural, lymphatic and adipose elements inside this compartment [3].

Conclusions

In this study we have described the two types of rectal wings - lateral and posterior.

The lateral rectal wings represent condensations of the pelvic subperitoneal connective tissue formed along the trajectory of the middle rectal vessels (if present) and the middle rectal nerves (rectal branches from the inferior hypogastric plexus), as well as around the pelvic splanchnic nerves, which emerge from the anterior sacral foramina and enter the inferior hypogastric plexus.

The posterior rectal wings are also condensations of the pelvic subperitoneal tissue around branches of the middle sacral vessels.

Thus, both the lateral and the posterior rectal wings represent distinctive components of the sacro-recto-genito-pubic laminae, which include the connective tissue condensations found around all the subperitoneal neurovascular structures and oriented mainly in the sagittal plane.

We identified the location of both types of rectal wings and demonstrated that they merge with the mesorectal fascia at the sites where their neurovascular elements perforate the mesorectal fascia, for then to traverse the mesorectum and reach the proper rectal wall.

In other words, we propose a compromise model, in which all pararectal connective structures - the lateral and posterior rectal wings, the sacro-recto-genito-pubic laminae and the rectosacral fascia - can coexist as complementary structures, provided that they are clearly defined and accurately localized.

Together, these structures represent topographical landmarks that the surgeon relies upon during rectal resection with total mesorectal excision.

The surgical protocol in the rectal resection with total mesorectal excision should mention the steps that the surgeon should take to perform the resection of the rectal ligament elements.

Even in the situations where the middle rectal artery does not exist, the resection of the lateral rectal wings involves the risk of injuring the inferior hypogastric plexus, which consequently determines functional disorders.

Our study demonstrates the anatomical risk in the ligation/sealing and resection of the lateral rectal ligaments.

These maneuvers should be preceded by a careful dissection in order to protect the neural elements and control the vascular structures.

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None to declare.

Author Contributions

Conceptualization, I.A.D. and D.E.G.M.; Methodology, C.M.P. and I.S.; Dissection, I.A.D., Z.F.F., and D.E.G.M.; Photography, Z.F.F.; Data analysis, C.M.P. and I.S.; Manuscript writing and initial draft preparation, Z.F.F., and I.S.; Manuscript review and editing, I.A.D, C.M.P. and D.E.G.M.; Supervision, D.E.G.M. and C.M.P. All authors read and approved the final manuscript.

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Conflicts of interest

The authors declare no competing interests.

Institutional Review Board

The study was conducted according to the guidelines of the Declaration of Helsinki; the study and the protocols utilized therein were approved by the Institutional Review Board of Ethics Committee of „Carol Davila" University of Medicine and Pharmacy, Bucharest, Romania (protocol no. 21062/October 1, 2021).

Consent Statement

All specimens were unclaimed cadavers, lawfully provided to the University through official procedures and maintained under institutional custody for research and educational purposes, in accordance with the Romanian legislation.

Their use for anatomical dissection and educational demonstration fully complied with the provisions of Law No. 104/27.03.2003 (republished), which regulates the acquisition, storage, and study of human cadavers for academic purposes.

Under this legal framework, medical education institutions are authorized to receive and use cadaveric material without individual informed consent or external ethical approval, provided that all procedures respect human dignity, professional standards, and public health regulations.

All dissections were performed exclusively within the facilities of the Discipline of Anatomy, solely for the advancement of anatomical and surgical knowledge.

Data availability

All data presented in the manuscript are available from the authors upon request.

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