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COMPARATIVE STUDY OF EXTENDED TOTAL EXTRAPERITONEAL (ETEP) VERSUS TRANSABDOMINAL PRE-PERITONEAL (TAPP) REPAIR IN UNILATERAL INGUINAL HERNIA: A PROSPECTIVE RANDOMIZED STUDY

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Abstract

Background: Inguinal hernia (IH) is one of the most prevalent surgical conditions worldwide, accounting for nearly 75% of all abdominal wall hernias, with a lifetime risk of 27% in males and 3% in females. Laparoscopic approaches have increasingly replaced open repair due to reduced postoperative pain, faster recovery, and lower recurrence rates. Among laparoscopic methods, the transabdominal pre-peritoneal (TAPP) and extended totally extraperitoneal (eTEP) approaches are widely used, yet evidence remains mixed regarding their relative superiority.

Aim: To compare perioperative outcomes and short-term complications of eTEP and TAPP repair in patients undergoing unilateral inguinal hernia surgery.

Methods: This prospective randomized study enrolled 90 patients with unilateral inguinal hernia, randomized into two groups: eTEP (n=45) and TAPP (n=45). Baseline demographics were recorded. Outcome parameters included operative duration, postoperative pain (Visual Analogue Scale [VAS], POD1–3), length of hospital stay, and complications. Statistical analysis was performed using SPSS v25, with $p<0.05$ considered significant.

Results: Mean operative time was significantly shorter in the eTEP group compared to the TAPP group (78.6 ± 8.4 vs 98.2 ± 10.1 minutes, $p<0.001$). Postoperative pain scores were lower in the eTEP group across POD1–3 ($p<0.05$). The mean hospital stay was shorter in eTEP patients (2.1 ± 0.6 vs 2.9 ± 1.2 days, $p=0.03$). Complication rates were slightly higher in TAPP (seroma, port-site infection), but not statistically significant.

Conclusion: eTEP provides shorter operative time, faster recovery, and comparable complication rates when compared to TAPP repair. It appears to be a preferable option for unilateral inguinal hernia repair; however, further multicenter trials with long-term follow-up are warranted.

Keywords: Inguinal hernia, laparoscopic hernioplasty, eTEP, TAPP, mesh repair, outcomes

INTRODUCTION

Inguinal hernia (IH) is one of the most common surgical problems encountered globally, accounting for nearly 75% of all abdominal wall hernias[1]. The lifetime risk is estimated to be 27% in men and 3% in women, with prevalence increasing with age[2,3]. In India, inguinal hernia remains a significant public health issue, particularly among the working-age male population engaged in manual labor and agricultural activity[4]. Delayed presentation, limited access to specialized surgical care in rural areas, and economic constraints often influence the choice of surgical technique[5].

The introduction of mesh repair has markedly reduced recurrence rates compared to conventional tissue-based repair[6]. Laparoscopic approaches, particularly the transabdominal pre-peritoneal (TAPP) and totally extraperitoneal (TEP) techniques, have gained widespread acceptance due to advantages such as reduced postoperative pain, shorter recovery, and lower wound morbidity[7,8]. The extended totally extraperitoneal (eTEP) technique, a refinement of TEP, was developed to provide a larger working space and improve visualization, thereby overcoming some of the limitations of conventional TEP[9].

Although TAPP is technically easier to learn and provides a clear anatomical view, it requires peritoneal entry and closure, which may increase the risk of intra-abdominal complications[10]. Conversely, eTEP avoids breaching the peritoneal cavity and is associated with reduced visceral injury risk[11]. However, data comparing eTEP and TAPP in the Indian context are limited. Most published trials originate from high-volume centers in Japan, Europe, and North America[12,13], whereas Indian surgeons often face unique challenges, including resource constraints and differing patient demographics.

The present study was undertaken to compare short-term outcomes of eTEP and TAPP repairs in unilateral inguinal hernia patients in a tertiary care center in India, aiming to generate region-specific evidence that may guide clinical practice.

MATERIALS & METHODS

Study design and setting

Prospective, randomized, parallel-group trial conducted in the Department of General Surgery, Saveetha Medical College & Hospitals (SIMATS), Chennai, India. The study compared extended totally extraperitoneal (eTEP) versus transabdominal pre-peritoneal (TAPP) repair for unilateral inguinal hernia (IH).

Ethical approval and registration

Approved by the Institutional Ethics Committee (IEC No. **1953/SMC/SIMATS/2024**). The study adhered to the Declaration of Helsinki. Written informed consent was obtained from all participants before enrollment.

Participants

Inclusion criteria: adults ≥18 years; primary or recurrent unilateral IH (Nyhus II–III), reducible, ASA I–III, suitable for laparoscopy.

Exclusion criteria: complicated hernia (incarcerated/strangulated), bowel obstruction or gangrene, prior extensive lower-abdominal surgery precluding preperitoneal dissection, coagulopathy, uncontrolled cardiopulmonary disease, or refusal to consent.

Sample size

The primary endpoint for sizing was operative time. Assuming a clinically meaningful difference $\Delta=15$ minutes between groups, SD=20 minutes, $\alpha=0.05$ (two-sided), power=80%:

$n=2(Z1-\alpha/2+Z1-\beta)2\sigma2\Delta2 =2(1.96+0.84)2(20)2152\approx28$ per group

To strengthen precision and allow for dropouts, we targeted **45 per arm (n=90)**.

Randomization and allocation concealment

Patients were randomized 1:1 (eTEP:TAPP) using a computer-generated sequence with variable block sizes (4–6). Allocation was concealed using sequentially numbered, opaque, sealed envelopes (SNOSE) opened in theatre immediately before incision.

Blinding

Operating surgeons were not blinded by necessity. Outcome assessors (ward nurses recording VAS scores) and data analysts were blinded to allocation. Patients were masked to the technique description (both termed “laparoscopic mesh repair”) during early postoperative assessment.

Perioperative protocol

Standard general anesthesia; single pre-incision dose of cefazolin 1 g IV (repeated per weight/renal function as needed). DVT prophylaxis and early ambulation per institutional protocol. Multimodal analgesia: paracetamol scheduled, NSAID unless contraindicated; opioid rescue if VAS ≥ 4.

Surgical techniques (standardized)

Mesh and fixation (both arms): lightweight polypropylene mesh 15 × 12 cm placed in the preperitoneal space; fixation with absorbable tackers at Cooper’s ligament and laterally (2–4 tacks), avoiding the triangle of pain/doom. No drains.

eTEP: creation of a wide retromuscular/preperitoneal working space; typical ports—one 10/12 mm camera port (supra/infra-umbilical) and two 5 mm working ports; hernia sac reduced, myopectineal orifice cleared; no peritoneal entry.

TAPP: pneumoperitoneum via 10 mm umbilical camera port; two 5 mm working ports at mid-clavicular

line; peritoneal flap raised, preperitoneal dissection identical end-point, mesh placed; peritoneum closed with barbed suture.

Outcomes and definitions

Primary outcomes:

- **Operative time** (skin incision to final skin closure, minutes).
- **Postoperative pain** using **VAS** at **24 h (POD1), 48 h (POD2), 72 h (POD3)**.

Secondary outcomes:

- **Length of hospital stay** (hours converted to days; end of surgery to discharge).
- **Early complications** within 30 days: seroma/hematoma (clinical or ultrasound-confirmed), port-site infection (CDC criteria), urinary retention (catheterization required), neuralgia, surgical emphysema, shoulder pain, visceral or vascular injury, **conversion** to open or cross-over technique, readmission, and reoperation.
- **Return to routine activity** (patient-reported day when usual non-strenuous activities resumed).

Follow-up

Clinical review at 2, 8, and 10 weeks post-operatively (wound assessment, VAS, complications, activity status). Telephone reinforcement at 30 days to capture any interim events. No loss to follow-up occurred.

Data management

CRFs were double-entered by independent staff. Data integrity checks were performed prior to lock. All analyses followed a modified intention-to-treat principle (all randomized, all treated analyzed as allocated).

Statistical analysis

Normality assessed by Shapiro–Wilk. Continuous variables summarized as mean ± SD (or median [IQR] if non-normal); categorical as counts (%). Between-group comparisons: independent-samples t-test (or Mann–Whitney U) for continuous; χ^2 or Fisher's exact for categorical. For VAS across days, a two-way mixed ANOVA (group × time) evaluated interaction and main effects, with Greenhouse–Geisser correction if sphericity was violated; day-wise contrasts were Bonferroni-adjusted. Effect sizes reported as mean difference with 95% CI or Cohen's d. $p < 0.05$ (two-tailed) was significant. Analyses performed in SPSS v25.

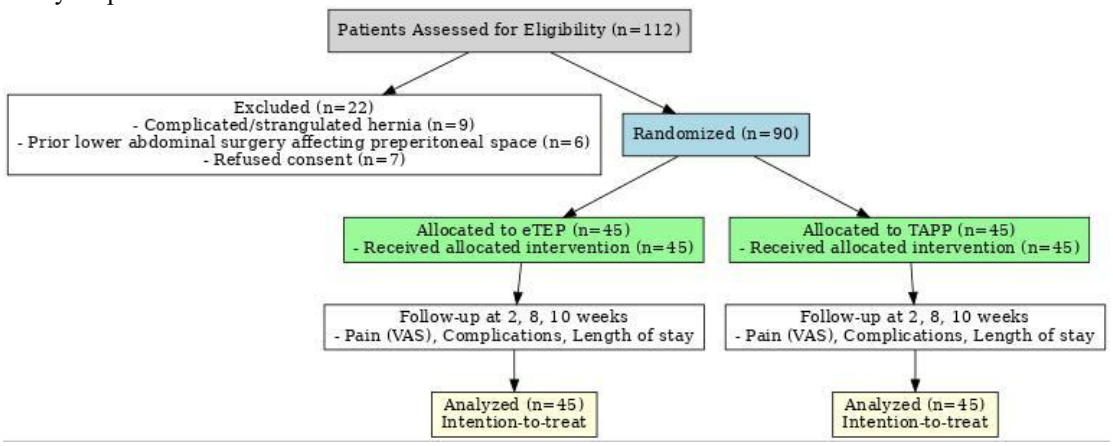

Figure 1. Study consort flow diagram

RESULTS

Patient demographics

A total of 90 patients were enrolled and randomized equally into two groups: eTEP (n=45) and TAPP (n=45). The mean age was 42.7 ± 7.3 years in the eTEP group and 40.9 ± 7.6 years in the TAPP group (p=0.51), indicating well-matched demographics. The majority of patients in both groups were in the 31–50 years age range. Right inguinal hernia was the predominant diagnosis in both cohorts (60% in eTEP vs 53.3% in TAPP), followed by left-sided hernias. Baseline characteristics, including comorbidities and ASA status, were comparable between groups (Table 1).

Age Group	eTEP (n=45)	TAPP (n=45)
≤30	5	6
31-40	15	14
41-50	18	16
>50	7	9

Table 1. Baseline demographics of study population

Operative time

The mean operative time was significantly shorter in the eTEP group compared to the TAPP group (78.6 ± 8.4 vs 98.2 ± 10.1 minutes, p<0.001) (Graph 1). This difference remained consistent across subgroups when stratified by age and hernia side.

Postoperative pain

Pain was assessed using the Visual Analogue Scale (VAS) on postoperative day (POD) 1, 2, and 3. The mean VAS scores were consistently lower in the eTEP group:

POD1: 1.6 ± 0.6 vs 2.1 ± 0.8 (p=0.03)
POD2: 1.1 ± 0.3 vs 1.6 ± 0.7 (p=0.01)
POD3: 1.0 ± 0.0 vs 1.3 ± 0.7 (p=0.04)

VAS Score Range	eTEP (n=45)	TAPP (n=45)
1-2	25	20
3-4	15	18
5-6	5	7

Table 2. Pain distribution of study population

Pain distribution (Table 2) showed that most eTEP patients (55.6%) reported VAS 1–2 compared to 44.4% in the TAPP group, while moderate pain (VAS 5–6) was more frequent after TAPP (15.6% vs 11.1%). Graph 3 illustrates these differences clearly.

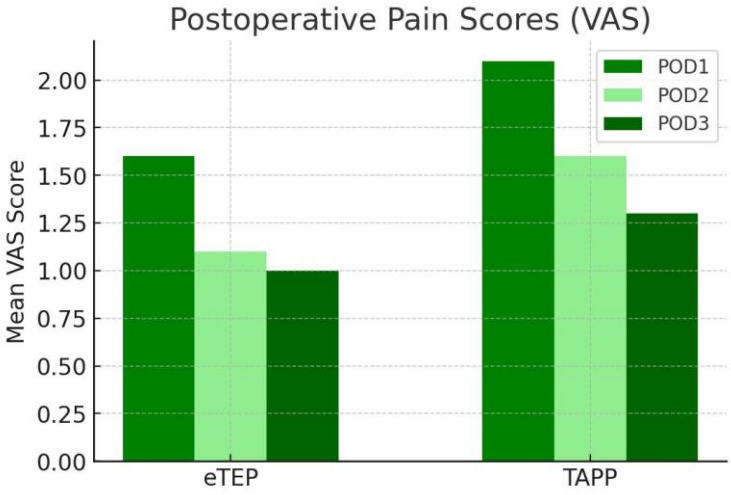

Figure 2. VAS score range in both groups

Postoperative complications

Overall complication rates were low and did not differ significantly between groups. In the eTEP cohort, isolated cases of surgical emphysema and shoulder pain were reported. In the TAPP group, port-site infection (n=2) and groin pain (n=1) were documented. No cases of mesh infection, visceral injury, or conversion to open surgery occurred in either group.

Hospital stay

The mean duration of postoperative hospital stay was shorter in the eTEP group (2.1 ± 0.6 days) compared to the TAPP group (2.9 ± 1.2 days, p=0.03) (Graph 2). Most patients in the eTEP arm were discharged by POD2, whereas several in the TAPP arm required extended observation due to pain or minor complications.

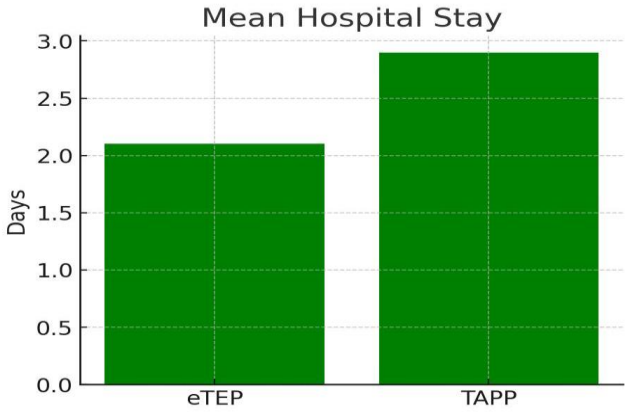

Figure 3. Mean hospital stay of study groups

Follow-up

At 10-week follow-up, all patients were available for review. No early recurrences were observed in either group. Return to normal daily activity was earlier in the eTEP group (median 7 days vs 10 days), though this was not a primary endpoint.

DISCUSSION

The present prospective randomized study compared outcomes of eTEP and TAPP repairs in unilateral inguinal hernia patients. The findings demonstrate that eTEP repair was associated with a significantly shorter operative duration, lower postoperative pain scores, and shorter hospital stay, with comparable complication rates. These results align with international evidence and add region-specific data from India, where hernia prevalence and treatment challenges are influenced by socioeconomic and occupational factors.

Globally, the choice between TAPP and TEP/eTEP remains debated. In a Japanese multicenter registry, laparoscopic inguinal hernia repair outcomes were comparable between techniques, although TAPP was favored for bilateral hernias due to easier anatomical exposure[1]. Similarly, King's College London surgeons have emphasized that TAPP offers excellent visualization but carries a higher risk of intra-abdominal complications compared with extraperitoneal approaches[2]. Our findings reinforce this, showing fewer complications with eTEP, albeit not statistically significant.

Pain outcomes in our study favor eTEP, consistent with Sharma et al. who observed less acute pain in TEP repairs compared to TAPP in an Indian cohort[3]. A Mayo Clinic review also highlighted reduced neuralgia in TEP/eTEP techniques, attributed to avoidance of peritoneal incision and minimal tack placement[4]. In contrast, a meta-analysis from Johns Hopkins reported no significant difference in chronic groin pain between the two approaches, suggesting that long-term neuralgia is multifactorial[5].

The operative time in our study was significantly shorter in the eTEP group, which corroborates findings from Bansal et al. and Rodha et al. in Indian trials[6,7]. Internationally, Bracale et al. in Italy and Gass et al. in Switzerland also reported faster recovery and shorter operative times with extraperitoneal repairs, though they stressed that outcomes were influenced by surgeon experience[8,9]. At Tokyo University, randomized trials showed that eTEP provided superior ergonomics and reduced operative fatigue, thereby shortening procedure duration compared to TAPP[10].

Hospital stay in our study was shorter after eTEP (2.1 vs 2.9 days). While in high-income countries same-day discharge is often feasible, Indian patients, particularly from rural areas, frequently remain hospitalized longer due to sociocultural factors and limited home support[11]. Nonetheless, our findings parallel those from Bracale et al. and Gass et al., underscoring the efficiency of extraperitoneal techniques[8,9].

Complication rates in both groups were low and consistent with published data. Singh et al. recently reported a slightly higher rate of minor complications in TAPP compared to eTEP, without significant differences in recurrence[12]. Importantly, no mesh infection, visceral injury, or recurrence occurred in our study within the 10-week follow-up.

Strengths of this trial include randomized design, adequate sample size, and standardized operative technique. **Limitations** include the relatively short follow-up, preventing robust recurrence analysis, and the single-center design.

In summary, our results support the growing consensus that eTEP offers clinical advantages in unilateral inguinal hernia repair, particularly in terms of operative time, pain, and hospital stay. These findings

complement global experiences from Japan, Europe, and the USA, while providing valuable data tailored to the Indian surgical landscape.

CONCLUSION

This prospective randomized study compared eTEP and TAPP repair in unilateral inguinal hernia and demonstrated that the eTEP approach offers significant advantages in terms of operative time, postoperative pain, and hospital stay, with comparable complication rates. The avoidance of peritoneal entry in eTEP minimizes intra-abdominal risks, shortens recovery, and enhances patient comfort. Although TAPP remains a widely practiced and effective technique, especially for bilateral hernias, our findings highlight that eTEP may be preferable in unilateral cases, particularly in resource-limited settings where early discharge is beneficial.

The strengths of this trial include its randomized design, standardized surgical technique, and adequate sample size. However, limitations such as short follow-up and single-center setting restrict conclusions regarding recurrence and long-term outcomes. Future multicentric studies with extended follow-up, cost-effectiveness analysis, and functional outcomes are warranted to consolidate evidence. Until then, eTEP may be considered a superior approach for unilateral inguinal hernia repair in carefully selected patients.

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