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Surgical significance of Rectusial Fascia during TEPP Hernioplasty

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Abstract

In addition to specific surgical planes and anatomical landmarks, understanding of adjacent access anatomy provides laparoscopic surgeons a clear procedural approach. Surgical implications of newly discovered 'rectusial fascia' (Ansari MM. Open Acc J Surg 2017 April; 3(4): 555618. DOI: 10.19080/OAJS.2017.03.555618., 2017) are discussed during laparoscopic total extraperitoneal preperitoneal (TEPP) hernioplasty.

TEPP hernioplasty was performed in adult patients with standard 3-midline port technique. Initial tissue planes with respect to posterior epimysium (Rectusial fascia) of rectus abdominis muscle were created carefully with direct telescopic dissection under CO_2 insufflation.

Sixty adult male patients underwent TEPP hernioplasty – Unilateral TEPP 52 and Bilateral TEPP 8. Rectusial fascia was easily recognizable under preperitoneal laparoscopy. It was variably thickened and condensed ranging from thin/flimsy to membranous/diaphanous. Correct plane of dissection was found underneath the rectusial fascia which was kept abutting and hiding the rectus abdominis muscle. Plane anterior to rectusial fascia was fraught with blood oozing due to its shared vascular supply with rectus abdominis muscle as well as undesirable taking down of deep inferior epigastric vessels hampering further dissection. Rectusial fascia divided the so-called retromuscular posterior rectus canal into two posterior rectus spaces extending differently into the pelvic and inguinal regions.

Rectusial fascia is an easily recognizable substantial structure and a well known surgical landmark to all practicing TEPP surgeons and trainers. Correct plane of dissection with respect to rectusial fascia as well as its judicious extension into the pelvic and inguinal regions is crucial for performance of seamless TEPP hernioplasty with ease, safety and rapidity.

Keywords: Rectusial fascia, rectus abdominis, epimysium, TEPP access anatomy, TEPP hernioplasty, posterior rectus canal

Introduction

Nothing goes as far forward preventing complications as the surgeon's awareness and fear of them.[1] The main concerns in advanced laparoscopic surgery include not only creation of specific surgical planes and timely recognition of anatomical landmarks in the target area but also the accurate knowledge of adjacent access anatomy. Such systematic understanding of laparoscopic anatomy provides the interested laparoscopic surgeons a clear

procedural approach, and also benefits the surgeons in training.[2] This also holds true for the newly discovered 'Rectusial Fascia' which was recently reported by the author.[3] Surgical implications of the rectusial fascia are not yet reported in the literature and are briefly discussed here in relation to the laparoscopic total extraperitoneal preperitoneal (TEPP) repair of the inguinal hernia.

Materials and methods

A prospective study was conducted in the Department of Surgery, J. N. Medical College, Aligarh w.e.f. April 2010 to November 2015. Laparoscopic Total Extra-Peritoneal Preperitoneal (TEPP) hernioplasty was performed under the Institutional Ethics Committee clearance and written informed consent. Inclusion criteria were adult patients with age ≥18 years, patients with primary inguinal hernia and patients with physiological score of ASA grade I – II only (American Society of Anesthesiologists). Exclusion criteria were patients <18 years, patients with high physiological score of ASA grade III- V, patients with history of lower abdominal surgery, patients with recurrent/ complicated inguinal hernia, patients with femoral hernia, and patient's refusal for laparoscopic repair. The 3-midline port technique was used for the laparoscopic TEPP hernioplasty as reported earlier by the author.[3,4]

Blind balloon dissection, which was used initially in the first three cases, was found entirely unnecessary, rather harmful for the thorough accurate study of the fascial structures which got torn in a haphazard fashion and made the study of the live surgical anatomy extremely difficult. It was found difficult rather impossible to recognize the individual structures and their continuity in presence of so many torn fascial layers in the inguino-pelvic region. Moreover, a blind step cannot also be recommended in terms of best laparoscopic surgical practice as each and every step must be done under direct vision in order to safeguard against the preventable complications. Hence use of the blind balloon dissection was abandoned and the technique of controlled telescopic dissection under CO_2 insufflation at a low pressure of 12 mmHg was used during remaining major part of the study. After placer of first 11-mm blunt trocar through a small infra-umbilical incision, unhurried telescopic dissection was carried out in the avascular plane of posterior rectus canal in order to make good visualization and careful observation of the undersurface of the rectus abdominis muscle that used to form the anterior boundary of the posterior rectus canal. This was followed by placement of two 5-mm working ports in the midline lower down for the definitive dissection in the pelvic and inguinal regions.

Results and discussion

Sixty eight TEPP hernioplasty (52 Unilateral and 8 Bilateral) were carried out successfully in 60 out of 63 adult male patients with uncomplicated primary inguinal hernia. Three patients required early conversion to Open/TAPP (Transabdominal preperitoneal) repair due to injury to the deep inferior epigastric vessels (1), excessive CO_2 retention with anaesthetic problem (1) and peritoneal injury on insertion of the first blunt 11-mm trocar (1). We could not get any opportunity to visualise and observe the posterior rectus canal and its boundaries properly, and hence these cases were excluded from the data analysis. Trainer's advice was always kept in the mind that the surgical plane needs to be created anterior to the posterior rectus sheath but at the same time, the bare muscle fibres of the rectus abdominis should not be seen in the surgical field.

The plane of surgical dissection was considered wrong if the muscle fibres of the

rectus abdominis were seen bare in the operative field.

Upon entry into the posterior rectus canal and viewing with 0º 10-mm telescope (laparoscope) passed through the infraumbilical port, the posterior rectus canal was found always bounded anteriorly by a fascial structure covering the undersurface of the rectus abdominis muscle (and hence its fibres were not seen bare and the plane was considered to be correct) and posteriorly by the posterior rectus sheath in the upper part and the transversalis fascia in the lower part if the posterior rectus sheath was incomplete (Fig. 1) as was seen in 79% of our cases[5] similar to its incidence of 80% reported in 2010 by Mwachaka et al[6]. In presence of the complete posterior rectus sheath as was seen in 21% of our cases[5] similar to its incidence of 20% reported in 2010 by Mwachaka et al[6], the posterior rectus canal was bounded posteriorly by the complete posterior rectus sheath extending upto the pubic symphysis (Fig. 2 and 3). This fascial structure (posterior epimysium) on the undersurface of the rectus abdominis muscle was named as the *'Rectusial Fascia'* by the author for future reference and discussion.[3]

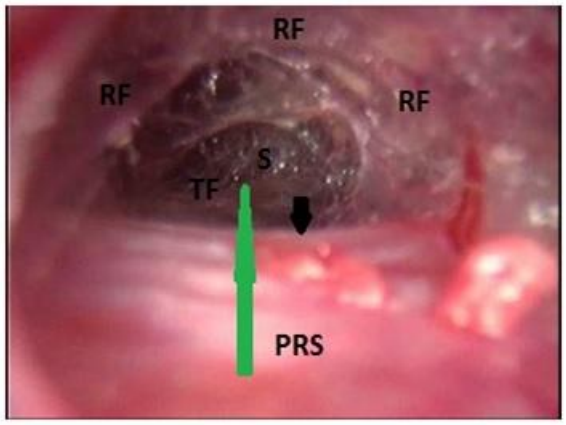

Figure 1: Totally Avascular Telescopic Dissection underneath the rectusial fascia (RF) in a patient with incomplete posterior rectus sheath: RF, thin rectusial fascia covering the undersurface of rectus abdominis muscle (not visible) and extending as the retropubic fascia in the pelvis; **S,** sign of lighthouse faintly visible due to presence of the retropubic fascia; **TF,** transversalis fascia; **PRS,** incomplete posterior rectus sheath; **Black arrow,** indicates arcuate line; **Green arrow,** indicates the plane of dissection between rectusial fascia (RF) and posterior rectus sheath (PRS) proximally and between rectusial fascia (RF) and transversalis fascia (TF) distally;

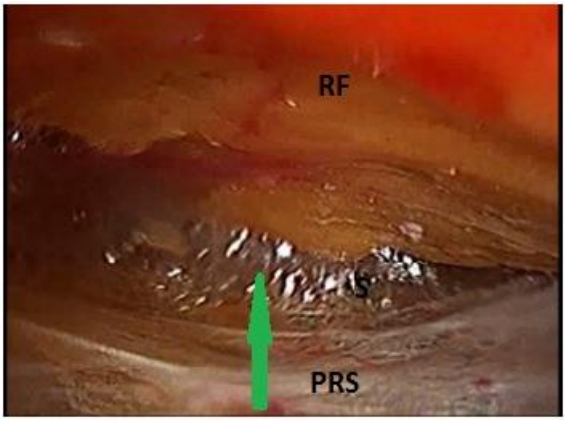

Figure 2: Totally Avascular Telescopic Dissection underneath the rectusial fascia (RF) in a patient with complete posterior rectus sheath: RF, well-defined diaphanous **r**ectusial fascia covering the undersurface of rectus abdominis muscle (not visible) and extending as the retropubic fascia in the pelvis; **S,** sign of lighthouse visible sparingly as patches due to presence of the retropubic fascia; **PRS,** grossly attenuated complete posterior rectus sheath without formation of an arcuate line covering the transversalis fascia (not visible) and extending upto the pubic bone; **Green arrow,** indicates the plane of dissection between rectusial fascia (RF) and complete posterior rectus sheath (PRS) upto the pubic bone;

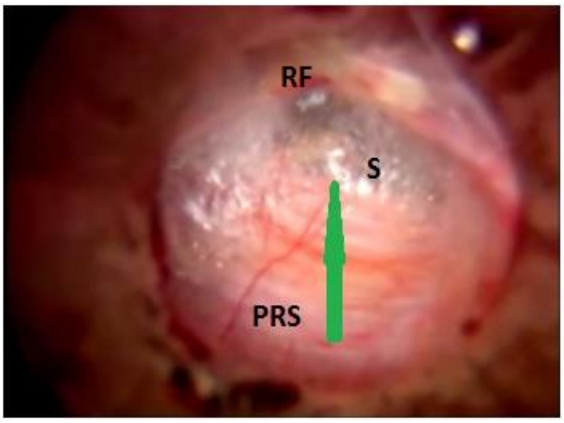

Figure 3: Totally Avascular Telescopic Dissection underneath the rectusial fascia (RF) in a patient with complete posterior rectus sheath: RF, thin **r**ectusial fascia covering the undersurface of rectus abdominis muscle (not visible) and extending as the retropubic fascia in the pelvis; **S,** sign of lighthouse faintly visible in the depth due to presence of the retropubic fascia; **PRS,** tendinous complete posterior rectus sheath without formation of an arcuate line covering the transversalis fascia (not visible) and extending upto the pubic bone; **Green arrow,** indicates the plane of dissection between rectusial fascia (RF) and complete posterior rectus sheath (PRS) upto the pubic bone;

The space between the posterior rectus sheath (PRS) and the rectusial fascia of rectus abdominis muscle could easily be opened up under direct vision with the to-and-fro movement of the 0º 10-mm telescope in order to reach the requisite preperitoneal space, clearly suggesting that the infraumbilical posterior rectus sheath was quite distinct and separate from the abdominis muscle/fascia with little/no attachment indicative of their separate vascular supply (Fig. 1 - 3). This feature of the posterior rectus sheath being neither closely applied nor attached/adherent to the undersurface of the rectus abdominis muscle/fascia confirmed the earlier observations[7-9], and made the rectus sheath approach technically feasible for the TEPP inguinal hernioplasty.

In 65 out of our 68 cases (95.6%) of successful TEPP hernioplasty, during the initial phase of the midline telescopic dissection underneath the rectusial fascia in the posterior rectus canal , the telescope used to enter the so-called cave of Retzius directly without any difficulty or extra effort in majority of our patients, indicating *a direct communication between the posterior rectus space/canal and the retropubic space of Retzius*, but the pubic bones were not seen bare due to the regular presence of a fascia in direct continuity of the rectusial epimysium/fascia (Fig. 1 - 3), which may be termed as *'Retropubic Fascia'*, and which appeared as an extension analog of the Rectusial fascia.[3] In this situation, the retropubic space was found bounded anteriorly by the Retropubic fascia and posteriorly by the transversalis fascia alone or by both the complete PRS (if present, *vide supra*) and the transversalis fascia (Fig. 2 and 3). This retropubic space may be termed as '*Interfascial Retropubic Space'* for further reference and discussion. This 'Interfascial Retropubic Space' could not be extended laterally without conscious deliberate division of the transversalis fascia (in presence of incomplete PRS) or division of both the transversalis fascia and the complete PRS if present. Since '*anatomy is unique to each individual' as endorsed by* Avisse et al (2000)[10], difficulties and complications are bound to occur if the operating surgeon is not cognizant of the actual anatomic disposition present at hand in that particular individual as emphasized by Faure et al (2006)[11], and does not adopt a judicious approach to reach the requisite preperitoneal space in the pelvic region and then its extension into the inguinal region.

In three cases (4.4%), the plane of dissection got initiated anterior to the rectusial fascia consciously (one case in the very beginning

of the study) or inadvertently (two cases later in the study). This prefascial plane of dissection was found not a straightforward avascular plane because of the shared neurovascular supply of the rectus abdominis muscle and its epimysium/ rectusial fascia (Fig. 4 and 5), leading to minor to moderate oozing and clouding the operative field, a severe disadvantage during laparoscopic surgery, especially in a closed space. Blood, howsoever small, used to colour the tissues, making the differentiation of the different tissue planes difficult, and blood also absorbs the light, resulting in poor endovision. *Moreover, this pre-fascial plane was found associated with five additional phenomena of extreme surgical importance.*

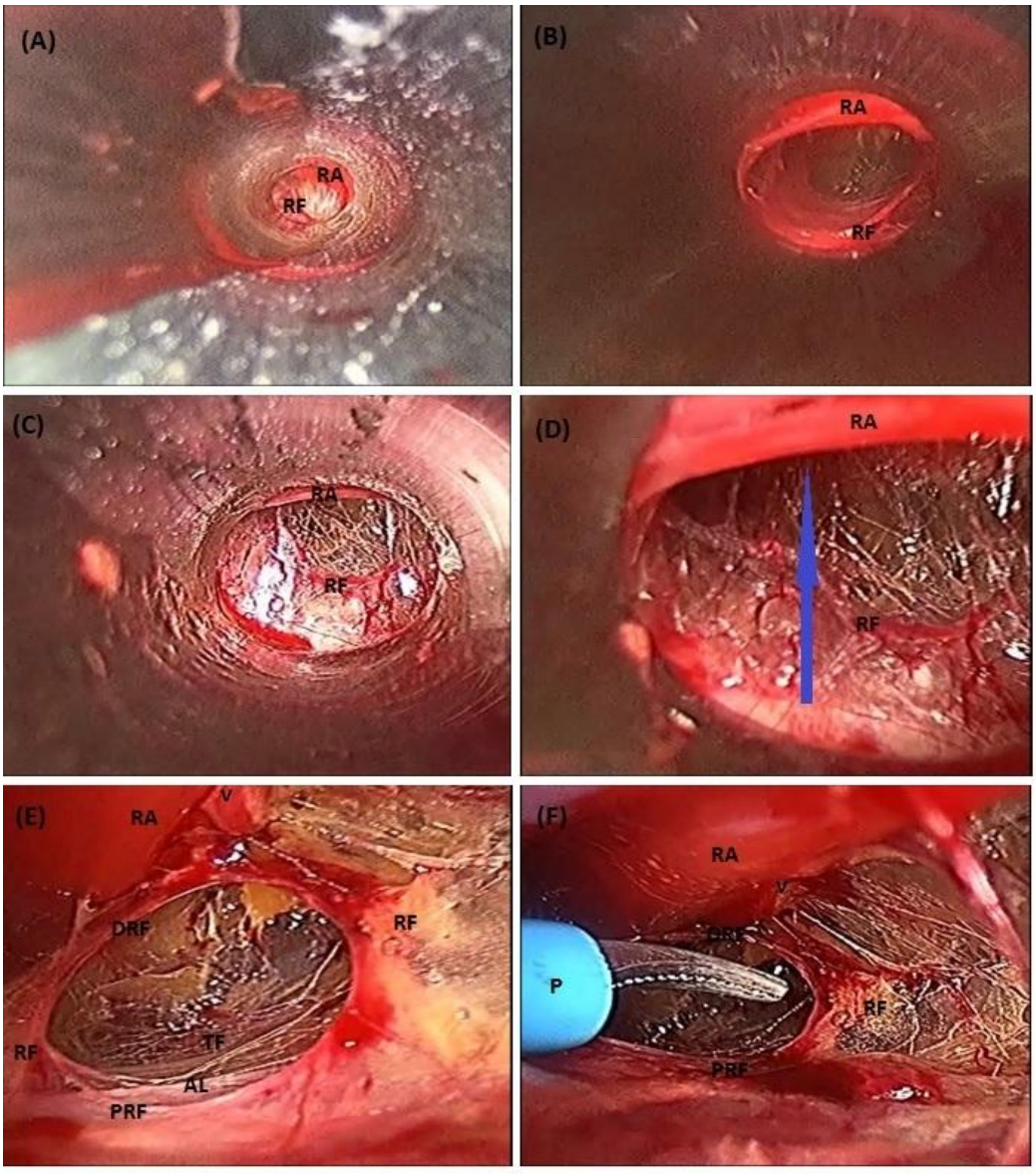

Figure 4: Prefascial Telescopic Dissection anterior to rectusial fascia in posterior rectus canal: (A-D): Initiation of prefascial telescopic dissection in posterior rectus canal with prefascial plane **(blue arrow)** getting opened up between rectus abdominis (**RA**) and rectusial fascia (**RF**); **(E):** Rectusial fascia opened up with transversalis fascia (**TF**) visible through the

rent in rectusial fascia, with proximal rectusial fascia (**PRF**) covering the incomplete posterior rectus sheath and its arcuate line (**AL**), and with distal rectusial fascial (**DRF**) abutting rectus abdominis muscle (**RA**); **(F):** Dissection started underneath rectusial fascia; **P,** plastic working port with Maryland dissector in-situ; **Green arrow,** indicates the plane of dissection between rectusial fascia (**RF**) and transversalis fascia (**TF**) distally; **V,** deep inferior epigastric vessels;

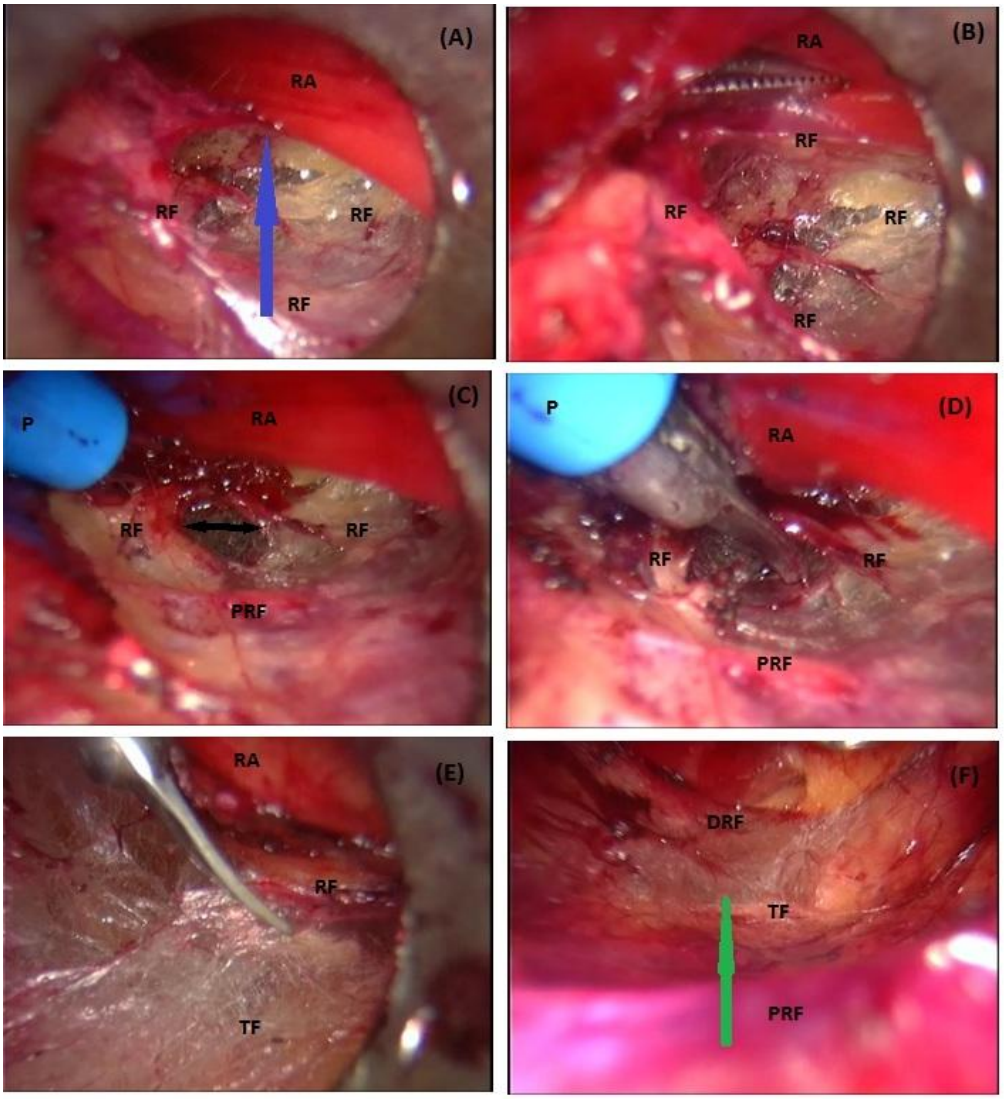

Figure 5: Prefascial Telescopic Dissection anterior to rectusial fascia in posterior rectus canal in another patient: (A-D): Initiation of prefascial telescopic dissection in posterior rectus canal with prefascial plane **(blue arrow)** getting opened up between rectus abdominis (**RA**) and rectusial fascia (**RF**); **(C):** Rectusial fascia (**RF**) opened up with black arrow showing the rent in rectusial fascia, with proximal rectusial fascia (**PRF**) covering the posterior rectus sheath, and with distal rectusial fascial (**DRF**) abutting rectus abdominis muscle (**RA**); **(D-F):** Dissection underneath rectusial fascia; **PRF,** proximal rectusial fascia covering incomplete posterior rectus sheath; **DRF,** distal rectusial fascia abutting rectus abdominis muscle; **Green arrow,** indicates the plane of dissection between rectusial fascia (RF) and between rectusial fascia (**RF**) and transversalis fascia (**TF**) distally;

Firstly, the deep inferior epigastric vessels (DIEV) lying within the rectusial fascia (above the arcuate line in presence of an incomplete posterior rectus sheath (Fig 4E-F), or above the pubic symphysis in presence of a complete posterior rectus sheath as reported earlier[5,12] was taken down on to the floor of the operative field, and attempt to keep it on the roof of the operative field abutting the anterior abdominal wall resulted in the free hanging vessels across the operative field, presenting the classical *'Cord Sign'*, a sign so commonly discussed in the surgical forums & operative workshops but rarely reported in the literature. In all three cases, the DIEV were hooked up by a transcutaneous polypropylene #1 suture in order to facilitate further dissection. However, in one of these three cases (33%), the deep inferior epigastric artery got sheared by the roughened joint of the Maryland dissector during the further dissection, and the simple clipping of the vessel was found sufficient to control the bleeding as is commonly recommended because electrocautery is usually not effective.[13,14] In other words, repeated passage of the working instruments underneath the free-hanging bared deep inferior epigastric vessels endangers them and may necessitate conversion if bleeding is not controlled speedily.

Secondly, the retro-muscular pre-fascial dissection further down was not straightforward due to presence of extensive fibroareolar tissues containing fine nerves and blood vessels, especially branches of inferior epigastric arteries, superficial and deep circumflex arteries in this region supplying both the rectus abdominis muscle and its epimysium/fascia[15], and was found associated with minor to moderate oozing because of the tearing of these tiny blood vessels. This pre-fascial dissection used to lead into a pelvic space bounded anteriorly by the pubic bone and posteriorly by the retropubic fascia, an extension of the rectusial fascia. This may be labelled as the *'Pre-fascial Retropubic Space'* or *'True Retropubic Space'* for future reference and discussion.

Thirdly, lateral extension of the prefascial plane into the inguinal region required sharp/blunt division of the rectusial fascia at the lateral border of the rectus abdominis muscle to which it was attached and this step was again associated with minor to moderate oozing for the same reason of their shared vascular supply from branches of inferior epigastric arteries, superficial and deep circumflex arteries in this region also.[15]

Fourthly, lateral extension of the prefascial plane into the inguinal region was possible after division of the rectusial fascia but it used to open the anatomical plane between the transversus abdominis muscle and its epimysium/fascia called the transversalis fascia, both of which are known to have shared or common neurovascular supply, especially branches of inferior epigastric arteries, superficial and deep circumflex arteries in this region.[15] Thus this plane of dissection in the inguinal region was not straightforward and associated with significant oozing and its unwanted consequences of poor endovision and difficult differentiation of the various tissue planes. Moreover dissection anterior to the transversalis fascia did not allow easy recognition of the hernial sac because of the presence of rather too much intervening fibrofatty tissues, making this plane of dissection improper and undesirable.

Fifthly, when the prefascial plane was entered advertently or inadvertently, the operating surgeon was required to make a rent in the rectusial fascia in order to reach the avascular plane of the true posterior rectus canal which is therefore bounded anteriorly by the rectusial fascia and posteriorly by the posterior rectus sheath only if complete (Fig. 2 and 3) or the incomplete posterior rectus sheath in its upper part and by the transversalis fascia in

the lower part (Fig. 1, 4E-F and 5C-D). Thus from the view point of laparoscopic surgical anatomy, the rectusial fascia in reality divided the posterior rectus canal into two spaces, namely, one, the *retromuscular posterior rectus space*, i.e., a space bounded anteriorly by the rectus abdominis muscle and posteriorly by the rectusial fascia, and second, the *retrofascial posterior rectus space*, i.e., a space bounded anteriorly by the rectusial fascia and posteriorly by the posterior rectus sheath. Only the retrofascial posterior rectus space was found avascular plane, making the TEPP repair technically feasible and easy straightforward.

Thus the rectusial fascia is a newly discovered entity of laparoscopic live surgical anatomy that can be easily recognized during the preperitoneal laparoscopy for TEPP hernioplasty, and it has assumed great surgical importance with respect to the judicious creation of a proper avascular plane of dissection during the very initial steps of TEPP approach for laparoscopic hernioplasty for groin hernias. Mentoring is valuable in addition to the sound laparoscopic skills for familiarization of the preperitoneal anatomy and its variations for seamless laparoscopic hernioplasty as has been strongly recommended in 2016 by Sherwinter and associates.[13]

Conclusion

In reality, the posterior rectus canal was bounded anteriorly by the rectusial fascia covering the under surface of the rectus abdominis muscle, and posteriorly by the posterior rectus sheath. The plane of dissection anterior to the rectusial fascia was fraught with difficult dissection and complications, while the plane of dissection posterior to the rectusial fascia was found avascular and straightforward. Thus the rectusial fascia needs to recognized and respected early during the TEPP approach with respect to the judicious creation of a proper avascular surgical plane.

Conflict of interest: None

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