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Open posterior component separation with transversus abdominis release (TAR) for large incisional abdominal wall hernias: Results from a single center

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Abstract

Transversus abdominis release (TAR) is the newest approach that allows effective myofascial mobilization, creating a large retromuscular space and wide mesh overlap to repair complex and large incisional ventral hernias. This article narrates the technical details and results of the TAR technique performed in a single center. The present study is a retrospective analysis of a prospective dataset from 25 patients who underwent posterior component separation (PCS) with TAR procedure for large incisional ventral hernias between October 2017 and July 2021. The minimum follow-up period was ten months. Twenty-five patients (five male, 20 female) with a mean age of 61.2 years, a mean BMI of 32.2 kg/m², and a median ASA score of 2.0 underwent the TAR procedure. Fifteen (60%) patients had a history of incisional hernia surgery. The mean surgical time was 248 minutes. The mean total defect and mesh areas were 187.4 (90-500) cm² and 1141.8 (750-2250) cm², respectively. The mean visual analog scale (VAS) pain score on the first postoperative day was 4.5 and the median hospital length of stay (LOS) was 5 days. There were three (12%) surgical site infections (SSIs), two of which were deep infections that needed debridement. During the follow-up period (median of 26 months), two (8%) recurrences were recorded. The TAR technique represents an effective and safe repair modality of large and complex incisional hernias. TAR is an essential addition to the repertoire of the surgical community.

Keywords: Transversus abdominis release, incisional hernia, ventral hernia, component separation

Introduction

Incisional hernias are seen in 11% to 50% of all laparotomies and are a common indication for reoperations [1]. Ramirez described the component separation technique (CST) in 1990 that enables the myofascial advancement for the definitive repair of large incisional ventral hernia defects [2]. This procedure requires creating extensive skin flaps to reach and incise the aponeurosis of the external oblique muscle and additional cutting of the posterior rectus sheath when needed [3]. Despite excellent results of midline myofascial advancement, significant wound morbidity and recurrence rates occur in the anterior CST [1,4,5]. Modifications of anterior CST were described, such as endoscopic anterior component separation and periumbilical perforator sparing (PUPS) techniques, to reduce wound morbidity [6,7]. The Rives-Stoppa technique (retrorectus repair) uses the plane extending bilaterally 6 to 8cm between the rectus abdominis muscle and its posterior sheath to place a mesh in a sublay fashion [8,9]. The American Hernia Society acknowledged the Rives-Stoppa technique as the gold standard for open abdominal wall hernia repair in 2004 [1]. However, since the retrorectus space ends by the linea semilunaris, it does not allow adequate mesh overlap for large midline defects. Modifications have been described that use preperitoneal space or intramuscular plane to reach beyond the semilunar line and place an extensive mesh [10,11].

In 2012, transversus abdominis release (TAR), another modification of the Rives-Stoppa procedure, was described by Novitsky et al. [12,13]. In the TAR technique, the fibers of the transversus abdominis muscle, which emerges after the internal oblique aponeurosis is cut, are divided. Thus, the potential retrorectus and pretransversalis/ preperitoneal spaces are connected, which allows the creation of an extended retromuscular plane to lay a wide mesh [12,14]. TAR has lower recurrence rates and fewer severe wound infections compared to other previously described techniques [15]. Posterior component separation (PCS) with the TAR technique has

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become popular and gained acceptance by the surgical community in recent years [14,15]. This article presents the technical details and results of the TAR technique performed in a single center.

Material and Methods

This study is a retrospective analysis of a prospective dataset that reveals the TAR technique performed by a single surgeon on patients who presented with large incisional abdominal wall hernias between October 2017 and July 2021.

Patients over 18 years of age who underwent incisional abdominal wall hernia surgery with the TAR technique were included in this study. The inclusion criteria were patients with defects ≥10cm in width or more minor defects associated with loss of domain (LOD) and those in whom the linea alba could not be closed with a standard retrorectus technique. The exclusion criteria were primary hernias and emergent cases. Routine laboratory tests and physical examinations were preoperatively performed on all patients. Preoperative computed tomography (CT) scan was used to measure the defect size, abdominal wall anatomy and hernia content of all patients. Tanaka's index was calculated using a software (3D Slicer, https://www.slicer.org/) in suspected LOD patients [16]. "The European Hernia Society (EHS) classification for incisional abdominal wall hernias" was used to show the distribution of the defects [17]. Data on age, sex, body mass index (BMI), comorbidities, American Society of Anesthesiology (ASA) score, defect characteristics, grade of hernia according to the Ventral Hernia Working Group (VHWG) Classification [18], operative time, postoperative length of stay (LOS), types of mesh and sutures, addition of panniculectomy, partial omentectomy, complications (intraoperative and postoperative) were collected and analyzed. To grade postoperative pain, the visual analogue scale (VAS) ranging from 0 to 10 was used on the first postoperative day. Follow-up evaluation of all patients was planned with physical examination at the postoperative day 10, one month, three months, six months, one year and two years. An evaluation with a CT scan was planned for all patients at the end of the first year. Due to abdominal discomfort, some patients needed CT scans earlier to evaluate possible recurrence.

The SPSS 22 software was used for statistical analysis of all data. Categorical variables are presented as n (%), and continuous variables are presented as mean ±SD. The ethics committee of Kanuni Training and Research Hospital at Health Sciences University, approved the protocol of the study (11382-2022/13).

Surgical Technique

The preoperative prophylaxis with cefazolin is administered to the patient 30 minutes before surgery. The patient is laid in the supine position on the operating table with arms abducted. An orogastric tube and a urinary catheter are placed after induction of general anesthesia. After skin preparation, a midline laparotomy incision is made, and the previous scar is removed. The entry point should always be far from the previous incision and current hernia defect to access the abdominal cavity safely. The hernia sac is preserved as a contribution to closing the posterior layer or bridging the potential bridging gap in the linea alba. All previous meshes are removed to prevent infection. All adhesions to the abdominal wall are lysed. Interloop adhesions can be ignored if there is no history or current symptoms of intestinal obstruction. A towel is laid over the intra-abdominal organs to protect them from an iatrogenic injury (Figure 1).

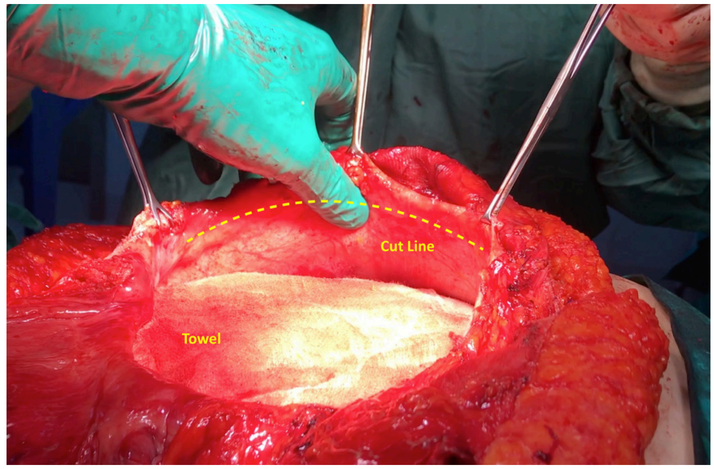

Figure 1. The initial incision line to enter the retrorectus plane

A longitudinal incision is made 0.5-1 cm. from the medial border of the rectus abdominis muscle to enter the retrorectus plane (Figure 1). Retromuscular dissection is performed until reaching the neurovascular bundles on the semilunar line (Figure 2). The posterior lamella of the internal oblique aponeurosis is divided 0.5–1cm. medial to the semilunar line to expose the fibers of the transversus abdominis muscle (TAM). The TAM fibers are then cut with electrocautery starting from the cephalad in the caudal direction (Figure 3,4). They are "swept" with blunt dissection as lateral as possible to develop the space between the TAM and transversalis fascia/peritoneum (Figure 5), which can be extended superiorly beyond the costal edge to the subdiaphragmatic plane and inferiorly to the Retzius space. The same dissection is made on the contralateral side. The pubic symphysis, Cooper ligaments, and myopectineal orifice can be exposed with dissection of the Retzius space. Superiorly, both subdiaphragmatic planes are connected in the midline, and dissection is carried out in the subxiphoid and retrosternal areas and can be continued until the diaphragm's central tendon if needed. At the end of the bilateral PCS, the merged retrorectus, pre-transversalis/preperitoneal, and midline preperitoneal (anterior of the falciform ligament) spaces allow a giant mesh to be placed.

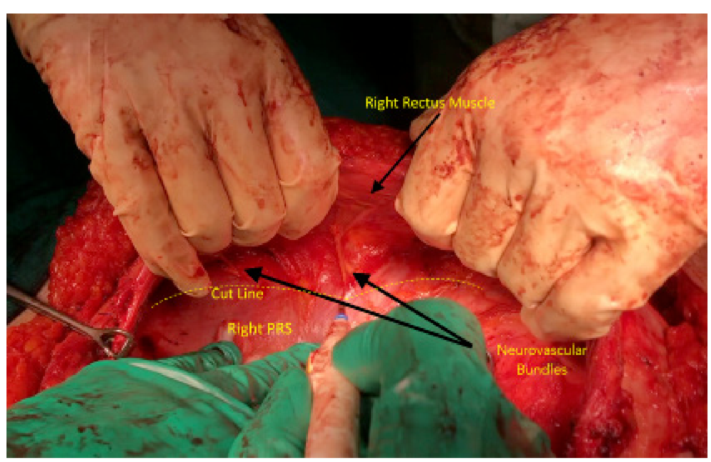

Figure 2. The retrorectus dissection and the initial incision on the posterior rectus sheath (PRS)

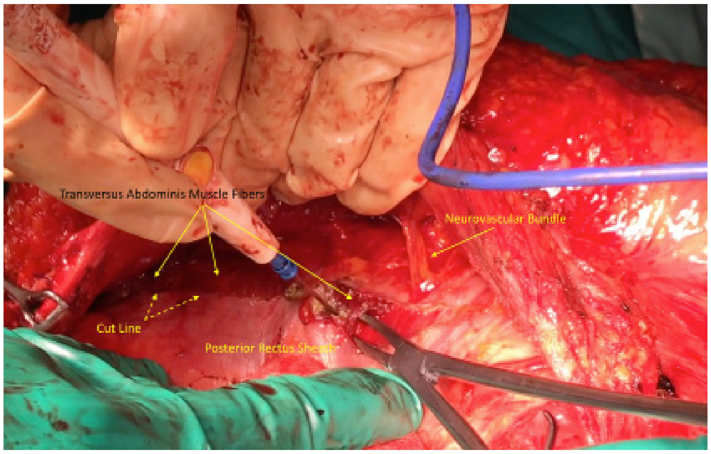

Figure 3. Division of transversus abdominis muscle (TAM) fibers

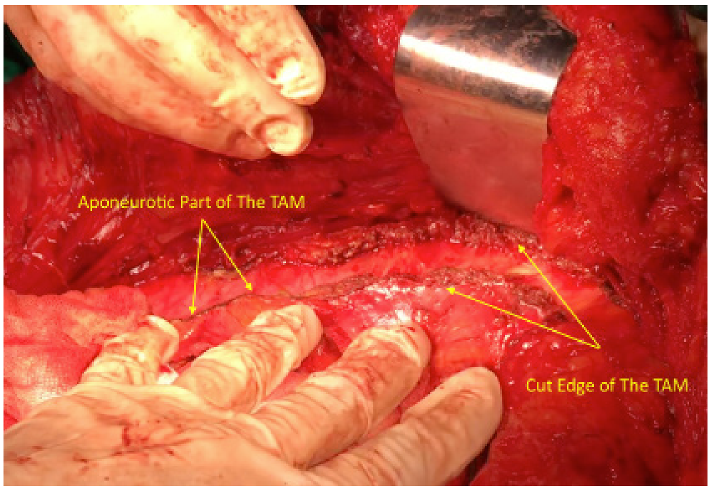

Figure 4. End of the transversus abdominis division (muscular and aponeurotic part)

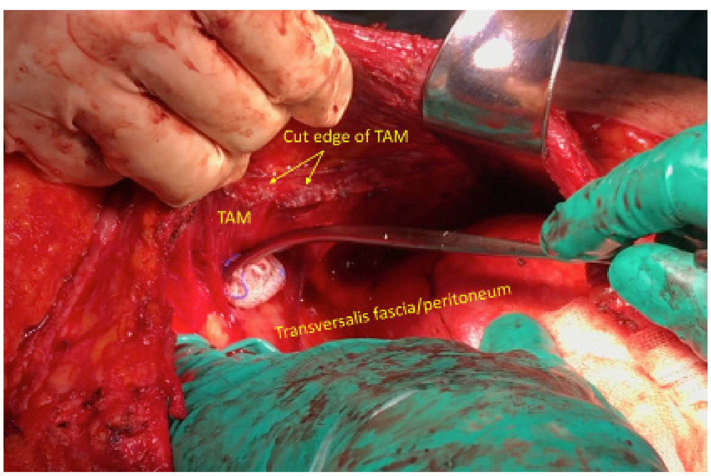

Figure 5. Blunt dissection to develop the plane between the TAM and transversalis fascia/peritoneum

The posterior layer is closed using running slowly-absorbing sutures (Figure 6). All holes created accidentally in the peritoneum are repaired with a primary suture or by using omentum if possible. If the posterior layer cannot be closed safely, absorbable, composite or biologic mesh or a preserved piece of the hernia sac can be used to bridge it.

A giant monofilament nonabsorbable mesh is laid flat to cover the whole dissected area. It is anchored to the Cooper ligaments inferiorly and the xiphoid superiorly with 2-0 nonabsorbable sutures. Transabdominal anchoring sutures can be selectively used as an addition. Two suction drains are placed anterior to the mesh. The midline is then closed with slowly absorbing or nonabsorbable running sutures (Figure 7). If an extensive subcutaneous dissection and previous mesh removal result in sizable dead space, placing another suction drain in the subcutaneous area is recommended. A panniculectomy might be needed.

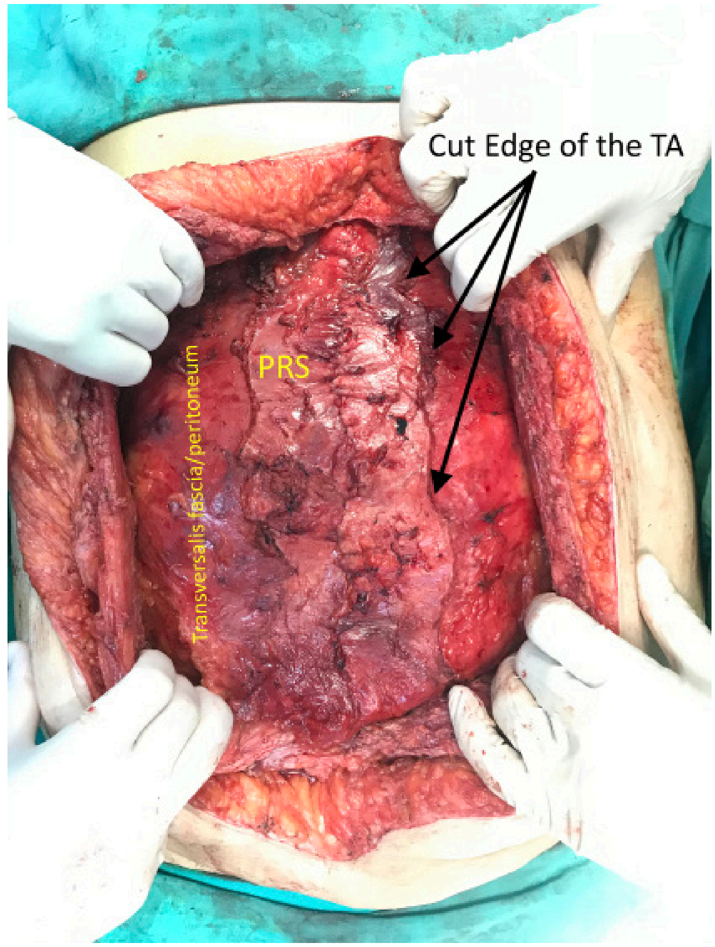

Figure 6. "The critical view of TAR" after completing TAR and closing the posterior layer. PRS: Posterior Rectus Sheath

Figure 7. Closure of the linea alba

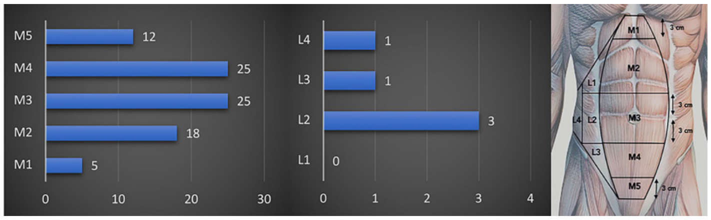

Figure 8. Defect locations according to the EHS classification

Postoperative Care

The patients typically remained on venous thrombosis prophylaxis during the hospital stay. Postoperative mobilization and diet were encouraged to be started as early as possible. Suction drains were kept in place until liquid output decreased to less than 50ml per day. The patients were sent home following tolerating adequate diet and pain control with analgesic tablets.

Results

Twenty-five patients underwent PCS with the TAR technique between October 2017 and July 2021. The median follow-up was 26 months (minimum of ten months). One-fifth (20, 80%) of the patients were female. The patients had a mean age of 61.2 years, a mean BMI of 32.2kg/m², and a median ASA score of 2.0. Fifteen (60%) patients had a history of incisional hernia surgery. Twenty-one (84%) patients had grade 2 incisional ventral hernia according to the VHWG Classification. The leading comorbidity was hypertension (52.0%), followed by diabetes (36.0%) and cancer history (28.0%). The patient demographic characteristics are summarized in Table 1.

Table 1. Patient Demographics

Variable	TAR
n	25
Age (years)	61.2±9.2
Sex (female)	20(80%)
Body Mass Index	32.2±5.4
ASA Score	
1	2(8.0%)
2	15(60.0%)
3	8(32.0%)
VHWG	
1	2(8.0%)
2	21(84.0%)
3	2(8.0%)
Incisional Hernia Repair History	15(60%)
Hypertension	13(52.0%)
Diabetes Mellitus	9(36.0%)
Cancer History	7(28.0%)
COPD	6(24%)
Hyperlipidemia	3(12.0%)
Active Smoker	6(24.0%)
Coronary Disease	2(8.0%)

ASA: American Society of Anesthesiologists, COPD: Chronic Obstructive Pulmonary Disease. VHWG: Ventral Hernia Working Group, Categorical variables are presented as n (%), and continuous variables are presented as the mean±SD

Table 2. Defect and Mesh Characteristics

Defect Characteristics	n	Defect Area (cm², Mean±SD Min-Max)	Mesh Area (cm²; Mean±SD Min-Max)	Mesh/Defect Ratio (Mean±SD Min-Max)
Medial Defects	22	198.8±94.4(90-500)	1174.7±399.4(750-2250)	6.4±1.7(2.7-8.62)
Multiple Site (Medial+Lateral) Defects	3	103.3±23.0(90-130)	900.0±150.0(750-1050)	8.9±2.4(6.9-11.6)
Total	25	187.4±94.0(90.0-500.0)	1141.8±387.0(750-2250)	6.72±1.9(2.7-11.6)

The localization and size of hernia defects were defined using CT in the preoperative period according to the EHS classification and confirmed intraoperatively (Figure 8). Four patients had LOD, which was confirmed with the calculation of Tanaka's index [16]. A single patient received Botulinum Toxin A and preoperative progressive pneumoperitoneum (PPP), and another patient received only PPP for preoperative optimization. The last two patients did not consent to optimization, so they underwent only the TAR procedure. The mean total defect and mesh areas were 187.4 (90-500) cm² and 1141.8 (750-2250) cm², respectively. Defect and mesh characteristics for medial defects and multiple site defects are shown in Table 2.

Twenty-two patients underwent bilateral TAR, whereas three patients with multiple site defects (medial and lateral) underwent unilateral TAR plus the Rives-Stoppa procedure. The mean operative time was 248 minutes. In most cases, macroporous middleweight polypropylene (MWPP) mesh was used (64.0%). Slowly absorbable barbed sutures were generally selected to close the posterior layer and restore the midline. Bridging of the gap on the linea alba was performed following the TAR procedure in four patients. After adhesiolysis, four patients needed partial omentectomy. Following the closure of the anterior layer, vertical panniculectomy was required for seven patients with large skin flaps due to extended dissection and old mesh removal. The mean VAS pain score on the first postoperative day was 4.5 and the median hospital LOS was 5 days (Table 3).

An iatrogenic intestinal seromuscular tear occurred in four (16%) patients. Five patients had clinical seroma, and one patient had a hematoma, all of which were treated conservatively. One patient developed a superficial surgical site infection (SSI) that responded well to antibiotics. Two patients had deep SSIs without mesh involvement, requiring surgical debridement and wide-spectrum antibiotics. There were two (8.0%) recurrences. The first recurrence occurred in the subxiphoid region of the third patient of this cohort due to inadequate mesh coverage, and the second occurred due to central mesh failure. One patient had chronic pain that was treated conservatively. The complications are summarized in Table 4.

Table 3. Surgical data

Procedures	
Bilateral TAR	22(88.0%)
Unilateral TAR+ Rives Stoppa(opposite site)	3(12.0%)
Operative Time	248±80.7
Mesh Type	
HWPP (microporous)	9(36.0%)
MWPP (macroporous)	16(64.0%)
Closure (anterior layer)	
Barbed suture (0)	13(52.0%)
Barbed suture (No1)	4(16.0%)
Polypropylene (No1)	4(16.0%)
PDS (No1)	4(16.0%)
Closure (posterior layer)	
Barbed suture (3/0)	11(44.0%)
Polyglactin 910 (2/0-3/0)	9(36.0%)
PDS (2/0)	5(20.0%)
Bridging	4(16.0%)
Partial omentectomy	4(16.0%)
Panniculectomy (vertical)	7(28.0%)
VAS Scores (PO1)	4.50±0.81
Hospital LOS	5.52±1.58

HWPP: Heavyweight Polypropylene, MWPP: Midweight Polypropylene, VAS: Visual Analogue Scales, PO1: Postoperative 1st Day, LOS: Length of Stay, Categorical variables are presented as n (%), and continuous variables are presented as the mean±SD

Table 4. Complications

Complications	**n(%)**
Intraoperative Complication	
Intestinal injury	4(16.0%)
(Seromuscular tear)	
Severe bleeding	0(0%)
Bladder injury	0(0%)
Surgical Site Complications	
Hematoma	1(4.0%)
Clinical Seroma	5(20.0%)
Surgical Site Infection (SSI)	3(12.0%)
Superficial	1/3(33.3%)
Deep	2/3(66.6%)
Intra-abdominal	0(0%)
Wound Dehiscence	3(12.0%)
30-day Readmissions	2(8.0%)
Small bowel obstructions	0(0%)
Recurrence	2(8.0%)
Chronic Pain	1(4.0%)

Discussion

The TAR technique is characterized as a posterior myofascial release decreasing tension on the linea alba reconstruction, creating a large retromuscular space by extending dissection beyond the semilunar line that allows placement of a large mesh and preservation of the neurovascular bundles to protect the abdominal wall blood supply [12,14,19].

The PCS with TAR promises a practical and durable surgical treatment of large and complex abdominal wall hernias. The TAR technique also showed low recurrence rates, low wound morbidity and satisfactory improvement in quality of life [14,20]. An early study comparing anterior component separation (ACS) and TAR has reported a lower recurrence rate (14% versus 4%) and a lower wound complication rate (48.2% versus 25.5%) for TAR [4]. Newer publications that described the endoscopic technique and perforator sparing method for ACS have revealed much lower wound morbidity rates [6,7,21]. Recent studies comparing ACS and TAR have showed similar one-year recurrence rates, quality of life, and SSI rates in both techniques, whereas surgical site occurrences were higher in ACS. However, it has been reported that ACS had more severe wound complications and required more extended hospital stays than TAR [19,22]. Laparoscopic and robotic approaches have been described and adopted in the TAR technique and have become popular among hernia surgeons, especially in the US [23–26]. It has been indicated that robotic TAR (R-TAR) and hybrid robotic TAR (hrTAR) techniques are associated with significantly shorter hospital LOS and lower systemic and surgical site complications [27,28].

Despite these advantages, operative times for R-TAR are longer than for open TAR [27,29]. It has been reported in the literature that the operative times for the open TAR technique range from 188 minutes to 383 minutes [14,20,30–34]. The mean operative time in the present study was 248 minutes, which is comparable to the aforementioned studies.

All meshes used were polypropylene, and 64% of meshes were of midweight macroporous design. Heavyweight mesh was chosen if there seemed to be high tension on the midline or a possible need to bridge the midline defect. Novitsky et al. reported that the central mesh failure was the most common mechanism of recurrence; most of these were polyester meshes [14]. Therefore, polyester meshes were not used in this cohort.

Thanks to the extensive mobilization afforded by the TAR technique, closing the anterior fascia with minimal tension is possible in most cases. Early studies have reported fascial closure rates of 97-100% [14,29,33,35], whereas some recent papers have indicated these rates as 81-91% [22,30,31]. The fascial closure rate in the present study was 84%. Bridging was used in four patients who had LOD.

In the literature, a routine panniculectomy is not recommended in TAR procedures because it increases the risk of wound morbidity [13,36]. Sadava et al. performed panniculectomy on 60% of their cohort and stated that panniculectomy did not significantly increase SSIs [20]. Seven patients (28%) needed vertical panniculectomy in our study. In contrast to the study mentioned above, two-thirds of all SSIs were seen in panniculectomy patients.

The median hospital LOS in this study's cohort was 5 (mean 5.5, 2-10) days. Hospital LOS reported in the literature ranges from 4.0 to 9.0 days, similar to the present study [12,14,15,20,22,27,29,31,34,37]. SSIs have been reported in between 27 and 41% of patients, and mesh infections can be as high as 5% to 10% of all ventral hernia repairs [1,36]. Although rates of SSI are still high in TAR procedures, infections are usually mild and can often be treated with antibiotics alone [36,38]. There were three (12%) SSIs in our cohort. Two patients with deep SSIs were treated with wide-spectrum antibiotics and surgical debridement. They both had a history of incisional hernia repair and wound infection (VHWG grade 3). In this cohort, there were no mesh infections that required removal.

Recurrence is still a significant challenge in ventral hernia surgery. A meta-analysis reported recurrence rates of 5.7% (3%-8.5%) for the TAR procedure [35]. The recurrence rate of the present study was 8%, which is comparable to the study above.

This study has several significant limitations: It was a retrospective study conducted at a single center with a small sample size and cannot be considered a comprehensive postoperative quality of life assessment.

Conclusion

In conclusion, the TAR technique represents an effective and safe repair modality of large and complex incisional hernias. TAR is an essential addition to the repertoire of the surgical community.

Conflict of interests
The authors declare that there is no conflict of interest in the study.

Financial Disclosure
The authors declare that they have received no financial support for the study.

Ethical approval
The ethics committee of Kanuni Training and Research Hospital at Health Sciences University, approved the protocol of the study (11382-2022/13).

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