

Original Research Article

EFFECTIVENESS OF ENHANCED-VIEW TOTAL EXTRA-PERITONEAL (E-TAP) REPAIR VERSUS TAPP AND TEP IN INGUINAL HERNIA: A COMPARATIVE STUDY

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ABSTRACT

Background: Laparoscopic inguinal hernia repair is predominantly performed using TAPP and TEP approaches, each with inherent advantages and limitations. The Enhanced-View Total Extra-Peritoneal (E-TAP) technique was developed to improve workspace and visualization in the extraperitoneal plane. This study compares the effectiveness of E-TAP with TAPP and TEP in primary inguinal hernia repair. The aim is to compare the effectiveness of E-TAP repair versus TAPP and TEP techniques in inguinal hernia repair in terms of operative time, intraoperative and postoperative complications, conversion rates, and hospital stay.

Materials and Methods: This prospective comparative study included 60 patients with primary inguinal hernia, allocated into three equal groups: E-TAP (n=20), TAPP (n=20), and TEP (n=20). Operative time, intraoperative parameters (workspace difficulty, peritoneal tear, subcutaneous emphysema), postoperative outcomes (pain score, seroma formation, surgical site infection), conversion rates, and length of hospital stay were recorded. Statistical analysis included ANOVA and Chi-square tests, with 95% confidence intervals and p-values reported.

Results: Mean operative time was significantly lower in the E-TAP group (56.9 ± 8.3 min) compared to TAPP (69.6 ± 9.1 min) and TEP (68.5 ± 7.3 min) ($p < 0.001$). E-TAP patients reported significantly lower mean pain scores at 24 hours (2.7 ± 0.6) versus TAPP (3.6 ± 0.6) and TEP (3.5 ± 0.6) ($p < 0.001$). Hospital stay was significantly shorter for E-TAP (1.48 ± 0.56 days) compared to TAPP (2.58 ± 0.48 days) and TEP (2.33 ± 0.61 days) ($p < 0.001$). Differences in intraoperative and postoperative complications and conversion rates were not statistically significant, though E-TAP showed lower numerical rates.

Conclusion: E-TAP repair provides a superior operative profile with shorter surgery time, less early postoperative pain, and reduced hospital stay, without increasing complication rates, making it a highly effective alternative to TAPP and TEP for primary inguinal hernia repair. Larger multicenter studies with long-term follow-up are warranted to confirm these benefits and assess recurrence rates.

Keywords: E-TAP repair, laparoscopic inguinal hernia, TAPP, TEP.

INTRODUCTION

Inguinal hernia is one of the most common surgical conditions encountered worldwide and represents a

significant proportion of abdominal wall hernias. By definition, a hernia is the protrusion of a viscus or part of a viscus through an abnormal opening in the walls of its containing cavity. Inguinal hernias specifically occur through the inguinal canal and account for

approximately 75% of all abdominal wall hernias. The lifetime risk is estimated at 27% in men and 3% in women, with higher prevalence in individuals over 45 years of age. Clinically, they manifest as groin swelling, sometimes accompanied by pain or discomfort, and carry the risk of complications such as incarceration or strangulation if untreated.^[1]

Historically, surgical repair has been the mainstay of treatment, with evolving techniques aimed at reducing recurrence rates, postoperative pain, and hospital stay. The advent of mesh repair has significantly decreased recurrence compared to tissue repairs. Traditionally, the open Lichtenstein tension-free mesh repair was the gold standard, but with advances in minimally invasive surgery, laparoscopic techniques have become increasingly popular.^[2]

Three laparoscopic techniques dominate current practice:

1. Transabdominal Preperitoneal (TAPP) Repair – This technique involves entering the peritoneal cavity, incising the peritoneum, and placing mesh in the preperitoneal space. It offers a wide operative field and allows identification and management of other intra-abdominal pathologies, but it carries the risks associated with entering the peritoneal cavity, such as visceral injury.
2. Total Extraperitoneal (TEP) Repair – This method avoids entry into the peritoneal cavity by developing the preperitoneal space entirely from an extraperitoneal approach. It reduces the risk of intra-abdominal injury but is technically challenging due to the limited working space, especially for large or complex hernias.
3. Enhanced-View Total Extraperitoneal (E-TEP) Repair – Developed to overcome the limitations of the conventional TEP approach, the E-TEP technique allows a larger working space, better ergonomics, and flexibility in port placement. It facilitates a more complete dissection of the myopectineal orifice, accommodates larger meshes, and offers better visualization, which may translate into improved patient outcomes.

Despite the availability of multiple techniques, there remains a lack of consensus on the optimal laparoscopic approach for inguinal hernia repair. Factors influencing the choice of technique include surgeon experience, hernia complexity, patient anatomy, and available resources. Comparative studies evaluating perioperative parameters—such as operative time, complications, conversion rates, and hospital stay—are essential to guide surgical decision-making.^[3,4]

Aim: To compare the effectiveness of E-TEP repair versus TAPP and TEP techniques in inguinal hernia repair in terms of operative time, intraoperative and postoperative complications, conversion rates, and length of hospital stay.

Objectives

1. To compare intraoperative parameters, including operative time, space creation, peritoneal tear

incidence, and subcutaneous emphysema, among E-TEP, TAPP, and TEP groups.

2. To evaluate postoperative outcomes, including pain scores, seroma formation, and surgical site infections, across the three techniques.
3. To determine the most effective method of inguinal hernia repair based on complication rates and hospital stay.

MATERIALS AND METHODS

Source of Data: This study was conducted in the Department of General Surgery at Medical College and S.S.G. Hospital, Vadodara. Patients diagnosed with inguinal hernia and meeting inclusion criteria were recruited from outpatient and emergency services.

Study Design: A prospective, comparative observational study.

Study Location: Department of General Surgery, Medical College and S.S.G. Hospital, Vadodara.

Study Duration: The study was carried out over a period of 18 months, from January 2023 to June 2024.

Sample Size: A total of 60 patients were included, divided equally into three groups:

- Group A: E-TEP (n=20)
- Group B: TAPP (n=20)
- Group C: TEP (n=20)

Inclusion Criteria

- Adults aged 18–70 years with primary unilateral or bilateral inguinal hernia.
- ASA physical status I or II.
- Patients consenting to laparoscopic repair.

Exclusion Criteria

- Recurrent inguinal hernias.
- Complicated hernias (incarcerated, strangulated, or obstructed).
- Patients unfit for general anaesthesia.
- Patients with previous lower abdominal surgeries causing dense adhesions.

Procedure and Methodology: Eligible patients were allocated to one of the three surgical techniques based on surgeon expertise and availability. All patients underwent preoperative evaluation including history, physical examination, and routine investigations. Prophylactic antibiotics were administered preoperatively.

Group A: E-TEP Repair – Accessed via the retrorectus space through an upper lateral abdominal port (Jorge Daes point), with large extraperitoneal space creation and ergonomic port placement. Mesh placement covered the myopectineal orifice completely.

Group B: TAPP Repair – Peritoneal cavity accessed laparoscopically, peritoneum incised to access the preperitoneal space, mesh placed, and peritoneal flap closed.

Group C: TEP Repair – Preperitoneal space developed without breaching peritoneum using balloon dissection or blunt dissection, mesh placed to cover the defect.

In all cases, standard polypropylene mesh was used, tailored to defect size with adequate overlap. Drains were not routinely placed. Postoperative analgesia, ambulation, and diet resumption were standardized.

Sample Processing: Operative time, intraoperative complications (peritoneal tear, bleeding, organ injury), and conversions to open surgery were recorded. Postoperative parameters assessed included pain score (VAS scale at 24 hrs), seroma, wound infection, and length of hospital stay.

Statistical Methods: Data were entered into Microsoft Excel and analyzed using SPSS v25. Continuous variables were expressed as mean $\pm$ standard deviation and compared using ANOVA. Categorical variables were compared using Chi-square or Fisher's exact test. A p-value <0.05 was considered statistically significant.

Data Collection: All findings were recorded in a predesigned proforma, including demographic data, operative details, intraoperative findings, complications, and follow-up outcomes.

RESULTS

[Table 1] shows that the mean operative time was significantly shorter in the E-TEP group (56.9 ± 8.3 min) compared to both TAPP (69.6 ± 9.1 min) and TEP (68.5 ± 7.3 min), with ANOVA indicating a highly significant difference ($p < 0.001$) and 95% confidence intervals confirming a reduction of approximately 7–18 minutes. Intraoperative and postoperative complication rates were lowest in E-TEP (5% and 10%, respectively) compared to higher rates in TAPP (25% and 25%) and TEP (20% and 20%), though these differences did not reach statistical significance. Conversion to open surgery occurred only in TAPP (10%) and TEP (5%), with none in E-TEP. The mean hospital stay was significantly shorter in E-TEP (1.48 ± 0.56 days) versus TAPP (2.58 ± 0.48 days) and TEP (2.33 ± 0.61 days), with $p < 0.001$.

Table 1: Overall effectiveness: E-TEP vs TAPP vs TEP (n=60)

Parameter	E-TEP (n=20)	TAPP (n=20)	TEP (n=20)	Test significance of	95% CI (E-TEP vs TAPP / E-TEP vs TEP)	p-value
Operative time (min), Mean $\pm$ SD	56.9 ± 8.3	69.6 ± 9.1	68.5 ± 7.3	ANOVA F=14.44	-18.2 to -7.1 / -16.5 to -6.5	<0.001
Intra-operative complications, n (%)	1 (5.0%)	5 (25.0%)	4 (20.0%)	$\chi^2=3.12$	—	0.210
Post-operative complications, n (%)	2 (10.0%)	5 (25.0%)	4 (20.0%)	$\chi^2=1.56$	—	0.459
Conversion to open, n (%)	0 (0.0%)	2 (10.0%)	1 (5.0%)	$\chi^2=2.11$	—	0.349
Length of stay (days), Mean $\pm$ SD	1.48 ± 0.56	2.58 ± 0.48	2.33 ± 0.61	ANOVA F=21.57	-1.4 to -0.8 / -1.2 to -0.5	<0.001

Table 2: Intraoperative parameters (n=60)

Parameter	E-TEP (n=20)	TAPP (n=20)	TEP (n=20)	Test significance of	95% CI (E-TEP vs TAPP / E-TEP vs TEP)	p-value
Operative time (min), Mean $\pm$ SD	56.9 ± 8.3	69.6 ± 9.1	68.5 ± 7.3	ANOVA F=14.44	-18.2 to -7.1 / -16.5 to -6.5	<0.001
Space-creation difficulty, n (%)	1 (5.0%)	5 (25.0%)	6 (30.0%)	$\chi^2=4.38$	—	0.112
Peritoneal tear, n (%)	1 (5.0%)	4 (20.0%)	5 (25.0%)	$\chi^2=2.14$	—	0.343
Subcutaneous emphysema, n (%)	0 (0.0%)	2 (10.0%)	2 (10.0%)	$\chi^2=2.11$	—	0.349

[Table 2], operative time differences mirrored those in Table 1, again favoring E-TEP ($p < 0.001$). Space-creation difficulty was uncommon in E-TEP (5%) but more frequent in TAPP (25%) and TEP (30%), though this was not statistically significant. Peritoneal tears occurred in 5% of E-TEP cases,

compared to 20% in TAPP and 25% in TEP. Subcutaneous emphysema was not seen in E-TEP but occurred in 10% of both TAPP and TEP cases. None of these secondary intraoperative differences achieved statistical significance, indicating a clear trend but limited by sample size.

Table 3: Postoperative outcomes (n=60)

Parameter	E-TEP (n=20)	TAPP (n=20)	TEP (n=20)	Test significance of	95% CI (E-TEP vs TAPP / E-TEP vs TEP)	p-value
Pain score at 24 h (VAS 0–10), Mean $\pm$ SD	2.7 ± 0.6	3.6 ± 0.6	3.5 ± 0.6	ANOVA F=15.01	-1.3 to -0.5 / -1.4 to -0.6	<0.001
Seroma formation, n (%)	1 (5.0%)	3 (15.0%)	2 (10.0%)	$\chi^2=1.11$	—	0.574
Surgical site infection, n (%)	0 (0.0%)	2 (10.0%)	1 (5.0%)	$\chi^2=2.11$	—	0.349
Any post-op complication, n (%)	2 (10.0%)	5 (25.0%)	4 (20.0%)	$\chi^2=1.56$	—	0.459
Length of stay (days), Mean $\pm$ SD	1.48 ± 0.56	2.58 ± 0.48	2.33 ± 0.61	ANOVA F=21.57	-1.4 to -0.8 / -1.2 to -0.5	<0.001

[Table 3] demonstrated significantly lower pain scores at 24 hours for E-TEP (VAS 2.7 ± 0.6)

compared with TAPP (3.6 ± 0.6) and TEP (3.5 ± 0.6), with $p < 0.001$ and confidence intervals showing a

consistent reduction of about 0.5–1.4 points. Seroma formation was rare in E-TEP (5%) compared to 15% in TAPP and 10% in TEP, and surgical site infection was absent in E-TEP but occurred in 10% of TAPP and 5% of TEP patients; however, these differences were not statistically significant. The overall

postoperative complication rate was lowest in E-TEP (10%) and higher in TAPP (25%) and TEP (20%). Length of stay findings were identical to those in Table 1, again showing significant reduction for E-TEP ($p < 0.001$).

Table 4: “Most effective” comparison based on complication rates & hospital stay (n=60)

Parameter	E-TEP (n=20)	TAPP (n=20)	TEP (n=20)	Test of significance	95% CI (E-TEP vs TAPP / E-TEP vs TEP)	p-value
Total complications (intra + post), n (%)	3 (15.0%)	10 (50.0%)	8 (40.0%)	$\chi^2=5.71$	—	0.057
Conversion to open, n (%)	0 (0.0%)	2 (10.0%)	1 (5.0%)	$\chi^2=2.11$	—	0.349
Length of stay (days), Mean $\pm$ SD	1.48 $\pm$ 0.56	2.58 $\pm$ 0.48	2.33 $\pm$ 0.61	ANOVA F=21.57	–1.4 to –0.8 / –1.2 to –0.5	<0.001

[Table 4], E-TEP showed the lowest total complication rate (15%), compared with 50% in TAPP and 40% in TEP; the difference approached statistical significance ($p = 0.057$), suggesting a clinically meaningful trend. Conversion to open repair occurred only in TAPP and TEP groups. Hospital stay duration remained shortest for E-TEP (1.48 $\pm$ 0.56 days), significantly lower than both comparator groups ($p < 0.001$). Overall, the findings consistently indicate that E-TEP offers shorter operative times, reduced postoperative pain, fewer complications, and shorter hospitalization compared to TAPP and TEP, with many of these advantages reaching statistical significance.

DISCUSSION

When benchmarked to large TEP vs TAPP series, E-TEP times also make sense. Registry and meta-analytic data generally find TEP and TAPP have similar overall outcomes, with modest trade-offs: some series report TAPP slightly shorter times while TEP yields less early pain and marginally shorter stays. Prakhar Get al,^[5] (2021) (17,587 cases) showed broadly equivalent peri-operative outcomes between TEP and TAPP, while a meta-analysis by Mishra Aet al.(2023),^[6] suggested TAPP can be a touch quicker but TEP reduces short-term pain and hospital stay. results slot neatly into that pattern-E-TEP is even faster than both, likely because it removes classical TEP’s “tight space” penalty while retaining its extraperitoneal benefits.

On intra-operative adversity (space-creation difficulty, peritoneal tears, emphysema), Table 2 trends favor E-TEP (5% difficulty; 5% tears; 0% emphysema) over TEP/TAPP, though not significant at n=60. This trend echoes why E-TEP was devised: to reduce difficult exposure and inadvertent peritoneal breaches that plague conventional TEP, especially in larger or more complex hernias. Xu Het al,^[7] (2023) Contemporary descriptions of E-TEP (and its extensions) repeatedly highlight fewer “workspace” problems and better triangulation, which likely underpins these lower (albeit non-significant) event rates in cohort. Singh Set al (2024).^[8]

Post-operative outcomes in Table 3 reinforce the efficiency signal. Pain at 24 h is significantly lower with E-TEP (VAS 2.7) than TAPP/TEP (3.5–3.6; $p < 0.001$). This dovetails with meta-analyses showing TEP reduces short-term pain vs TAPP; if E-TEP preserves TEP’s extraperitoneal mesh plane but improves dissection/mesh lay, an incremental analgesic benefit is plausible. length-of-stay advantage (E-TEP $\approx$ 1.5 days vs 2.3–2.6 days; $p < 0.001$) mirrors both guideline expectations for laparoscopy and comparative TEP/TAPP studies where extraperitoneal approaches often discharge sooner—again, E-TEP seems to accentuate that edge. Andreuccetti Jet al (2021).^[9]

CONCLUSION

The present study demonstrates that Enhanced-View Total Extra-Peritoneal (E-TEP) repair offers significant advantages over both Transabdominal Preperitoneal (TAPP) and Totally Extra-Peritoneal (TEP) techniques for inguinal hernia repair in terms of reduced operative time, lower early postoperative pain, and shorter hospital stay, without compromising safety. Although intraoperative and postoperative complication rates, as well as conversion rates, were not statistically different, E-TEP consistently showed numerically lower adverse event rates. These findings suggest that E-TEP combines the ergonomic benefits of improved visualization and workspace with the advantages of an extraperitoneal approach, making it a highly effective and patient-friendly option for primary inguinal hernia repair when performed by experienced surgeons.

Limitations of the Study

1. The sample size was relatively small (n=60), which may limit the statistical power to detect differences in uncommon complications and conversion rates.
2. The study was conducted at a single center, which may restrict the generalizability of the results to other surgical settings and populations.
3. Surgeon expertise and the learning curve for E-TEP may have influenced operative time and complication rates, potentially biasing the comparison.

4. Long-term follow-up data on recurrence rates and chronic pain were not included, preventing conclusions about durability and late outcomes.
5. The study did not stratify results based on hernia type, size, or complexity, which could have influenced operative difficulty and outcomes.

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