

Clinical Outcome of Extended Total Extraperitoneal Rives-stopppa versus Intraperitoneal Onlay Mesh Repair in Ventral Hernia: A Prospective Interventional Study

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ABSTRACT

Introduction: Umbilical hernias are a common anterior abdominal wall defect, often necessitating surgical intervention to prevent complications such as incarceration and recurrence. Among minimally invasive approaches, the extended Total Extraperitoneal Rives-Stopppa (eTEP-RS) and Intraperitoneal Onlay Mesh (IPOM) techniques are widely used.

Aim: To compare the clinical outcomes of two laparoscopic techniques, the eTEP-RS and IPOM techniques, in patients undergoing umbilical hernia repair.

Materials and Methods: A prospective interventional study was conducted over 16 months (March 2023 to July 2024) in the Department of General Surgery, SRM Medical College Hospital and Research Centre, Tamil Nadu, India, involving 60 patients diagnosed with primary umbilical hernia. Participants were equally divided into two groups: eTEP-RS group (n=30) and IPOM group (n=30). Parameters assessed included operative time, postoperative pain by Visual Analogue Scale (VAS) score, Surgical Site Infection (SSI), hospital stay and recurrence rates. Continuous variables such as operative time, VAS scores, and duration of hospital stay were first assessed

for normality. Non normally distributed data were expressed as median with interquartile range and compared using the Mann-Whitney U test. Categorical variables, including SSI and recurrence, were presented as frequencies and percentages, and compared using the Chi-square test or Fisher's-exact test where appropriate. A p-value of less than 0.05 was considered statistically significant.

Results: Patients in the eTEP-RS group had significantly lower postoperative pain scores at 6 hours, 24 hours, and one week postoperatively (p-value <0.001). The eTEP-RS group also showed a shorter mean hospital stay (4.6±3.17 days) compared to the IPOM group (5.9±2.19 days) (p-value=0.02). The operative time was significantly longer in the eTEP-RS group (p-value <0.001). SSIs were absent in the eTEP-RS group but occurred in one patient in the IPOM group. No recurrences were reported in either group during the follow-up period.

Conclusion: The eTEP-RS technique offers significant benefits in terms of reduced postoperative pain and shorter hospital stay, with comparable safety and recurrence rates. It represents a promising alternative to IPOM, particularly in resource-optimised laparoscopic settings.

Keywords: Herniorrhaphy, Laparoscopic hernia surgery, Postoperative outcomes, Surgical wound infection

INTRODUCTION

Umbilical hernia is a common anterior abdominal wall defect frequently encountered in general surgical practice, particularly among individuals with elevated intra-abdominal pressure due to obesity, pregnancy, ascites, or chronic straining [1]. While small hernias may remain asymptomatic, larger defects can result in pain, cosmetic concerns, and life-threatening complications such as incarceration and strangulation [2].

Traditionally, open suture repair was the standard method, but due to high recurrence rates, prosthetic mesh repairs became the preferred approach. Among the minimally invasive methods, two prominent laparoscopic techniques are employed: IPOM repair and the eTEP-RS technique. IPOM, introduced by LeBlanc KA et al., in 1993, involves intraperitoneal mesh placement and is known for its technical simplicity. However, it carries risks such as adhesion, bowel erosion, and increased postoperative pain due to trans-fascial fixation [3]. Conversely, the eTEP-RS technique, adapted from Daes J's work in 2012, positions the mesh in the retrorectus plane without entering the peritoneal cavity, thereby minimising mesh-related complications. It provides a larger working space and better mesh integration while preserving anatomical planes. However, it demands advanced laparoscopic skills and a longer operative time [4].

Existing literature suggests that eTEP-RS may offer advantages in terms of reduced postoperative pain, shorter hospital stays, and lower

rates of SSIs, although it requires longer operating times [5,6]. IPOM, while widely practised and simpler to perform, has been associated with a relatively higher risk of adhesions and seromas [7].

There is a lack of robust comparative data evaluating the outcomes of eTEP-RS and IPOM techniques, specifically in the context of primary umbilical hernia repair. Literature available on laparoscopic ventral hernia repair is retrospective, single-centre, or limited to single-surgeon experiences, thereby providing only restricted evidence on early postoperative outcomes such as pain, SSI, and hospital stay [8]. The present study aims to fill this gap by providing a prospective analysis of eTEP-RS and IPOM repairs in a well-matched patient population. Its uniqueness lies in the targeted focus on primary umbilical hernias and practical relevance for surgical units operating in resource-limited environments. The results are intended to support more informed technique selection and contribute to improved perioperative management in routine laparoscopic hernia surgery. Hence, this study aimed to compare these two techniques in terms of operative time, hospital stay, recurrence rate, and surgical outcomes. The findings will help refine surgical decision-making and optimise patient care, particularly in resource-limited settings.

MATERIALS AND METHODS

This study was designed as a prospective interventional study, conducted over a period of 16 months (March 2023 to July 2024) in

the Department of General Surgery, SRM Medical College Hospital and Research Centre, Tamil Nadu, India. The study was approved by the Institutional Ethics Committee (IEC No: SRMIEC-ST0624-1309). Informed written consent was obtained from all participants before inclusion in the study.

Inclusion criteria: Adult patients above 18 years of age, diagnosed with primary umbilical hernia and scheduled for elective laparoscopic repair under general anaesthesia, were considered eligible. The hernia defect size was restricted to 6 cm or less. The restriction to hernia defects measuring ≤ 6 cm was applied to ensure technical feasibility, standardisation of patient selection, and reproducibility between the two laparoscopic approaches (eTEP-RS and IPOM). Repair of larger defects often requires more complex myofascial release, larger mesh sizes, and carries a higher risk of recurrence. By focusing on ≤ 6 cm defects, our study population remained homogeneous, enabling meaningful comparison of perioperative outcomes. Recent prospective studies have also limited inclusion to this range. A randomised controlled trial from New Delhi (2019–2023) specifically included primary umbilical and para-umbilical hernias >2 cm and up to 6 cm, aligning with the European Hernia Society (EHS) classification (W1/W2) [9]. In addition, a recent Delphi consensus proposed a procedure selection algorithm stratified by defect width, recommending eTEP-RS primarily for defects 5–8 cm, while smaller defects were managed with IPOM/IPOM-Plus [10]. This further validates our choice of ≤ 6 cm as a practical and guideline-concordant cut-off.

Exclusion criteria: Patients were excluded if they were younger than 18 years, had incisional or complicated hernias, had defect sizes >6 cm or were medically unfit for general anaesthesia.

Sample size calculation: The required sample size was calculated based on the primary outcome variable: postoperative pain, as measured by the VAS score. Data from a previous comparative study by Jain M et al. (2022) [6] reported VAS scores of 4.5 ± 0.8 for eTEP-RS and 5.5 ± 0.6 for IPOM on postoperative day one [6].

Using the formula for comparing two independent means:

$$\frac{(Z\alpha/2 + Z1-\beta)^2 \cdot (\sigma_1^2 + \sigma_2^2)}{(\mu_1 - \mu_2)^2}$$

where-

- $Z\alpha/2 = 1.96$ (95% confidence),
- $Z1-\beta = 0.84$ (80% power),
- $\mu_1 - \mu_2 = 1.0$,
- $\sigma_1 = 0.8$, $\sigma_2 = 0.6$

The calculated sample size was approximately eight patients per group. To improve statistical reliability and account for potential dropouts, 30 patients were enrolled in each group, resulting in a total sample size of 60.

Study Procedure

All patients underwent preoperative evaluation, including clinical history, physical examination, routine blood investigations, and abdominal imaging {Ultrasonography (USG) or Computed Tomography (CT) scan}. The choice of surgical technique, either eTEP-RS or IPOM, was based on the surgeon's discretion and institutional protocol. Patients were equally divided into two groups of 30 each.

eTEP-RS technique: Performed under general anaesthesia, the retrorectus space was developed via a horizontal incision in the posterior rectus sheath. A 15×15 cm polypropylene mesh was placed and fixed with endotackers. Fascial closures were performed, and the abdomen was decompressed before wound closure.

IPOM technique: Pneumoperitoneum was established using a Veress needle. Hernia contents were reduced, the defect was closed using 1-0 Prolene sutures, and a 15×15 cm composite mesh was positioned intraperitoneally and secured with endotackers.

Postoperative assessment parameters: Postoperative outcomes were systematically recorded and compared between groups. Pain was evaluated using the VAS at six hours, 24 hours, and on the 7th postoperative day, as well as at six weeks and three months, both at rest and during activity. SSI was identified according to the Centers for Disease Control and Prevention (CDC) criteria and monitored on postoperative days 0, 3, and 7 and during subsequent follow-up visits [11]. The length of hospital stay was calculated from the day of surgery until discharge, with discharge criteria including clinical stability, adequate pain control ($VAS \leq 3$), tolerance of oral diet, and independent ambulation. Recurrence was assessed clinically at one, three, and six months, with ultrasonography or computed tomography performed when recurrence was suspected. Postoperative complications such as seroma, haematoma, mesh migration, bowel obstruction, and pneumoperitoneum-related respiratory issues were documented and managed as per institutional protocol. Operative time was measured in minutes, beginning with skin incision and ending with wound closure.

STATISTICAL ANALYSIS

All data collected during the study were compiled and analysed using IBM SPSS Statistics for Windows, Version 26.0 (IBM Corp., Armonk, NY, USA). Continuous variables such as operative time, pain scores, and duration of hospital stay were presented as Mean $\pm$ Standard Deviation (SD). These were compared between the two groups using the unpaired (Independent) t-test. Categorical data, including gender distribution, incidence of complications, and SSIs, were compared using the Chi-square test or Fisher's-exact test, depending on data distribution and sample size. A value of p-value < 0.05 was considered statistically significant.

RESULTS

A total of 60 patients were analysed, with 30 patients each in the eTEP-RS and IPOM groups. Both groups were well-matched in terms of age, sex distribution, Body Mass Index (BMI), hernia location, and duration of symptoms, with no statistically significant differences noted [Table/Fig-1]. Paraumbilical hernias were the most common in both groups.

Characteristics	eTEP-RS group n (%)	IPOM group n (%)	p-value
Age (years) (Mean $\pm$ SD)	47.9 $\pm$ 13.2 (Range: 25–65)	47.1 $\pm$ 10.9 (Range: 29–65)	0.8
Gender (Male: Female) (Mean $\pm$ SD)	14: 16 (46.7%: 53.3%)	13: 17 (43.3%: 56.7%)	0.5
BMI (kg/m ²) (Mean $\pm$ SD)	27.9 $\pm$ 1.5	28.0 $\pm$ 1.6	0.8
Hernia duration (months) (Mean $\pm$ SD)	23.3 $\pm$ 7.5	24.7 $\pm$ 7.4	0.5
Hernia location			0.7
Infraumbilical	10 (33.30%)	11 (36.70%)	
Paraumbilical	16 (53.40%)	15 (50%)	
Supraumbilical	4 (13.30%)	4 (11.30%)	

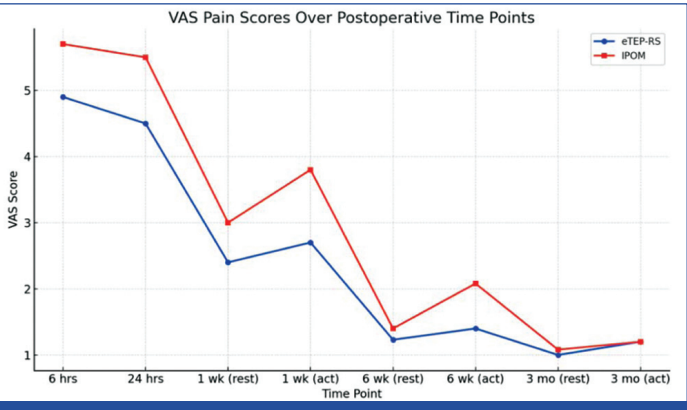
[Table/Fig-1]: Baseline characteristics comparing the eTEP-RS and IPOM groups.

The mean operative time was significantly longer in the eTEP-RS group (99.6 $\pm$ 22.6 minutes) compared to the IPOM group (57.1 $\pm$ 19.1 minutes) (p-value < 0.001). Mesh fixation differed between the groups: only 3 (10%) patients in the eTEP-RS group required trans-fascial sutures, while 30 (100%) of patients in the IPOM group underwent double-crowning fixation using sutures and tackers. Postoperative pain scores, assessed using the VAS, were significantly lower in the eTEP-RS group at six hours, 24 hours, and one week postoperatively (both at rest and during activity; p-value=0.001). A significant difference persisted at six weeks during activity (p-value=0.005), but pain scores became similar between the groups by three months [Table/Fig-2,3]. SSI were reported in one patient (3.3%) in the IPOM group and none in the eTEP-RS

group (p-value=1.000). The average hospital stay was shorter for the eTEP-RS group (4.6±3.17 days) compared to the IPOM group (5.9±2.19 days) (p-value=0.02) [Table/Fig-2]. Although hospital stay values are higher than what is typically reported in literature, this may reflect institutional protocols, routine postoperative observation practices, or delayed discharges due to associated co-morbidities. There were no recurrences in either group during the six-month follow-up period. No complications like seroma, haematoma, mesh migration or bowel obstruction were seen in either group.

Outcome measures	eTEP-RS group (Mean±SD)	IPOM group (Mean±SD)	p-value
Operative time (minutes)	99.6±22.6	57.1±19.1	<0.001
Mesh fixation n (%)	3/30 (10% with trans-fascial sutures)	30/30 (100% with double crowning + sutures)	<0.001
VAS pain score at 6 h	4.9±0.7	5.7±0.6	0.001
VAS pain score at 24 h	4.5±0.8	5.5±0.6	0.001
VAS at 1 week (rest)	2.4±0.7	3.0±0.6	0.0017
VAS at 1 week (activity)	2.7±0.9	3.8±0.8	0.001
VAS at 6 weeks (rest)	1.23±0.8	1.4±0.5	0.36
VAS at 6 weeks (activity)	1.4±1.0	2.08±0.63	0.005
VAS at 3 months (rest)	1.0±0.6	1.08±0.27	0.53
VAS at 3 months (activity)	1.2±0.8	1.2±0.4	1
Surgical Site Infections (SSI) n (%)	0 at POD 0, POD 3, and POD 7	0 at POD 0, POD 3, and 1(3.3%) POD 7	1.000
Hospital stay (days)	4.6±3.17	5.9±2.19	0.02
Recurrence rate (%)	0	0	1.000

[Table/Fig-2]: Comparing outcomes between the eTEP-RS and IPOM groups.



[Table/Fig-3]: The VAS pain scores at different postoperative time points.

Further analysis by gender revealed no significant difference in outcomes such as pain, infection, hospital stay, or recurrence rates (p-value >0.05) as shown in [Table/Fig-4].

Parameters	Male (n=27)	Female (n=33)	p-value
Operative time (min), (mean±SD)	79.5±20.2	76.8±22.3	0.62
VAS (24 hrs), (Mean±SD)	4.9±0.6	5.0±0.7	0.58
SSI (n, %)	0	1 (3%)	0.64
Hospital stay (days) , (Mean±SD)	5.0±2.1	5.2±2.2	0.74
Recurrence	0	0	-

[Table/Fig-4]: Gender-wise comparison of operative and postoperative outcomes.

DISCUSSION

This prospective interventional study was conducted to compare the efficacy and safety of two laparoscopic techniques, eTEP-RS and IPOM, for the repair of umbilical hernia. The comparison focused on

perioperative and postoperative outcomes, including operative time, postoperative pain, SSI, hospital stay, and recurrence rates. The results demonstrated that while both techniques are effective and safe, eTEP-RS offers several advantages in the early postoperative period.

One of the most significant findings in this study was the reduction in postoperative pain in the eTEP-RS group compared to the IPOM group. Pain was assessed using the VAS at multiple time points. Patients undergoing eTEP-RS reported significantly lower pain scores at 6 hours, 24 hours, and at 1 week postoperatively, both at rest and during activity (p-value=0.001). These results are consistent with findings by Jain M et al., (2022), who reported significantly lower early postoperative pain scores in patients who underwent eTEP compared to IPOM [6]. Li J et al., (2022) also corroborated the pain-relieving benefits of eTEP-RS, finding a day 1 VAS score of 1.84 in eTEP-RS patients compared to 3.2 in the IPOM group [7]. The absence of trans-fascial sutures and tackers in most eTEP-RS procedures reduces somatic pain, which is frequently encountered in IPOM repairs due to fixation to the abdominal wall. Although this study showed similar VAS scores at three months in both groups, the early postoperative period demonstrated a clear advantage for eTEP-RS.

Regarding SSI, the current study recorded a 0% infection rate in the eTEP-RS group and 1 patient (3.3%) in the IPOM group. Although not statistically significant, this aligns with the literature indicating that eTEP-RS is associated with fewer wound complications. Jain M et al., (2022) reported a 6.7% SSI rate in IPOM patients, compared to none in the eTEP group (p-value <0.05) [6]. Similarly, Xu H et al., (2023) observed a 9.6% SSI rate in IPOM versus 0% in eTEP-RS. The extraperitoneal approach minimises exposure to intra-abdominal contents and reduces the risk of mesh contamination [8]. Moreover, reduced dissection of peritoneal surfaces in eTEP-RS contributes to a more favourable healing environment.

The duration of hospital stay was significantly shorter in the eTEP-RS group in this study (4.6±3.17 days vs. 5.9±2.19 days; p-value=0.02). Although eTEP-RS is technically more demanding and requires a longer operative time, its associated reduction in pain and complications facilitates faster recovery. This finding is similar to results reported by Li J et al., (2022), who also observed shorter hospital stays with eTEP-RS (mean 4.6 vs. 5.9 days; p-value=0.02) [7]. Xu H et al., (2023) found a more dramatic difference (1.2 days for eTEP-RS vs. 2.2 days for IPOM, p-value <0.01), highlighting its value in enhancing postoperative recovery [8]. Faster ambulation and fewer narcotic requirements likely contribute to this trend.

Notably, the eTEP-RS group took significantly longer to perform the surgery in the current study (99.6 minutes compared to 57.1 minutes; p-value <0.001), which shows that this procedure is more technically challenging. This is a commonly reported limitation of the technique. Jain M et al., (2022) and Binthaf PP and Parag G, (2025) also found that eTEP-RS had longer operative times compared to IPOM, particularly during the surgeon's learning curve [6,12]. However, it is widely accepted that with experience, the time disparity narrows and may become negligible. No recurrences were observed in either group during the 6 month follow-up period in this study. This is in line with studies by Jain M et al., 2022 and Sholapur S et al., (2024), which also reported 0% recurrence rates over similar follow-up durations [6,9]. Jain M et al. (2022) reported slightly higher recurrence in IPOM (1.2%) compared to eTEP-RS (0%), although the difference was not statistically significant [6]. The mesh location in eTEP-RS, situated within the retro-muscular space, provides enhanced mechanical support and reduces the risk of bulging or recurrence.

Gender-based analysis in the present study showed no significant variation in outcomes between males and females, indicating that both surgical techniques are equally effective across sexes. These observations were consistent with findings by Xu H et al., (2023), who also reported no statistically significant differences in

postoperative pain, complications, or recurrence between male and female patients [8]. In terms of mesh fixation, all IPOM cases used trans-fascial sutures and double crowning, whereas only 10% of eTEP-RS cases required sutures. This difference not only contributes to the pain differential but also impacts mesh-related complications such as seromas and infection. Studies by Aliseda D et al., (2022) and Henriksen NA et al., (2020) support these findings, emphasising that retro muscular mesh placement reduces the need for fixation and enhances integration into the native tissue [2,13].

However, earlier reports indicate that despite longer operative times and higher initial expense, eTEP-RS can provide long-term benefits by reducing complications, lowering recurrence rates, and shortening hospital stay [14].

Limitation(s)

This study has certain limitations that must be acknowledged. It was conducted at a single institution with a relatively small cohort, which may affect the wider applicability of the results. Patient allocation to the eTEP-RS or IPOM groups was determined by surgeon preference and institutional protocol rather than by randomisation, which may have introduced selection bias. The duration of follow-up was limited to six months, and therefore, the study could not evaluate long-term recurrence or mesh-related complications. Additionally, a cost-effectiveness analysis was not conducted, which limits the conclusions regarding the economic aspects of the two techniques.

CONCLUSION(S)

This study supports the growing body of evidence favouring the eTEP-RS technique over IPOM for primary umbilical hernia repair, particularly in terms of early postoperative pain, infection rates, and hospital stays. However, the requirement for advanced laparoscopic expertise and longer operative time remains a consideration. It needs larger multicentre studies with extended follow-up to validate long-term outcomes, recurrence rates, and economic benefits.

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