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e-TEP recommendations and outcomes for incisional hernia repair

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Resumo

Introdução: A hérnia incisional corresponde a uma hérnia da parede abdominal no local de uma incisão cirúrgica prévia, sendo uma complicação frequente das cirurgias abdominais. A presença de uma hérnia incisional está associada a uma morbilidade significativa e a um grande impacto na qualidade de vida dos doentes, podendo levar a situações como obstrução intestinal e encarceramento e estrangulamento de ansas intestinais. A laparoscopia é uma técnica relativamente recente no tratamento das hérnias incisionais, tendo sido inicialmente descrita em 1993. Em 2012 foi descrita pela primeira vez a técnica *Enhance view Totally Extraperitoneal* (e-TEP) para a correção cirúrgica por via laparoscópica de hérnias inguinais, sendo que esta técnica foi posteriormente adaptada em 2017 para o tratamento cirúrgico de hérnias abdominais primárias e incisionais. Embora as técnicas laparoscópicas como o e-TEP estejam associadas a uma menor taxa de complicações, nomeadamente infeção e hemorragia, a um menor tempo de hospitalização e uma retoma mais precoce da atividade laboral, ainda não há evidência científica disponível até ao momento que comprove a existência de superioridade da via laparoscópica em relação à via aberta a longo prazo.

Objetivos: O presente estudo tem como objetivos: (1) revisão do estado de arte relativo ao tratamento cirúrgico da hérnia incisional, (2) identificar possíveis indicações para realização de e-TEP na correção da hérnia incisional e (3) análise dos *outcomes* a curto e longo prazo desta técnica cirúrgica.

Métodos: Foram selecionados doentes diagnosticados com hérnia incisional, tratada cirurgicamente utilizando a técnica e-TEP no Centro Integrado de Cirurgia de Ambulatório (CICA) - Hospital Geral de Santo António, entre outubro de 2020 e fevereiro de 2023. Foram analisados dados demográficos, características da hérnia, complicações peri e pós-operatórias, tempo de internamento, taxa de readmissão em 30 dias, recorrência da hérnia e avaliação da dor.

Resultados: Neste estudo foram incluídos 13 doentes, com idade média de 53.6 anos. Todos os doentes apresentavam hérnias mediais. Na altura do diagnóstico 84.6% dos doentes encontravam-se assintomáticos. O tempo cirúrgico médio foi 172 minutos, sendo que a maioria dos doentes teve alta no próprio dia. Em 2 doentes ocorreram complicações relacionadas com a ferida cirúrgica e 1 doente apresentou recidiva de hérnia incisional. No pós-operatório, a maioria dos doentes apresentou dor severa a moderada, sendo que ao fim de 30 dias a maioria já tinha retomado às atividades diárias normais, sem dor ou com dor ligeira.

Conclusões: O e-TEP é uma técnica promissora no tratamento cirúrgico de hérnias incisionais, que oferece diversas vantagens em relação às outras técnicas disponíveis. No entanto, são necessários mais estudos para avaliar os resultados a curto e longo prazo desta técnica, bem como para comparar o e-TEP com outras técnicas usadas no tratamento da hérnia incisional. Este estudo representa uma contribuição importante nesse sentido.

Palavras-chave: Hérnia incisional; Enhance view Totally Extraperitoneal Technique; e-TEP; Cirurgia laparoscópica.

Abstract

Introduction: The incisional hernia corresponds to a hernia of the abdominal wall at the site of a previous surgical incision, being a common complication of abdominal surgeries. The presence of an incisional hernia is associated with significant morbidity and a major impact on patients' quality of life, potentially leading to situations such as intestinal obstruction and incarceration or strangulation of intestinal loops. Laparoscopy is a relatively recent technique in the treatment of incisional hernias, initially described in 1993. In 2012, the Enhanced View Totally Extraperitoneal (e-TEP) technique was first described for laparoscopic correction of inguinal hernias, and later in 2017, this technique was adapted for the surgical treatment of primary and incisional abdominal hernias. Although laparoscopic techniques such as e-TEP are associated with lower complication rates, including infection and bleeding, shorter hospital stays, and earlier return to work, there is currently no available scientific evidence to prove the long-term superiority of the laparoscopic approach over the open approach.

Methods: The present study aims to: (1) review the state of the art regarding the surgical treatment of incisional hernia, (2) identify potential indications for performing e-TEP in the correction of incisional hernia, and (3) analyse the short- and long-term outcomes of this surgical technique.

Results: In this study, 13 individuals were included, with a mean age of 53.6 years. All patients had medial hernias. At the time of diagnosis, 84.6% of patients were asymptomatic. The average surgical time was 172 minutes, and the majority of patients were discharged on the same day. Two patients experienced complications related to the surgical wound, and one patient had a recurrence of incisional hernia. In the postoperative period, the majority of patients experienced severe to moderate pain, but after 30 days, most had returned to normal daily activities with mild to no pain.

Conclusions: The e-TEP technique is a promising approach in the surgical treatment of incisional hernias, offering several advantages compared to other available techniques. However, further studies are needed to evaluate the short- and long-term outcomes of this technique and to compare e-TEP with other techniques used in the treatment of incisional hernia. This study is a contribution in this regard.

Keywords: Incisional hernia; *Enhance view Totally Extraperitoneal Technique*; e-TEP; Laparoscopic surgery.

List of Abbreviations

ASA	American Society of Anesthesiology
BMI	Body Mass Index
CICA	Centro Integrado de Cirurgia de Ambulatório
EHS	European Hernia Society
e-TEP	extended view Totally Extraperitoneal
EuraHS-QoL	European Registry for Abdominal Wall Hernias – Quality of Life
IPOM	Intraperitoneal Onlay Mesh
IPOM-Plus	Intraperitoneal Onlay Mesh Plus
TAPP	Transabdominal Preperitoneal
TEP	Totally Extraperitoneal
VAS	Visual Analogue Scale

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Introduction

An abdominal incisional hernia can be defined as an abdominal wall gap that occurs at the site of a previous abdominal incision ⁽¹⁾⁽²⁾. The development of an incisional hernia is a common complication after abdominal surgery, and it can occur after any type of incision ^{(3)–(5)}.

Incisional hernia development is a multifactorial process that depends on the patient's related factors and factors associated with the surgical technique ⁽¹⁾⁽³⁾⁽⁴⁾⁽⁶⁾⁽⁷⁾. The patient's risk factors include male, advanced age, obesity, smoking, and other factors that can influence normal wound healing (diabetes, malnutrition, immunosuppressive therapy, and connective tissue disorders) ⁽²⁾⁽³⁾⁽⁶⁾⁽⁷⁾. Within these, obesity is the main risk factor for incisional hernias and has been associated with a higher incidence of complications and recurrence following hernia repair ⁽⁷⁾⁽⁸⁾. The location and size of the incision of previous surgery, wound closure technique, wound infection, or hematoma can also predispose to incisional hernia formation ⁽²⁾⁽³⁾⁽⁶⁾⁽⁷⁾.

Based on the clinical presentation, incisional hernias can be considered asymptomatic, symptomatic, incarcerated, or strangulated ⁽²⁾⁽³⁾⁽⁷⁾⁽⁹⁾. Most abdominal hernias are asymptomatic, although they can present with abdominal pain or discomfort, bowel obstruction, and back pain ⁽¹⁾⁽³⁾⁽⁹⁾⁽¹⁰⁾. Cosmetic concerns must also be considered for the patient's well-being ⁽⁹⁾. Incarcerated or strangulated hernias are associated with higher morbidity and mortality ⁽⁴⁾.

In 2008, the European Hernia Society (EHS) developed a classification system for incisional hernias ⁽¹¹⁾. This widely used and comprehensive system takes into account several factors such as hernia localization and size and recurrence of incisional hernia ⁽¹¹⁾. Proper classification of an incisional hernia is important to determine the optimal surgical approach and predict outcomes and potential complications ⁽⁹⁾⁽¹¹⁾.

The EHS classification divides the abdomen into the medial zone – medial to the lateral margins of the rectus sheath, and lateral zone ⁽¹¹⁾. As mentioned in *Table I*, these zones can be subdivided into five and four subzones, respectively ⁽¹¹⁾.

Regarding the hernia size, the hernia width can be classified into three categories: less than 4 cm (W1), between 4 and 10 cm (W2), or more than 10 cm (W3) ⁽¹¹⁾. In case of multiple hernia defects, the width is considered the distance between the most laterally located margins of the most lateral defect ⁽¹¹⁾.

Table 1 - EHS classification of incisional abdominal wall hernias.

Medial (M)	M1 – Subxiphoid	Between the xiphoid and 3 cm below the xiphoid
	M2 – Epigastric	Between 3 cm below the xiphoid and 3 cm above the umbilicus
	M3 – Umbilical	Between 3 cm above and 3 cm below the umbilicus
	M4 – Infraumbilical	Between 3 cm below the umbilicus and 3 cm above the pubic bone
	M5 - Suprapubic	Between the pubic bone and 3 cm above the pubic bone
Lateral (L)	L1 – Subcostal	From the costal margin till a horizontal line 3 cm above the umbilicus
	L2 – Flank	Between a horizontal line 3 cm above and 3 cm below the umbilicus
	L3 – Iliac	Between a horizontal line 3 cm below the umbilicus and the inguinal region
	L4 – Lumbar	Lateral to the anterior axillary line

Depending on the location, size of the defect, clinical presentation and based on the patient's wishes, the incisional hernia can be managed expectantly, or it can be surgically repaired recurring to open, laparoscopic or hybrid techniques ⁽¹⁾⁽⁷⁾⁽¹²⁾.

The application of laparoscopic techniques to incisional hernia repair was first described by LeBlanc and Booth in 1993, which used the laparoscopic Intraperitoneal Onlay Mesh (IPOM) technique ⁽¹³⁾⁽¹⁴⁾. However, this technique presented some limitations and was associated with complications such as adhesive bowel obstruction, mesh erosion, enterocutaneous fistula and chronic pain resulting from mesh fixation ^{(15)–(18)}. In an effort to avoid the complications due to intraperitoneal mesh placement and prevent bulging or seroma formation, also associated with the IPOM technique, it was introduced the suture closure of the defect prior to mesh placement, an approach known as Intraperitoneal Onlay Mesh Plus (IPOM-Plus) ⁽¹⁵⁾⁽¹⁹⁾. Despite the advancements in this technique, it still presented high recurrence and complication rates ⁽¹⁴⁾⁽¹⁹⁾.

In order to avoid direct contact between the mesh and the abdominal organs, alternative mesh placements were developed such as in laparoscopic Transabdominal Preperitoneal (TAPP) repair ⁽²⁰⁾. This technique was originally described for inguinal hernia repair and then used in ventral hernia repair, including incisional hernias ⁽²⁰⁾⁽²¹⁾. In this approach, the hernia defect is sutured, and a synthetic mesh is placed directly behind the rectus muscle ⁽²¹⁾⁽²²⁾. However, the adoption of this method was limited by the technical difficulty, extended operative time and poor reproducibility ⁽²⁰⁾⁽²²⁾⁽²³⁾.

In 2012, Daes *et al.* described a new technique called the extended view Totally Extraperitoneal (e-TEP) for laparoscopic inguinal hernia repair, based on the laparoscopic Totally Extraperitoneal (TEP) inguinal hernia repair described by Ferzli and McKernan in 1992 and 1993 respectively ⁽¹⁸⁾⁽²⁴⁾⁽²⁵⁾. Latter the e-TEP technique was applied to ventral and incisional hernias repair by Belyansky *et al.*, in 2017 ⁽¹⁶⁾⁽²⁶⁾. The main goal of the e-TEP approach was to optimize the surgical workspace allowing a flexible trocar placement and enhancing the procedure ergonomics, thereby addressing certain limitations associated with previous methods ⁽¹⁶⁾⁽²¹⁾⁽²⁷⁾. The e-TEP technique has several potential advantages over traditional open or laparoscopic approaches to hernia repair, including reduced pain and scarring, faster recovery time, and lower rates of complications and hernia recurrence ^{(16),(26)–(28)}.

The aim of this study is to identify and evaluate the risk factors for incisional hernia development, evaluate the outcomes of e-TEP in terms of postoperative complications, surgery recovery and recurrence rates, and improve the understanding and management of incisional hernias.

Methods

For the present study were selected patients diagnosed with an incisional hernia that was surgically treated recurring to e-TEP technique at Centro Integrado de Cirurgia de Ambulatório (CICA) – Hospital Geral de Santo António, between October 2020 and February 2023.

The inclusion criteria were patients with a diagnosis of incisional hernia confirmed by imaging or physical examination, patients who undergo e-TEP hernia repair, patients 18 years or older and that who provided informed consent for participation in the study. Patients with missing medical records or incomplete data were excluded from the study.

The data regarding patient demographics, hernia characteristics, and peri-operative and postoperative were analysed. The main outcomes comprised surgery duration, peri and postoperative complications, length of hospital stay, 30-day readmission rates, follow-up time, hernia recurrence and pain assessment according to Numeric Rating Scale, where 0 corresponds to no pain and 10 to the worst pain possible.

The statistical analysis was conducted using version 25.0 of Statistical Package for Social Sciences (SPSS) software. Continuous quantitative variables were expressed as mean and standard deviation, whereas categorical variables' results were shown as percentages.

This study was approved by the Ethics Committee of Hospital Geral de Santo António with the decision dated 19th May 2023, reference number 2023.009(009-DEFI/009-CE).

Results

This study included 13 patients, 6 males (46.2%) and 7 females (53.8%), with a mean age of 53.6 years. The average Body Mass Index (BMI) was 34.1 kg/m², with 69.2% of the patients presenting with obesity. The mean American Society of Anaesthesiology (ASA) score was 2.2 and the most frequent comorbidities in this group of patients were type 2 diabetes, hypertension, and dyslipidaemia. *Table II* provides a comprehensive overview of the patient demographics.

Table II – Patients' Demographics.

Age (years)		53.6 ± 9.1
Gender (%)		
	Male	46.2 %
	Female	53.8 %
Body Mass Index (kg/m²)		34.1 ± 3.6
	Underweight (<18.5)	0 %
	Normal weight (18.5-24.9)	7.7 %
	Pre-obesity (25-29.9)	23.1 %
	Obesity class I (30-34.9)	30.7 %
	Obesity class II (35-39.9)	23.1 %
	Obesity class III (> 40)	15.4 %
ASA score		2.2 ± 0.5
Comorbidities (%)		
	Hypertension	30.7 %
	Dyslipidaemia	30.7 %
	Type 2 Diabetes	38.5 %
	COPD	0.0 %
Smoking (%)		23.1 %

Regarding the clinical presentation of the incisional hernia, at the time of diagnosis, 11 of the patients were asymptomatic while 2 presented with abdominal discomfort and pain. Applying the EHS Classification, all the patients exhibited medial hernias, with the majority being epigastric and umbilical incisional hernias. In 69.3% of the cases, the width of the defects ranged between 4 and 10 cm (W2), whereas the remaining patients had a defect inferior to 4 cm (W1). None of the patients presented with a defect size exceeding 10 cm (W3). The incisional hernias were recurrent in 3 cases, accounting for 23.1% of the total. *Table III* presents a summary of the incisional hernia characteristics observed in this group of patients.

Table III - Hernia characteristics.

Clinical presentation	Asymptomatic (%)	84.6 %
EHS Classification		
	Medial (%)	100 %
	M1	11.7 %
	M2	41.2 %
	M3	35.3 %
	M4	11.7 %
	M5	0.0 %
	Lateral (%)	0.0 %
	Width (%)	
	W1 (<4 cm)	30.7 %
	W2 (4-10 cm)	69.3 %
	W3 (>10 cm)	0.0 %
Incisional Hernia Recurrence (%)		23.1 %

Table IV - Peri-operative and postoperative data.

Surgery duration		172 minutes ± 30 minutes
Intra-operative complications		0.0 %
Wound-related Complications		
	Seroma	0.0 %
	Hematoma	7.7 %
	Wound infection	7.7 %
	Mesh infection	7.7 %
Non-wound-related complications		0.0 %
Length of hospital stay	Mean	0.2 days
	Same-day discharge	76.9 %
	Overnight stay	23.1 %
30 days readmissions		7.7 %
Follow-up time		15.7 ± 8.0 months
Hernia Recurrence		7.7 %

As for the surgical procedure, the average surgical time was 172 minutes, with no intra-operative complications reported. None of the cases required conversion to open surgery. Ten of the patients (76.9%) had same-day medical discharge, while 3 were only discharged the day after the surgery. Regarding the peri and postoperative complications, one patient (7.7%) presented with hematoma while another presented with wound and mesh infection requiring a new hospitalization and surgical intervention. No other complications were registered. The median follow-up time was 15.7

months, and 8 patients had completed at least one year of follow-up. One case of incisional hernia recurrence was observed 19 months after e-TEP hernia repair. *Table IV* displays the peri-operative and postoperative data.

Postoperative pain assessment was performed in 11 patients, using the Numeric Rating Scale ⁽²⁹⁾. *Figure 1* represents the pain progression reported by the patients, at 1, 3, 7, and 30 days after surgery, with the black line being the average pain score reported. At 1 and 3 days, most of the patients reported moderate to severe pain, with a mean score of 6.7 and 6.1, respectively. At the 7-day mark, the average pain score was 3.3, which decreased to 2.1 at 30 days, indicating that most of the patients presented with mild to no pain. After 30 days all except one patient had resumed normal daily activities.

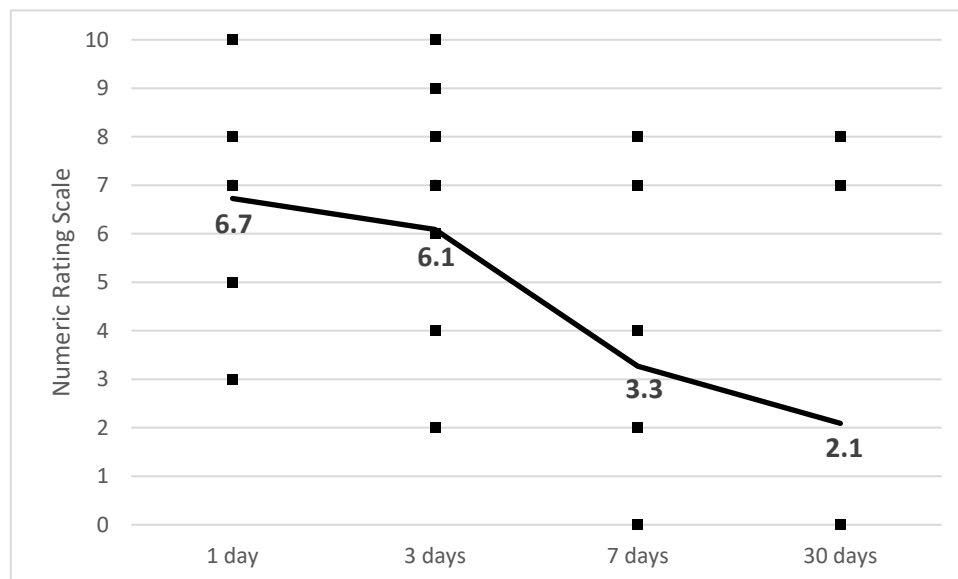


Figure 1 - Pain assessment after surgery using the Numeric Rating Scale, where 0 corresponds to no pain and 10 to the worst pain possible. The black line represents the average pain score reported by the patients.

Discussion

Incisional hernia is a common complication of abdominal wall surgery, with a reported incidence after open abdominal surgery of 2 to 20% ⁽⁹⁾. The presence of an incisional hernia is associated with significant morbidity and has a considerable impact on patients' overall quality of life ⁽³⁰⁾⁽³¹⁾.

For many years, open techniques were the only surgical treatment for incisional hernia repair ⁽³²⁾. Over the past few decades, laparoscopic hernia repair techniques have been developed and are continuously evolving, demonstrating the potential to supplant open repair methods ⁽³²⁾.

The e-TEP technique, described by Belyansky *et al.* for primary and incisional hernia repair, appears to be a safe and feasible new surgical approach for incisional hernia repairs, associated with shorter hospitalization, an early return to work and reduced surgical wound complications compared to the open approach ⁽⁷⁾⁽¹⁶⁾⁽²⁷⁾⁽³²⁾. However, evidence is still lacking regarding the perioperative, postoperative and long-term outcomes of this technique and there are limited studies comparing e-TEP to other surgical techniques ⁽²⁶⁾⁽³³⁾.

Aliseda *et al.* ⁽³³⁾ performed a meta-analysis of 13 studies based on the e-TEP approach. Regarding peri-operative characteristics, the intraoperative complications, conversion rate, operative time and length of hospital stay were evaluated. The meta-analysis reported a proportion rate of 2% for the intraoperative complications and 1% for the conversion rate, with a mean operative time of 148.89 minutes and a length of hospital stay of 1.77 days. Compared to the herein presented results, the meta-analysis showed higher values for intraoperative complications, conversion rate and length of hospital stay. Henriksen *et al.* ⁽¹⁵⁾ study found that the median duration of hospital stay after laparoscopic repair was significantly shorter than after open repair.

Due to the relatively recent implementation and challenging nature of the e-TEP technique longer operative times for e-TEP compared to other minimally invasive ventral hernia repair techniques have been reported ⁽³³⁾. When compared to IPOM and IPOM-Plus, the e-TEP technique has been reported to have significantly longer operative times ⁽³⁴⁾⁽³⁵⁾. Eker *et al.* ⁽³¹⁾ found that operative time in laparoscopic techniques was significantly longer when compared to the open surgery approach.

Some complications can emerge from the e-TEP approach such as surgical site infection, hematoma, seroma, postoperative ileus, mesh infections and non-wound-related complications ⁽¹⁸⁾⁽²⁸⁾⁽³³⁾. In the study conducted by Kumar *et al.* ⁽³⁶⁾, it was found a 13% incidence of seroma and a 4% recurrence rate. Chalabi *et al.* ⁽⁷⁾ reported a significantly reduced risk of infection in laparoscopy techniques,

with infection rates being nearly five times lower compared to open surgery. Regarding recurrence, no significant difference between the two methods was found ⁽⁷⁾.

Concerning postoperative pain, the reduction in pain is a compelling rationale for the adoption of minimally invasive techniques ⁽³⁷⁾. In Luque *et al.* ⁽³⁴⁾ study, the e-TEP approach had significantly less pain when compared to other approaches such as IPOM Plus, with a mean score of 2.8 at 24 hours measured using the Visual Analog Scale (VAS). Kumar *et al.* ⁽³⁶⁾ reported an average pain score of 5.4 and 2.4 at 7- and 30 days post-surgery, which is similar to the pain scores presented in this study. Postoperative cumulative parenteral analgesia requirement was significantly lower in patients who underwent e-TEP repair ⁽³⁶⁾.

Another important outcome when adopting a new surgical technique is the quality of life and the functional impact it brings to patients ⁽³⁸⁾. Luque *et al.* ⁽³⁴⁾ showed that patients submitted to e-TEP hernia repair presented a faster functional recovery when compared to other approaches, measured using the European Registry for Abdominal Wall Hernias – Quality of Life (EuraHS-QoL) score for restriction.

Regarding cost analysis, the use of uncoated polypropylene meshes allied to reduced hospitalization time, shorter recovery periods, and decreased postoperative complications allow to minimize the cost of the e-TEP procedure ⁽³³⁾⁽³⁴⁾⁽³⁶⁾. However, laparoscopic techniques, such as e-TEP, are associated with higher costs for disposable surgical materials when compared to open surgery ⁽³⁹⁾.

Despite the numerous advantages of the e-TEP technique, it presents some limitations ⁽¹⁶⁾. Previous xiphoid incision extending from the xiphoid process to the pubic bone, previous retromuscular ventral hernia repair, incarcerated hernias, dystrophic or ulcerated skin and loss of domain are relative contraindications of the e-TEP technique while active mesh infection or fistulas constitute absolute contraindications of this approach ⁽¹⁶⁾⁽⁴⁰⁾.

This study presents some limitations regarding sample number, quality of life assessment and comparison to other hernia repair techniques. Despite its limitations, the present study provides valuable insights into hernia development risk factors and e-TEP outcomes regarding postoperative complications, surgery recovery and recurrence rates.

Conclusion

The e-TEP is a promising technique in the surgical management of incisional hernias. This minimally invasive procedure offers several advantages, including improved visualization, broader access to the hernia defect, and reduced postoperative pain. The e-TEP approach allows for effective mesh placement in the preperitoneal space, promoting optimal tissue ingrowth and long-term stability.

As a new approach to hernia repair, further studies are needed to evaluate the short- and long-term outcomes as well as to compare the e-TEP procedure with other incisional hernia repair techniques. These future studies will provide a more comprehensive understanding of the indications and limitations of the e-TEP technique, allowing for evidence-based decision-making in surgical practice.

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