

# Anterior abdominal wall hernia repair with e-TEP technique: A single-center experience with short term results

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## ABSTRACT

**Introduction:** Ventral hernia repair is one of the most common surgical procedures performed by surgeons. Extended-view totally extraperitoneal (e-TEP) hernia repair is an emerging surgical technique that can be applied in the surgical treatment of ventral hernias. We present our experience of an e-TEP technique with the corresponding short-term results.

**Materials and Methods:** Between June 2019 and February 2020, 18 patients with ventral hernia were operated on by the same surgeon using the e-TEP technique and were reviewed retrospectively. Patients diagnosed with diastasis recti defect  $\geq 2$  cm with concomitant umbilical hernia were included in the study.

**Results:** A total of 18 cases underwent eTEP until February 2020. Out of 18 patients, 10 (55.5%) were male while eight (44.5%) were female. The mean age was 46.4 years (29–68), mean body mass index (BMI) was 25.7 kg/m<sup>2</sup> (18.7–30.8 kg/m<sup>2</sup>), average hospitalization time was 1.78 days (1–3 days), average ASA score was 1.7 (1–2), mean operation time was 145 minute (100–298 min.), and mean mesh area used was 266 cm<sup>2</sup>. Cyanoacrylate glue (Liquiband@Fix8™) was used to fix the mesh to the peritoneum in 14 patients, while no fixation method was used in 4 patients. None of the cases underwent open surgery. No recurrence was detected during the follow-up, with a maximum of 12 months and a minimum of 4 months (mean 8.3 months).

**Conclusion:** e-TEP is a safe and feasible emerging surgical technique for primary or incisional ventral hernia repairs. This new approach that has all the advantages of laparoscopic surgery allows flexible port insertion and the closure of defects by allowing large size mesh placement in the retromuscular area. Placing the meshes in the extraperitoneal area may also prevent the development of mesh-related complications from its contact with intraperitoneal organs.

**Keywords:** e-TEP; umbilical hernia; laparoscopy; ventral hernia.

## Introduction

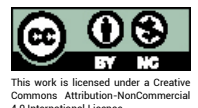
Despite the rapid development of minimally invasive surgery and hernia repair, general surgeons have not yet developed an ideal, standard method that sufficiently re-

duces common postoperative complications such as healing of the wound, recurrence of the hernia, and pain.<sup>[1]</sup>

Both open and laparoscopic intraperitoneal onlay mesh (IPOM) repair techniques are now being replaced by retro



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muscular repair techniques and when hernia defect cannot be closed in the midline transversus abdominis release (TAR) techniques, due to ongoing problems related to the mesh, nowadays.

Until 1993, all ventral hernias were repaired with open surgical methods. Although the exact incidence is unknown, it is estimated that 30-50% of these patients develop incisional hernias.<sup>[1-4]</sup> With the coming into use of meshes, recurrence in ventral hernia repair has decreased to 1-14%.<sup>[1,5,6]</sup>

In 1993, laparoscopic intraperitoneal onlay mesh (IPOM) repair was first described by LeBlanc and Booth.<sup>[7]</sup> Faster recovery and less surgical wound complications are observed in this technique. However, IPOM; can cause adhesive bowel obstruction, serious complications such as mesh erosion, and enterocutaneous fistula arising from direct contact of the mesh with the intestines.<sup>[8,9]</sup> Transfascial sutures provide better detection as they pass through the strong anterior fascia. However, since they compress the nerves and muscles in the abdominal wall, they can cause severe pain after surgery.<sup>[1,10]</sup>

A new technique called the extended view- totally extraperitoneal (e-TEP) or endoscopic Rives-Stoppa (e-RS) for laparoscopic inguinal hernia repair was described by Daes in 2012.<sup>[11]</sup> It has been recommended in complex cases such as large scrotal hernias, sliding hernias, and incarcerated hernias, as well as in obese, patients after obesity surgery, those who have undergone pelvic surgery, and in patients with a short pubis-umbilicus distance.<sup>[11]</sup>

Belyansky et al.<sup>[12]</sup> reported that this technique can also be used for ventral hernia repair in 2017. This technique includes many advantages that allow the anatomical and functional reconstruction of the abdominal wall with the extraperitoneal use of the mesh without fixing.<sup>[12,13]</sup> Placement of the mesh in the retro muscular area can also prevent the development of complications such as adhesion, mesh erosion, and fistula, which may occur when the mesh is in contact with the intraperitoneal organs. Also, due to the use of relatively low-cost meshes, the total cost of surgery can be lowered and fewer recurrence rates can be obtained as it is reported in large case series.<sup>[14-16]</sup>

The retro muscular e-TEP/e-RS approach combines the advantages of the sublay position of the mesh and all benefits from the minimal invasiveness of the procedure.<sup>[3]</sup>

In this paper, we would like to present our e-TEP experience in ventral hernia repair with short-term results.

## Materials and Methods

Between June 2019 and February 2020, 18 patients with a ventral hernia and diastasis recti were operated by the same surgeon using the e-TEP technique were reviewed retrospectively. Diastasis recti diagnosed by a physical examination. While the patient was in a lying position, the abdominal muscles tightened and diastasis recti was measured. Patients with a ventral hernia and diastasis recti which an opening of 2 cm or more were included in the study.

**Marking first trocar insertion:** Before the operation, while the patient was awake, the first trocar insertion site was determined by tightening the abdominal muscles by the patient for marking the lateral border of the rectus muscles.

**Positioning of the patient and ports:** The patient's left arm is closed. Surgery was started with the surgeon and camera assistant on the left side of the patient. In two patients with a hernia in the upper part of the navel, the first entry was made from the left lower quadrant. In these patients, the surgeon worked between the legs. The patients were operated with three trocar entries; one 10 mm trocar and two 5 mm trocars were used. Four trocars were used only in one case with gallbladder stones. Visiport™ optical trocar (Medtronic) was used in the first trocar insertion. Later, a 10 mm trocar was passed. The balloon dissector was not used to create a surgical area. A medium-weight, wide-porous standard polypropylene mesh was used as the mesh. In 14 patients, the mesh was fixed to the peritoneum with cyanoacrylate glue (Liquiband® Fix8™). No fixation was used in 4 cases, these were cases covering the entire area and using a large mesh. Antibiotic prophylaxis was applied with a single dose of 1 g of first-generation cephalosporins preoperatively. Hemovac drain was not used in any case. Similarly, a foley catheter was not used in any case.

In cases with gallbladder stones with a ventral hernia; One 10 mm trocar and two 5 mm trocar were entered from the left lateral abdomen in the same way as in e-TEP cases. In one of the cases, an additional 5 mm trocar was entered from the upper right quadrant of the abdomen. In the case with gallbladder stone, standard laparoscopic cholecystectomy was performed in first place after the abdominal cavity entrance. The gallbladder was taken

out from the 10 mm trocar site with the endobag. Then, the trocars were withdrawn slightly and the e-TEP was continued by moving to the retro muscular area. In cases with inguinal hernia together, after dissection of retro muscular space, after dissection until symphysis pubis, as in the TEP technique, inguinal hernias were repaired with 10x15 cm polypropylene meshes, fixed with cyanoacrylate glue (Liquiband®/Fix8™). Patients' demographic, clinical, and operational data were given in Table 1.

**Operative technique:** There are certain steps in this surgical technique that require fine and meticulous dissection. The patient was placed in a supine position and the body was partially bowed. In all cases, the surgeon and camera assistant were placed on the left side and the video-monitor was on the right side of the patient.

**Trocar insertions:** After entering the retro muscular, preperitoneal space with Visiport™ optical trocar (Medtronic) from the left upper quadrant approximately two cm inferior to the rib arch, CO<sub>2</sub> insufflation, and blunt dissection was performed with a 10 mm 30 degrees telescope (Fig. 1).

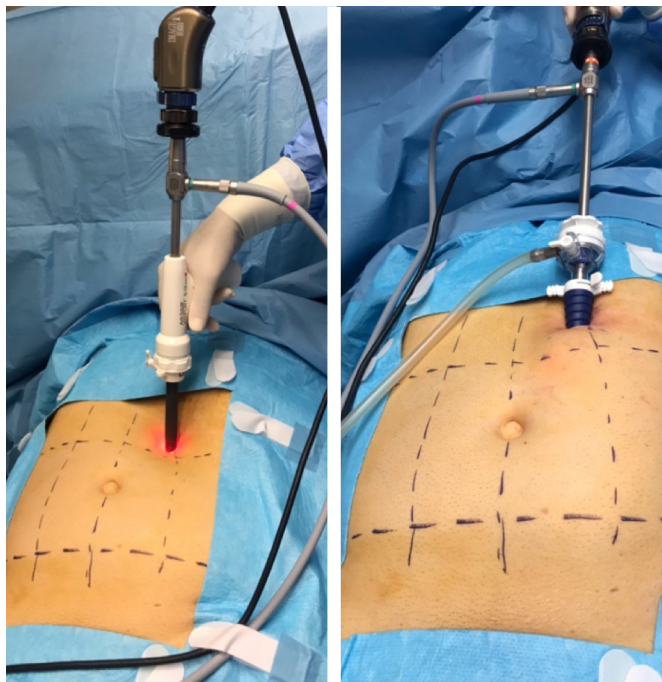
After creating enough space, two more 5 mm trocars were entered from the inferior of this trocar. Trocar insertions should be immediately medial to the semilunar line. In two cases, we applied the first trocar insertion from the lower left quadrant. The surgical area is created in the retro muscular and preperitoneal plane, and dissection is continued (Fig. 2).

Trocars are entered through the medial of the semilunar line. The Trocar settlement is shown in the picture below (Fig. 3).

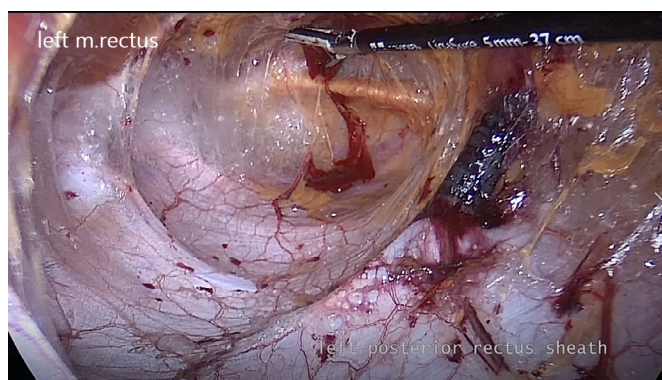
**Dissection:** The creation of the surgical area can be achieved by balloon trocar or by blunt dissection with the telescope. A suitable dissection should be made to open as wide working area as possible around the hernia defect. An early peritoneal puncture can cause loss of pneumoperitoneum and working area. It is necessary to dissect the infra umbilical and

Table 1. Demographic, clinical, and operational information of the cases.

No	Age	Length	Weight	Gender	BMI	Day	Time	ASA	Diagnosis	Mesh	Mesh (cm <sup>2</sup> )	Fixation
1	64	164	72	F	26.8	2	115	2	Umbilical hernia	Prolene Mesh 15*20	300	No
2	55	174	80	M	26.4	2	130	2	Epigastric hernia	Prolene Mesh 15*20	300	cyanoacrylate
3	50	163	68	F	25.6	1	120	1	Nux Umbilical hernia	Prolene Mesh 15*20	300	cyanoacrylate
4	52	175	82	M	26.8	2	105	2	Umb Her+Right ing h	Pro M.15*20 + 10*15	300	No
5	38	180	98	M	30.2	2	195	1	Umbilical hernia	Prolene Mesh 15*15	225	cyanoacrylate
6	50	170	82	M	28.3	2	115	2	Umbilical hernia	Prolene Mesh 15*15	225	cyanoacrylate
7	68	170	78	M	27	2	145	2	Umbilical hernia	Prolene Mesh 15*15	225	cyanoacrylate
8	52	173	82	M	27.3	3	143	2	Umb Her +Bil Ing her	Pro M.15*20+10*15(2)	300	cyanoacrylate
9	46	183	103	M	30.8	1	100	2	Umbilical hernia	Prolene Mesh 15*15	225	cyanoacrylate
10	39	159	52	F	20.6	2	298	1	Umbilical hernia	Prolene Mesh 20*15	300	cyanoacrylate
11	36	168	62	F	21.9	2	125	1	Umbilical hernia	Prolene Mesh 15*15	225	cyanoacrylate
12	47	170	75	M	25.9	2	180	2	Umb her+Gall stone	Prolene Mesh 20*15	300	No
13	35	182	82	M	24.7	2	125	2	Umbilical hernia	Prolene Mesh 15*14	210	cyanoacrylate
14	29	160	48	F	18.8	2	130	1	Umbilical hernia	Prolene Mesh 15*15	225	cyanoacrylate
15	36	162	67	F	25.5	1	135	1	Umbilical hernia	Prolene Mesh 15*15	180	cyanoacrylate
16	35	160	68	F	26.5	2	195	2	Umb her+Gall stone	Prolene Mesh 20*25	500	No
17	40	180	85	M	26.2	1	125	2	Umbilical hernia	Prolene Mesh 15*15	225	cyanoacrylate
18	63	152	60	F	25.9	1	130	2	Port side hernia	Prolene Mesh 15*15	225	cyanoacrylate

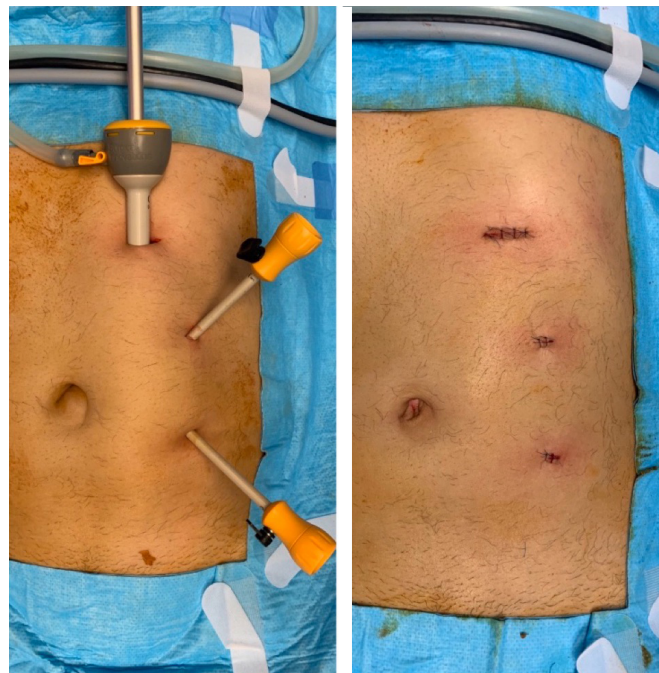


**Figure 1.** First trocar entry from the upper left quadrant and transition to retro muscular area.



**Figure 2.** Creation of a surgical area in the retro muscular plane.

supraumbilical areas by moving around the hernia defect to the retro muscular area on the opposite side. Linea alba opens with hook cautery and ligasure. Dissection in the infra umbilical area is easier than supraumbilical area dissection since the arcuate line ends slightly below the umbilicus. The incision is made primarily in the medial, posterior line of the opposite retro muscular sheath, and advances towards the falciform ligament behind the linea alba. The dissection area extends to; xiphoid process on the top, linea semilunaris and crista iliaca anterior superior on the lateral, and to the retro pubic cavity in the inferior. Opening the posterior rectus sheath and entering the peritoneum is dangerous due to the possibility of bowel injury. There is a risk of injury to the neurovascular bundle at the linea semilunaris. Careful dissection is required while approaching these structures. When transversus



**Figure 3.** Trocar insertion points and post-operative view in the e-TEP technique.

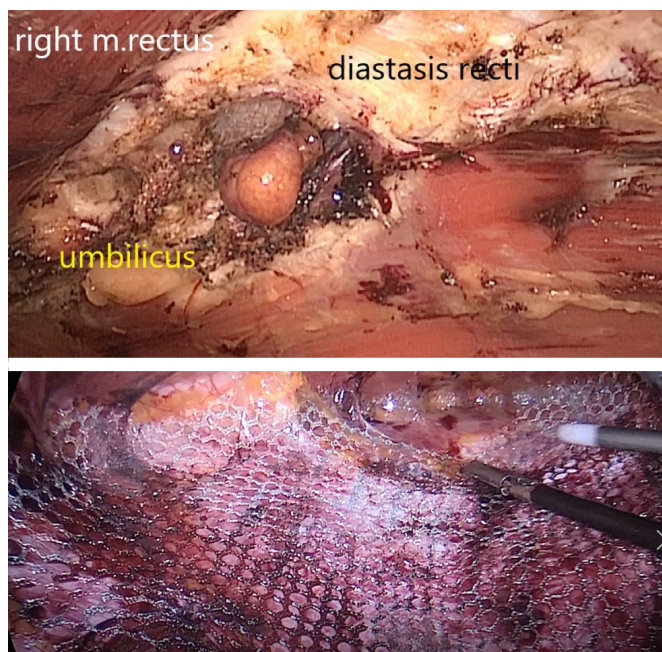
abdominis muscle release (TAR) is done, the danger of peritoneal perforation should always be kept in mind. The peritoneum can be closed with absorbable sutures if necessary. Insufflator pressure was kept between 10-12 mmHg. According to the course of the operation, transitions were made from 5 mm trocars to 5 mm-30 degree camera.

**Suturing:** Peritoneal openings were repaired with absorbable 3/0, 26 mm, V-Loc™ (Medtronic) continuous sutures, and fascia defect and diastasis recti with 2/0, 35 mm, V-Loc™ (Medtronic) continuous sutures. During the closure of the rectus diastasis with continuous sutures in the midline the pressure was reduced to 8-10 mmHg especially during the joining of rectus muscles (Fig. 4).

**Placement of mesh:** When the dissection is complete, measurement should be made with a ruler to be thrown into the area. After the appropriate size polypropylene mesh was rolled, it was laid by sending it from the 10 mm trocar to the retro muscular area.

**Mesh fixing:** Cyanoacrylate glue (Liquiband®Fix8™) was used for mesh fixing. There may also be situations that do not require the use of a detection tool. Drains were not used in the retro muscular area.

Patients data were analyzed for operative details, intra-operative and post-operative complications.



**Figure 4.** A view from umbilical hernia accompanied by diastasis recti and mesh fixation.

This study was approved by the Ethics Committee of Acibadem University with the decision dated 09.04.2020 and numbered 2020-05/32.

Informed consent was obtained from all our patients presented in this report.

## Results

Of 18 patients, 10 (55.5%) were male and 8 (44.5%) were female. Average age was 46.4 years (29-68), average body mass index was (BMI) 25.7 kg/m<sup>2</sup> (18.7-30.8 kg/m<sup>2</sup>), average hospitalization time was 1.78 days (1-3 days), average ASA score was 1.7 (1-2). The mean operation time was 155 minutes (100-298 min). Two cases were ventral hernia accompanied by rectus diastasis, which gave birth approximately 6 and 8 months before the operation. Two patients also had gallbladder stones, one patient had a bilateral inguinal hernia, one patient had a right inguinal hernia, and two patients had an incisional hernia. Peritoneal openings were repaired with absorbable V-Loc™ (Medtronic) sutures, and fascia defect and diastasis recti, repaired with non-absorbable V-Loc™ (Medtronic) running sutures. Standard polypropylene meshes were used in cases. The average area of the meshes used was 266 cm<sup>2</sup>. An additional 10x15 cm mesh was used on each side of the inguinal hernias. Foley catheters were not used to the cases. Hemovac drain was not used in any patient. Postoperative pain and analgesic requirements of cases were quite low. The need for analgesics after surgery is less due to the lack

of pain nerves in the studied anatomical plane. Cyanoacrylate glue (Liquiband®Fix8™) was used to fix the mesh to the peritoneum in 14 patients, and no fixation method was used in 4 patients. Balloon dissector was not used in any patient to create a surgical area, and blunt dissection was performed with a telescope. In one case, the right unilateral transversus abdominis release (TAR) procedure was performed in the e-TEP plan with the thought that the hernia defect in the posterior rectus sheath would be tightened. None of the patients needed to open surgery. One patient developed soft tissue infection at the port site. No recurrence was detected during a maximum of 12 months minimum of 4 months (mean 8.3 months) follow-up.

This new approach permits flexible port entries, as well as the closure of the defects by placing a large size mesh in the retro muscular, preperitoneal area. Accompanying clinical conditions such as gallstones and the inguinal hernia can be operated in the same session. Standard polypropylene meshes are sufficient as a mesh.

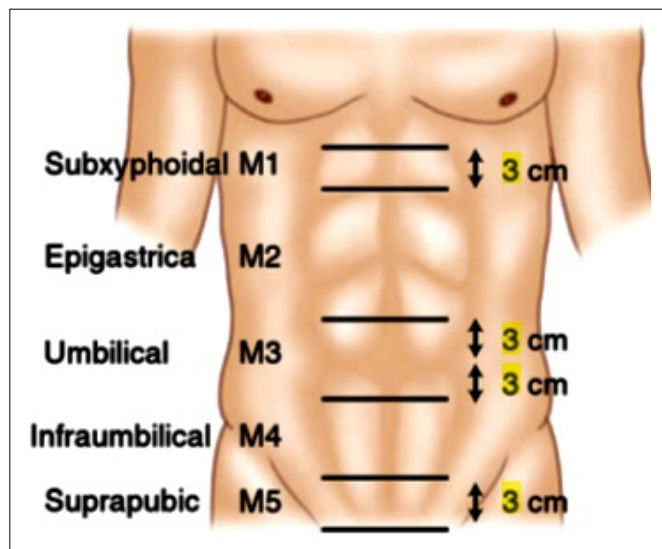
## Discussion

Rectus abdominis diastasis describes a situation in which the two rectus muscles are separated by a distance of more than 2 cm.<sup>[17]</sup> It is often seen with an umbilical or epigastric hernia (45%).<sup>[17]</sup> The authors concluded that umbilical or epigastric hernias, regardless of size, with concomitant rectus abdominis diastasis require mesh repair owing to unacceptably higher recurrence rates.<sup>[17]</sup> We included cases with primary or incisional ventral hernias accompanied by rectus diastasis of 2 cm and more.

There are different approaches to choosing the first trocar entrance. According to the European Hernia Society (EHS) classification, there are also studies reporting that entrance to the retro muscular area is made through the lower right quadrant in M1 and M2 defects, and in the left upper quadrant in M3, M4, M5 defects (3) (Fig. 5).

We started from the lower left quadrant in only two of our cases, and the upper left quadrant in other cases (Fig. 1).

It is important not to damage the semilunar line, which is the only connection point between the medial and lateral myofascial abdominal wall.<sup>[13]</sup> Before the operation, while the patient is awake the abdominal muscles are tightened so we can be able to mark the lateral border of the rectus muscles. Thus, we determine the first trocar location. As it is also stated in the literature, the semilunar line should be determined before surgery with ultrasound.<sup>[14]</sup>



**Figure 5.** Middle ventral hernia classification according to European Hernia Surgery (EHS).

The retro muscular area can be entered with open technique or Visiport™ optical trocar (Medtronic).<sup>[16]</sup> In all of our cases, we entered the retro muscular plane from the medial of the semilunar line with the Visiport™ optical trocar at the first entry.

In all our cases, after entering the retro muscular plane with the first trocar, we created a surgical field by making blunt dissection while on the one hand insufflation with CO<sup>2</sup>. At this stage, a balloon dissector can also be used.<sup>[12,13]</sup>

TAR process can be added to large defects that need wide mesh. Belyansky reported that they added 52% TAR processing in their series.<sup>[13,15]</sup> In one of our cases, a unilateral TAR procedure was performed in the e-TEP plan with the idea that the hernia defect in the posterior rectus sheath would be tightened.

In all our cases we used a medium-weight, wide-porous standard polypropylene mesh. We determined the dimensions of the mesh after the measurement with the sterile ruler which we threw to the area during the operation.

No trans facial fixation was used in any case. In 14 cases, the mesh was fixed on the peritoneum with cyanoacrylate glue (Liquiband@Fix8™). We did not apply any fixation method in our 4 cases.

Chronic pain and movement limitations are among the main complaints of hernia patients, promoting a cycle of inactivity, weight gain, and progressive loss of function. Six months after e-TEP, most patients in some series showed significant relief from pain and movement limi-

tation.<sup>[12]</sup> One of the biggest benefits of the e-TEP access approach is the use of retro muscular space for placement of large macroporous mesh, thus nearly eliminating penetrating fixation and provides less observation of post-operative pain.<sup>[12]</sup> We also noticed significantly less pain compared to our IPOM patients.

Except for mandatory situations, drains should be avoided in the retro muscular area.<sup>[13]</sup> If drains are placed, they are usually removed on the second day after surgery. We did not use drains in any of our cases.

Placement of the mesh in the extraperitoneal area prevents the development of complications related to mesh.<sup>[12]</sup> We did not encounter any complications in our short term follow-up.

e-TEP learning curve and the extended length of the operation time are among the disadvantages.<sup>[3]</sup> Our average operation time was 155 minutes including the cases we performed together in the same session such as gallbladder stone and inguinal hernia.

## Conclusion

e-TEP seems to be a safe and feasible new surgical technique for primary and incisional ventral hernia repairs. We believe that this surgical technique would find a place in the surgical armamentarium of ventral hernia repair and could be an important tool for minimally invasive surgery. The e-TEP technique allows for dissection in an untouched plane and enables additional techniques such as TAR makes it possible to place a large size mesh on the retro muscular plane without tension, usually not requiring fixation. In this technique, meshes are placed in the most physiological anatomical plan that can be placed. Placement of the mesh in the retro muscular area can also prevent the development of complications such as adhesion, mesh erosion, and fistula, which may occur when the mesh is in contact with intraperitoneal organs. More studies with long term follow-up are needed to have an evidence-based answer and clarified patient selection criteria.

## Disclosures

**Ethics Committee Approval:** This study was approved by the Ethics Committee of Acibadem University with the decision dated 09.04.2020 and numbered 2020-05/32.

**Peer-review:** Externally peer-reviewed.

**Conflict of Interest:** None declared.

**Authorship Contributions:** Concept – M.E., Design – M.E., T.B., Supervision – M.E., Materials – M.E., Data collection and/or processing – T.B., E.Ö., Analysis and/or interpretation – M.E., T.B., Literature search – T.B., E.Ö., Writing – M.E., T.B., Critical review – M.E., T.B.

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