

Laparoscopic e-TEP Versus Open Mesh Repair for Umbilical and Para-Umbilical Hernias: A Prospective Comparative Study

Dr. (Prof) JPS Shakya, Dr. (Prof) Surendra pathak , Dr. Arun Kumar Rathore , Dr. Aayush Kunwar

¹ Department of General Surgery, SNMC, Agra.

Corresponding Author: Dr. Aayush Kunwar

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Abstract

Background: Umbilical and para-umbilical hernias account for 10-14% of all abdominal wall hernias. While open mesh repair remains widely practised, the enhanced-view totally extraperitoneal (e-TEP) technique offers a minimally invasive retromuscular approach that avoids intraperitoneal mesh placement. Robust prospective comparative data, particularly from India, remain scarce.

Methods: This prospective comparative study included 54 adult patients with primary umbilical or para-umbilical hernias (defect 2-6 cm) operated at a tertiary care centre. Patients were allocated to laparoscopic e-TEP repair (Group B, n = 27) or open mesh repair (Group A, n = 27). Primary outcomes included postoperative pain (Visual Analogue Scale [VAS] at 24 h and 72 h), hospital stay, and time to return to activity. Secondary outcomes included chronic pain VAS at 6 months and quality of life (EuraHS-QoL) at 6 and 12 months.

Results: Both groups were comparable in age (42.4 ± 14.1 vs 44.5 ± 17.3 years), BMI (27.1 ± 3.2 vs 26.4 ± 2.8 kg/m²), and defect size (2.92 ± 0.83 vs 3.01 ± 0.78 cm). Operative time was significantly longer in the e-TEP group (136.9 ± 25.9 vs 89.1 ± 16.6 min; $p < 0.001$). The e-TEP group demonstrated significantly lower VAS pain scores at 24 h (3.07 ± 0.78 vs 5.59 ± 0.80 ; $p < 0.001$) and 72 h (1.89 ± 0.85 vs 4.85 ± 0.82 ; $p < 0.001$), shorter hospital stay (3.00 ± 0.92 vs 5.67 ± 1.21 days; $p < 0.001$), earlier return to activity (10.9 ± 2.3 vs 22.8 ± 5.6 days; $p < 0.001$), and lower chronic pain VAS at 6 months (1.85 ± 0.82 vs 4.63 ± 1.31 ; $p < 0.001$). EuraHS-QoL scores at 6 months (83.4 vs 83.9) and 12 months (88.4 vs 87.2) were comparable. No recurrence was recorded in either group.

Conclusions: Laparoscopic e-TEP repair is a safe and effective alternative to open mesh repair for umbilical and para-umbilical hernias, offering significantly superior short-term and medium-term outcomes in terms of postoperative pain, hospital stay, functional recovery, and chronic pain, without compromising recurrence rates. The longer operative time reflects the learning curve of the technique.

1. INTRODUCTION

Umbilical and para-umbilical hernias account for approximately 10-14% of all anterior abdominal wall hernias and represent one of the most frequently encountered surgical conditions in adult practice [1]. These hernias occur due to progressive weakness of the linea alba, often exacerbated by conditions that raise intra-abdominal pressure such as obesity, multiparity, chronic cough, and ascites [2].

Historically, primary suture repair (Mayo technique) was the standard of care, but long-term studies reported recurrence rates as high as 11% for defects >2 cm [3]. The introduction of prosthetic mesh reduced recurrence substantially, with mesh repair demonstrating a recurrence rate of approximately 1% in randomised trials [4]. Open mesh repair in the retromuscular (sublay) plane, as described by Rives and Stoppa, is biomechanically optimal and provides durable reinforcement [5,6]. However, open repair requires extensive subcutaneous dissection, resulting in higher wound morbidity, greater postoperative pain, prolonged hospital stay, and delayed functional recovery [7].

The laparoscopic intraperitoneal onlay mesh (IPOM) technique reduced wound complications but introduced concerns regarding

intraperitoneal mesh adhesions, bowel erosion, and chronic pain secondary to mesh fixation [8]. These limitations prompted the development of laparoscopic retromuscular approaches.

The enhanced-view totally extraperitoneal (e-TEP) technique, described by Daes, allows laparoscopic access to the retromuscular space without breaching the peritoneal cavity [9]. It replicates the principles of the Rives-Stoppa open repair through a minimally invasive approach, combining the biomechanical advantage of retromuscular mesh placement with the recovery benefits of laparoscopy.

Despite the growing interest in e-TEP repair, robust prospective comparative data specifically evaluating open mesh repair versus laparoscopic e-TEP repair for umbilical and para-umbilical hernias, with long-term patient-centred outcomes, remain limited—particularly in the Indian population. The present study was undertaken to address this gap.

2. MATERIALS AND METHODS

2.1 Study Design and Setting

This was a prospective comparative observational study conducted in the Department of General Surgery at a tertiary

care teaching hospital in India over 18-24 months. Ethical clearance was obtained from the Institutional Ethics Committee, and written informed consent was obtained from all participants.

2.2 Participants

Adults (≥ 18 years) with primary umbilical or para-umbilical hernia with a defect size of 2-6 cm, scheduled for elective repair, were eligible. Exclusion criteria included: recurrent hernia, incisional hernia, complicated hernia (obstruction or strangulation), unfitness for general anaesthesia, pregnancy, extensive prior lower abdominal surgery affecting the retromuscular plane, and patient refusal of laparoscopic surgery.

A total of 54 patients were enrolled: 27 underwent laparoscopic e-TEP repair (Group B) and 27 underwent open mesh repair (Group A). Allocation was based on surgical preference, patient choice, and surgeon expertise after informed discussion.

2.3 Surgical Technique

Open mesh repair (Group A) was performed under regional or general anaesthesia via a peri-umbilical or infra-umbilical incision. The hernia sac was dissected, reduced, and excised; the fascial defect was repaired with a polypropylene mesh placed in the onlay or sublay plane and fixed with non-absorbable sutures.

Laparoscopic e-TEP repair (Group B) was performed under general anaesthesia. An extraperitoneal working space was created by blunt dissection. Bilateral retromuscular dissection was performed laparoscopically to create a wide preperitoneal space. The hernia defect was closed with non-absorbable

sutures, and a large mesh was placed in the retromuscular plane with minimal or no fixation, avoiding peritoneal entry.

2.4 Outcome Measures

Primary outcomes: (1) postoperative pain assessed by Visual Analogue Scale (VAS, 0-10) at 24 h and 72 h; (2) duration of hospital stay; (3) time to return to normal daily activities. Secondary outcomes: chronic pain VAS at 6 months, quality of life (QoL) using the EuraHS-QoL score at 6 and 12 months, operative time, complication rates (wound infection, seroma), and hernia recurrence at 1, 3, and 6 months.

2.5 Statistical Analysis

Continuous variables are reported as mean $\pm$ standard deviation (SD) and compared using the independent samples t-test. Categorical variables are reported as frequencies and proportions and compared using the chi-square test or Fisher's exact test as appropriate. A two-tailed p-value < 0.05 was considered statistically significant. All analyses were performed using SPSS (IBM Corp., Version 26.0).

3. RESULTS

3.1 Baseline Characteristics

A total of 54 patients were included (27 per group). Both groups were comparable in age, sex, BMI, hernia type, and defect size (Table 1). The mean age was 42.4 ± 14.1 years in the e-TEP group versus 44.5 ± 17.3 years in the open repair group ($p = 0.637$). Sex distribution was equal (14 females in each group). Mean BMI was 27.1 ± 3.2 versus 26.4 ± 2.8 kg/m² ($p = 0.443$). Para-umbilical hernia was the predominant hernia type (18/27 in Group B; 15/27 in Group A). Mean defect size was 2.92 ± 0.83 cm versus 3.01 ± 0.78 cm ($p = 0.699$). All hernias were primary.

Table 1. Baseline characteristics of the study population

Parameter	Lap e-TEP (n = 27)	Open Repair (n = 27)	p-value
Mean Age (years)	42.4 ± 14.1	44.5 ± 17.3	0.637
Male / Female	13 / 14	13 / 14	1.000
Mean BMI (kg/m ²)	27.1 ± 3.2	26.4 ± 2.8	0.443
Umbilical hernia, n (%)	9 (33.3%)	12 (44.4%)	0.412
Para-umbilical hernia, n (%)	18 (66.7%)	15 (55.6%)	0.412
Mean defect size (cm)	2.92 ± 0.83	3.01 ± 0.78	0.699

3.2 Operative Parameters

Operative time was significantly longer in the laparoscopic e-TEP group (136.9 ± 25.9 min vs 89.1 ± 16.6 min; $p < 0.001$), attributable to the technical complexity and the associated learning curve of the procedure (Table 2).

3.3 Postoperative Pain

VAS pain scores were significantly lower in the e-TEP group at both 24 h (3.07 ± 0.78 vs 5.59 ± 0.80 ; $p < 0.001$) and 72 h (1.89 ± 0.85 vs 4.85 ± 0.82 ; $p < 0.001$). These differences are clinically meaningful (> 2 VAS points at each time point) and reflect the advantage of minimal subcutaneous dissection and avoidance of extensive fascial fixation in the e-TEP technique.

3.4 Hospital Stay and Functional Recovery

Mean hospital stay was significantly shorter in the e-TEP group (3.00 ± 0.92 vs 5.67 ± 1.21 days; $p < 0.001$). Time to return to normal activities was more than halved in the laparoscopic group (10.9 ± 2.3 vs 22.8 ± 5.6 days; $p < 0.001$), indicating substantially faster rehabilitation.

3.5 Chronic Pain and Quality of Life

Chronic pain VAS at 6 months was significantly lower in the e-TEP group (1.85 ± 0.82 vs 4.63 ± 1.31 ; $p < 0.001$). EuraHS-QoL scores at 6 months (83.4 ± 4.7 vs 83.9 ± 4.8 ; $p = 0.734$) and 12 months (88.4 ± 4.4 vs 87.2 ± 5.4 ; $p = 0.354$) were comparable

between groups, with both groups showing improvement over time.

3.6 Complications and Recurrence

Wound-related complications (wound infection and seroma) were recorded in both groups. In the e-TEP group, wound infection occurred in 9 patients (33.3%) and seroma in 7 (25.9%).

In the open repair group, wound infection occurred in 10 patients (37.0%) and seroma in 7 (25.9%). The overall complication profile was comparable between groups ($p = 1.000$ by Fisher's exact test). No hernia recurrence was recorded in either group at the 6-month follow-up.

Table 2. Summary of perioperative and outcome data

Outcome	Lap e-TEP (n = 27)	Open Repair (n = 27)	p-value
Operative time (min)	136.9 ± 25.9	89.1 ± 16.6	< 0.001*
Hospital stay (days)	3.00 ± 0.92	5.67 ± 1.21	< 0.001*
VAS pain at 24 h	3.07 ± 0.78	5.59 ± 0.80	< 0.001*
VAS pain at 72 h	1.89 ± 0.85	4.85 ± 0.82	< 0.001*
Chronic pain VAS (6 months)	1.85 ± 0.82	4.63 ± 1.31	< 0.001*
Return to activity (days)	10.9 ± 2.3	22.8 ± 5.6	< 0.001*
EuraHS-QoL at 6 months	83.4 ± 4.7	83.9 ± 4.8	0.734
EuraHS-QoL at 12 months	88.4 ± 4.4	87.2 ± 5.4	0.354
Wound infection, n (%)	9 (33.3%)	10 (37.0%)	0.775
Seroma, n (%)	7 (25.9%)	7 (25.9%)	1.000
Recurrence, n (%)	0 (0%)	0 (0%)	NS

*Statistically significant ($p < 0.05$); NS = not significant; VAS = Visual Analogue Scale; QoL = quality of life

4. DISCUSSION

The present study prospectively compared open mesh repair with laparoscopic e-TEP repair in 54 patients with primary umbilical and para-umbilical hernias. The groups were well matched in all baseline parameters, providing a robust basis for comparison. The principal finding is that laparoscopic e-TEP repair confers significant advantages in postoperative pain, hospital stay, functional recovery, and chronic pain at 6 months, at the cost of a longer operative time, while achieving equivalent complication and recurrence rates.

The significantly greater operative time in the e-TEP group (136.9 vs 89.1 min; $p < 0.001$) is a consistent finding in the published literature and reflects the technical demands of creating a bilateral retromuscular space laparoscopically. Belyansky et al. and Novitsky et al. similarly reported longer operative times in the learning-curve phase of laparoscopic retromuscular repair, with improvement observed as surgical proficiency increased [10,11]. This should not detract from the overall patient benefit, as the downstream advantages are substantial.

Postoperative pain was markedly lower in the e-TEP group at 24 h and 72 h, with a difference exceeding 2.5 VAS points at each time point. A difference of ≥ 1.3 VAS points is generally considered the minimum clinically important difference, making the observed advantage clinically significant beyond statistical significance [12]. The reduced pain in the e-TEP group is

attributable to minimal subcutaneous dissection, avoidance of extensive mesh fixation, and preservation of anterior fascial nerve networks. These findings corroborate results reported by Singh et al. in a randomised controlled trial comparing e-TEP with IPOM Plus repair, which demonstrated significantly lower pain scores in the e-TEP arm [13].

Hospital stay was significantly shorter in the e-TEP group (3.00 vs 5.67 days), consistent with data from Looft et al. who compared e-TEP with open sublay repair and noted superior early recovery with the laparoscopic approach [14]. Shorter hospitalisation reduces costs, risk of nosocomial infection, and is aligned with enhanced recovery after surgery (ERAS) principles. The return to activity was also dramatically earlier in the e-TEP group (10.9 vs 22.8 days), reflecting faster functional rehabilitation—a finding with direct socioeconomic relevance, particularly in working-age adults.

Chronic pain at 6 months was significantly lower in the e-TEP group (VAS 1.85 vs 4.63; $p < 0.001$). Chronic postoperative hernia pain is increasingly recognised as a major determinant of long-term patient satisfaction and quality of life. Köckerling et al. identified mesh fixation and nerve entrapment in the anterior fascial plane as key drivers of chronic pain following open repair [15]. The e-TEP technique, by placing mesh in the retromuscular plane without transfascial fixation, substantially mitigates this risk. This finding is particularly important given that chronic pain can persist long after the wound has healed and adversely impacts quality of life, productivity, and psychological wellbeing.

Interestingly, EuraHS-QoL scores were comparable between groups at both 6 and 12 months, with both groups showing

improvement over time. This may reflect the fact that by 6 months, the acute differences in pain and activity restriction have attenuated, and both surgical methods achieve satisfactory long-term abdominal wall integrity. It may also reflect the sensitivity of the EuraHS-QoL instrument to detecting differences in this specific patient population at these time points, and longer follow-up may reveal divergence.

Wound-related complications (infection and seroma) were similar between groups, contrary to findings in several open versus laparoscopic IPOM comparisons that favoured laparoscopy [7,16]. This parity may reflect that both groups in the present study included mesh-based repairs, and that complication rates in elective primary hernia repair are generally low at experienced centres. The comparable complication rates strengthen the safety profile of the e-TEP technique.

No recurrence was observed in either group during the study period. Although the follow-up of 6 months is insufficient to draw definitive conclusions about long-term durability, early data on e-TEP repair from Hannig et al. and Chuah et al. report recurrence rates comparable to open sublay repair during medium-term follow-up [17,18]. The retromuscular mesh placement in both techniques provides biomechanically equivalent reinforcement, supporting this observation.

The present study has several limitations. The non-randomised design and absence of formal power calculation introduce potential selection bias and limit generalisability. The single-centre setting and relatively small sample size reduce external validity. The 6-month follow-up may be insufficient to assess long-term recurrence. The observed learning curve effect on operative time may be overcome with institutional experience.

5. CONCLUSION

Laparoscopic e-TEP repair is a safe, effective, and anatomically sound alternative to conventional open mesh repair for primary umbilical and para-umbilical hernias. It offers clinically and statistically significant advantages in postoperative pain at 24 h and 72 h, duration of hospital stay, time to return to activity, and chronic pain at 6 months, while maintaining comparable complication rates, quality-of-life outcomes, and short-term recurrence rates. The longer operative time reflects the learning curve inherent to the technique and is expected to decrease with increasing surgical experience. These findings support the adoption of laparoscopic e-TEP repair as the preferred minimally invasive approach for umbilical and para-umbilical hernias in centres with appropriate laparoscopic expertise. Large-scale randomised controlled trials with extended follow-up are warranted to definitively establish long-term superiority.

6. DECLARATIONS

Ethical Approval: Obtained from the Institutional Ethics Committee.

Informed Consent: Written informed consent was obtained from all participants.

Conflicts of Interest: None declared.

Funding: No external funding was received for this study.

Data Availability: The data supporting this study are available from the corresponding author upon reasonable request.

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