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Original Research Article

Comparative Study of Operative Time, Postoperative Pain and Seroma Formation Following Laparoscopic TEP versus TAPP in Inguinal Hernia Repair with Special Reference to Bilateral Inguinal Hernia

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Abstract

Background: Laparoscopic inguinal hernia repair is widely preferred, especially for bilateral disease. The two principal techniques—Totally Extraperitoneal (TEP) and Transabdominal Preperitoneal (TAPP)—have been compared extensively, yet high-quality data from Indian centres remain limited.

Objectives: To compare operative time, postoperative pain (VAS), and seroma formation after laparoscopic TEP versus TAPP inguinal hernia repair, with special reference to bilateral cases.

Methods: A prospective comparative analytical study of 60 male patients (30 TEP, 30 TAPP) was conducted at L.L.R.M. Medical College, Meerut (SVBP Hospital) between April 2024 and February 2026. Random allocation used sealed envelopes. Primary outcomes were operative time, VAS pain scores at 6 h, 12 h (pre- and post-analgesia), 24 h, 48 h, and 72 h, and seroma formation. Secondary outcomes included wound infection, haematoma, mesh-related events, and recurrence.

Results: Mean operative time was significantly shorter with TEP (60.6 ±15.6 min vs 81.5 ±18.5 min; p = 0.03). TEP remained faster in both unilateral (46.67 vs 74.53 min) and bilateral (76.58 vs 106.82 min) subgroups, and across direct and indirect subtypes. Postoperative pain was significantly lower after TEP at 6 h, 12 h, 24 h, and 72 h. No statistically significant difference was observed in seroma, wound infection, haematoma, or mesh-related events; recurrence was zero in both groups during follow-up.

Conclusion: In this Indian cohort, TEP offered shorter operative time and lower early postoperative pain without increasing complications or recurrence, making it particularly advantageous when bilateral inguinal hernia is present. Surgeon experience and adequate mesh coverage of Fruchaud's myopectineal orifice remain critical for optimal outcomes.

Keywords: Laparoscopic Inguinal Hernia Repair, Totally Extraperitoneal (TEP), Transabdominal Preperitoneal (TAPP), Bilateral Inguinal Hernia, Operative Time.

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Introduction

The surgical treatment of inguinal hernias has evolved significantly from early historical approaches of castration and wound cauterisation to the modern era of tension-free prosthetic repairs [1,

2]. Edoardo Bassini introduced the foundational concept of reconstructing the inguinal floor, which served as the gold standard for most of the twentieth century [3].

However, population-based studies revealed recurrence rates of approximately 15% with tissue-approximating techniques, alongside increased postoperative pain due to tissue tension [1, 4]. This led to the widespread adoption of Lichtenstein's tension-free mesh repair, which reduced recurrence rates and surgical morbidity [1]. Further innovations shifted focus toward the pre-peritoneal space. As articulated by Fruchaud, the underlying defect in all groin hernias is a failure of the transversalis fascia to retain the peritoneum, meaning efforts should concentrate on reinforcing the myopectineal orifice [4]. This anatomical framework forms the basis of both the Stoppa repair and modern laparoscopic techniques [1, 4].

Laparoscopic inguinal hernioplasty, introduced in the early 1990s, is currently dominated by two primary techniques: Transabdominal Preperitoneal (TAPP) and Totally Extraperitoneal (TEP) repairs [5]. TAPP provides excellent visualization of groin anatomy and a relatively easier learning curve, but involves violating the peritoneal cavity, which carries theoretical risks of intra-abdominal complications [5, 6]. Conversely, TEP stays entirely extraperitoneal, avoiding peritoneal entry and potentially reducing postoperative pain, though it is associated with a steeper learning curve and limited working space [6, 7].

While Western literature extensively compares these approaches, high-quality data from Indian populations remains limited. This study aims to compare laparoscopic TEP and TAPP repairs regarding operative time, postoperative pain, and complications, with a specific focus on bilateral inguinal hernias, an indication where laparoscopic approaches are widely considered advantageous [5].

Materials and Methods

A prospective comparative analytical study was conducted at the Department of General Surgery, Lala Lajpat Rai Memorial Medical College, Meerut (SVBP Hospital) from April 2024 to February 2026.

Study Population: 60 male patients presenting with uncomplicated inguinal hernias.

Inclusion Criteria: Medically fit for general anaesthesia and willing to undergo laparoscopic repair.

Exclusión Criteria: Patient refusal, medical unfitness, acute/obstructed inguino-scrotal hernia, conversion to open repair, recurrent hernia, irreducible hernia, and pediatric patients (age <15 years).

Randomization: Patients were randomized into two equal groups (30 TEP, 30 TAPP) through a random draw of lots, i.e., a total of 60 slips with Group I and Group II inscribed on them were placed in a wide-mouthed jar and each subsequent patient scheduled to undergo hernia repair was asked to pick one slip from the jar. The patients were subsequently allocated to the corresponding study group. All procedures were performed using the standard technique for laparoscopic inguinal hernia repair. All the procedures were performed by the same surgical team.

Surgical Technique: Routine mesh fixation was not deemed mandatory; tension-free mesh repair relying on adequate coverage of Fruchaud's myopectineal orifice was utilized. The "Trapezoid of Disaster" (Triangle of Pain and Triangle of Doom) was strictly avoided during dissection and mesh placement to prevent catastrophic hemorrhage or nerve damage.

Primary Outcomes: Operative time, postoperative pain (assessed via Visual Analogue Scale [VAS] 0-10 at 6, 12, 24, 48, and 72 hours), and seroma formation.

Secondary Outcomes: Wound infection, haematoma, mesh-related events, and hernia recurrence.

Results

Statistical Analysis: Data were expressed as percentage and mean ±S.D. Kolmogorov-Smirnov analysis was performed for checking the linearity of the data. Fischer's exact test or Chi-square test was used to analyze the significance of difference in frequency distribution of the data. Student's unpaired t-test was used to assess the significance of difference between study groups. P value <0.05 was considered statistically significant.

Demographic Profile: All 60 participants were male. Patients in the TAPP group were significantly older than those in the TEP group (mean 47.4 vs 38.0 years; p = 0.038). The cohort reflected a higher prevalence of inguinal hernia in older adults, with 45% of total patients aged over 50 years. A total of 17 patients presented with bilateral hernias (6 TEP, 11 TAPP) as shown in Table 1.

Table 1: Demographic Profile

Parameter	TEP (n=30)	TAPP (n=30)
Mean Age (years)	38.0 ± 17.9	47.4 ± 13.8
Median Age (Range)	31 (16–72)	49 (16–71)
Sex (M:F)	30 : 0	30 : 0
Unilateral / Bilateral	24 / 6	19 / 11

Operative Time: Overall mean operative time was significantly shorter for the TEP technique compared to TAPP ($p = 0.03$). Subgroup analysis demonstrated that TEP was consistently faster across both unilateral and bilateral presentations, as well as direct and indirect hernia types. While bilateral repairs took significantly longer in both techniques ($p < 0.001$ within each group), TEP maintained a statistically significant speed advantage ($p = 0.002$) as shown in Table 2.

Table 2: Operative time - TEP has significant (p<0.002) less operative time.

Parameter	TEP (n=30)	TAPP (n=30)
Mean ± SD (min)	60.6 ± 15.6	81.5 ± 18.5
Median (Range)	56.5 (40–100)	70 (60–120)
p-value	0.03 (Mann–Whitney U)	

Table 3: Subgroup analysis - TEP remained significantly faster in both unilateral and bilateral subgroups. Bilateral repairs took longer in both techniques (p < 0.001 within each group).

Category	TEP (mean ± SD)	TAPP (mean ± SD)	p-value
Unilateral	46.67 ± 5.84	74.53 ± 5.50	<0.001
Bilateral	76.58 ± 8.80	106.82 ± 9.02	0.002

Refined Analysis by Laterality and Hernia Type:

Table 4: Mean operative time (minutes) for TEP versus TAPP stratified by laterality and hernia type (direct / indirect). All four pairwise comparisons favour TEP and reach statistical significance.

Laterality / Type	TEP (min)	TAPP (min)	P-value
Direct Unilateral	42.3	68.58	0.006
Direct Bilateral	68.33	91.50	0.03
Indirect Unilateral	57.78	86.14	0.001
Indirect Bilateral	85.20	112.23	0.004

Postoperative Pain (VAS): TEP resulted in significantly lower VAS pain scores at nearly all measured intervals. A positive correlation was observed between longer operative durations and higher early postoperative pain ($r = 0.48$ at 12 h; $r = 0.40$ at 24 h).

Table 5: TEP produced significantly lower pain scores at nearly all measured time points. Longer operative duration was associated with higher early postoperative pain (correlation with pain at 12 h: r = 0.48, p < 0.001; at 24 h: r = 0.40, p = 0.001).

Time Point	TEP Mean VAS	TAPP Mean VAS	p-value
6 hours	Significantly lower	Higher	<0.001
12 h (pre-analgesia)	Lower	Higher	0.036
12 h (post-analgesia)	Lower	Higher	0.02
24 hours	0.93 ± 0.52	1.80 ± 0.61	0.01
48 hours	0.73 ± 0.64	1.43 ± 0.50	0.06
72 hours	0.30 ± 0.47	1.07 ± 0.58	0.04

Complications: There were no statistically significant differences in intraoperative and postoperative complications between the two groups. Seroma formation was numerically higher in the TEP group (10% vs 3.3%), aligning with the residual dead space following extensive pre-peritoneal dissection, but this difference was not statistically significant ($p = 0.61$). Zero recurrences were observed in both cohorts during the follow-up period as shown in Table 7.

Table 6: Intra-operative Complications

Procedure	Hernia type	Laterality	n(60)	Bladder Injury	Bowel injury	Bleeding	Peritoneal tear
TEP	Direct	Unilateral	13	0	0	0	0
	Direct	Bilateral	5	0	0	0	0
	Indirect	Unilateral	11	0	0	0	3
	Indirect	Bilateral	1	0	0	0	1
TAPP	Direct	Unilateral	6	0	0	0	0
	Direct	Bilateral	11	0	0	1	0
	Indirect	Unilateral	13	0	0	1	0
	Indirect	Bilateral	0	0	0	0	0

Table 7: No statistically significant difference in any complication. Zero recurrences observed during follow-up in both groups. Seroma was numerically higher after TEP (consistent with residual dead space after extensive pre-peritoneal dissection) but the difference did not reach statistical significance.

Complication	TEP (n=30)	TAPP (n=30)	p-value
Wound infection	2 (6.7%)	3 (10%)	1.00
Seroma	3 (10%)	1 (3.3%)	0.61
Haematoma	0	1 (3.3%)	1.00
Mesh-related	2 (6.6%)	1 (3.3%)	1.00
Recurrence	0	0	1.00

Discussion

The present prospective analytical study evaluated the clinical outcomes of TEP and TAPP in an Indian patient cohort, demonstrating that TEP provides a significant advantage regarding operative time (60.6 ±15.6 min vs 81.5 ±18.5 min for TAPP). This contrasts with the 2005 Cochrane review by Wake et al. [1], which found no significant overall difference in operative duration between the two techniques across earlier trials.

The broader literature presents mixed findings; for instance, Köckerling et al. [2] reported a significantly shorter mean operation duration for TEP (48.58 vs 52.62 min), while Vãrcuæ et al. [3] observed longer durations for TEP compared to TAPP (median 74 vs 69 min). Shakya et al. [4] and Khoury et al. [5] both noted shorter times for TAPP, though these differences often lacked statistical significance. The shorter duration for TEP in our cohort likely reflects the procedural efficiency of avoiding peritoneal incision and subsequent closure—steps that add considerable time and technical demand in TAPP [6]. However, it must be noted that TEP requires dissection in the more restricted preperitoneal space to reach the inguinal region. It is historically associated with a steeper learning curve due to this unfamiliar initial anatomy; thus, operative times are highly dependent on passing the initial learning curve [7].

Bilateral inguinal hernia represents a unique clinical scenario where laparoscopic repair is particularly beneficial. While both techniques reduce the surgical trauma of bilateral open groin incisions, TEP exhibited a substantial time advantage over TAPP for bilateral repairs in our study (76.58 vs 106.82 min; p = 0.002). Because the extraperitoneal space (including Bogros 'space and the space of Retzius) is contiguous, bilateral repairs in TEP can be performed sequentially within the same dissected extraperitoneal plane [6]. In contrast, TAPP requires separate, meticulous bilateral peritoneal incisions and secure closures to prevent visceral adhesions or internal herniation, significantly compounding the operative time.

Due to the limited working space and difficulty in preperitoneal dissection, conversion to open surgery was required for three subjects in the TEP group, while it was absent in the TAPP group, though this difference failed to reach statistical significance. This aligns with a comprehensive review by Schrenk et al. [8], which reported a higher conversion rate in the TEP group, and Vãrcuæ et al. [3], who noted conversions from TEP to the open Lichtenstein procedure due to a lack of muscle relaxation and inability to create proper working space. Ultimately, when dissection is not possible laparoscopically, open conversion is mandated regardless of the initial approach, mitigating any significant difference in conversion rates overall.

A cornerstone of our surgical methodology was the avoidance of routine mesh fixation. Historically, surgeons relied on metallic tacks to prevent mesh folding and migration. However, placing tacks in the pre-peritoneal space—specifically near the "Triangle of Pain" and "Triangle of Doom"—carries an inherent risk of neuropathic pain and vascular injury [9, 10]. Extensive contemporary literature supports the non-fixation paradigm. Early studies by Ferzli et al. [9] and Khajanchee et al. [11] demonstrated that omitting fixation does not increase recurrence rates. Subsequent randomized

controlled trials by Koch et al. [12], Taylor et al. [13], and Garg et al. [14] confirmed that eliminating tack fixation significantly reduces postoperative narcotic use, chronic pain, and operative costs without compromising the repair. Recent meta-analyses by Teng et al. [15] and Sajid et al. [16] definitively concluded that non-fixation is safe, provided a sufficiently large prosthesis is used to adequately cover Fruchaud's myopectineal orifice [17].

Postoperative pain was significantly reduced in the TEP group during the early recovery phase (6h to 72h). At 24 hours, VAS scores were higher in TAPP subjects, though the difference in our specific cohort did not reach statistical significance. The reduced early pain in TEP is largely attributed to remaining entirely extraperitoneal, thereby averting peritoneal irritation, intra-abdominal gas distension, and visceral manipulation [1, 6]. Furthermore, our study established a positive correlation between extended operative duration and higher early pain scores. The prolonged pneumoperitoneum and tissue handling required in TAPP likely contributed to these elevated VAS scores, a finding supported by Bansal et al. [18], who reported significantly higher pain scores and parenteral analgesia requirements in the TAPP group at 6 and 24 hours. Conversely, Vãrcuæ et al. [3] recorded comparable pain between both methods. Beyond pain, the time to liquid diet was identical in both groups. The duration of hospital stay was also similar, with two subjects from each group requiring an extended two-day stay, mirroring findings by Shakya et al. [4] that recovery times are generally comparable, though Khoury et al. [5] reported shorter stays for TEP. Because both procedures dissect and place the mesh in the same preperitoneal plane, minor variations in diet tolerance and stay duration are likely incidental.

Postoperative complications were evaluated systematically. At one week, hematoma and seroma formation were more frequent in the TEP group (17.6% seroma vs 15% for TAPP). This increased seroma formation is a recognized physiological consequence of the larger continuous extraperitoneal dead space created during TEP dissection, compounded by the raw surfaces created [6]. Rates of wound infection and scrotal edema were similar between the groups at one week, echoing Bansal et al. [18], who found comparable wound infection rates but noted a higher incidence of cord edema in TAPP. Köckerling et al. [2] similarly reported significant differences in complications, noting more frequent secondary bleeding in TEP but more seromas in TAPP. By the one-month and six-month follow-ups, these early complications had resolved with no significant differences remaining between the two groups. Importantly, our finding of zero early recurrences, port site hernias, bowel obstructions, or mesh infections during the six-month follow-up aligns robustly with the established evidence base for non-fixation. While our study is limited by its single-center design and modest sample size (n=60), the safety and excellent long-term durability of extraperitoneal repairs are well-supported, with long-term studies reporting 5-year recurrence rates as low as 1% [19, 20].

Conclusion

Both TEP and TAPP are safe and effective techniques for laparoscopic inguinal hernia repair, showing comparable intra-operative and postoperative complication rates and zero early recurrence. However, TEP repair was associated with a shorter operative time and significantly lower early postoperative pain scores.

These advantages are likely due to the avoidance of peritoneal entry and reduced intra-abdominal manipulation. While both approaches yield satisfactory outcomes, TEP may be preferred to facilitate better early recovery and operative efficiency, particularly in patients presenting with bilateral inguinal hernias. The ultimate choice of technique should rely on surgeon expertise, patient-specific factors, and hernia characteristics.

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