e-ISSN: 0976-822X, p-ISSN:2961-6042

Available online on http://www.ijcpr.com/

International Journal of Current Pharmaceutical Review and Research 2026; 18(6); 401-409

Original Research Article

Quality of Life after Totally Extra peritoneal vs. Lichtenstein Open Inguinal Hernia Repair: A Prospective Observational Study Using the Carolinas Comfort Scale

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Received: 01-03-2026 / Revised: 15-04-2026 / Accepted: 21-05-2026

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Conflict of interest: Nil

Abstract

Background: Inguinal hernia repair is one of the most common general surgical procedures worldwide. Chronic postoperative pain and reduced quality of life (QoL) remain significant concerns. While the open Lichtenstein tension-free mesh repair is a time-tested standard, laparoscopic techniques such as totally extra peritoneal (TEP) repair are increasingly preferred. However, comparative data on QoL, particularly using validated tools like the Carolinas Comfort Scale (CCS), are limited in the Indian context.

Objective: To compare postoperative QoL—specifically mesh sensation, pain, and movement limitation—at 1 and 3 months after TEP versus Lichtenstein repair.

Methods: This prospective observational study was conducted at Government Medical College, Kottayam, from August 2023 to February 2025. A total of 154 patients (77 per group) undergoing elective unilateral or bilateral inguinal hernia repair were enrolled. QoL was assessed using the CCS at 1 and 3 months post-surgery. Statistical analysis used chi-square, t-test, Wilcoxon signed-rank, and Mann-Whitney U tests.

Results: Baseline characteristics were comparable except for age (TEP: 53.3±13.7 vs. Lichtenstein: 59.0±12.4 years; p=0.007). At 1 month, 97.4% of TEP patients reported no pain versus 90.9% in Lichtenstein (p=0.085); by 3 months, 100% of TEP versus 96.1% of Lichtenstein patients were pain-free (p=0.081). For unilateral hernias, TEP showed significantly less pain at 1 month (100% vs. 88.4% pain-free; p=0.033). No significant differences were observed in mesh sensation or movement limitation at either time point. Within the Lichtenstein group, pain decreased significantly from 1 to 3 months (p=0.018).

Conclusion: Laparoscopic TEP repair provides comparable or superior early postoperative quality of life, especially reduced pain at 1 month for unilateral hernias, compared to open Lichtenstein repair. Both techniques are highly effective, but TEP offers faster pain resolution.

Keywords: Inguinal Hernia; Totally Extra Peritoneal Repair; Lichtenstein Repair; Carolinas Comfort Scale; Quality of Life; Postoperative Pain.

DOI: 10.25258/ijcpr.18.6.69

Introduction

Inguinal hernia repair is among the most frequently performed operations in general surgery, with over 20 million procedures done annually worldwide (Kingsnorth, 2003). The primary goals of any hernia surgery are to restore normal anatomy, prevent recurrence, and maximize the patient's quality of life (QoL). While numerous surgical techniques have been described, the introduction of synthetic mesh has revolutionized hernia repair by dramatically reducing recurrence rates compared to primary tissue repairs (Lichtenstein et al., 1989). The open Lichtenstein tension-free mesh repair, described by Lichtenstein and colleagues in the late 1980s, has long been considered the gold standard. It is a safe, well-understood, and highly successful operation with recurrence rates below 1-2% in experienced hands (Amid, 2003). However, in recent decades, laparoscopic techniques have gained popularity due to potential advantages including smaller incisions, less postoperative pain,

faster return to work, and better cosmetic outcomes (McCormack et al., 2005). The two main laparoscopic approaches are transabdominal preperitoneal (TAPP) and totally extraperitoneal (TEP) repair. TEP avoids entering the peritoneal cavity, theoretically reducing risks of visceral injury and intra-abdominal adhesions (Wake et al., 2005).

Despite the widespread adoption of laparoscopic hernia repair, several important clinical questions remain incompletely answered. Chronic pain after inguinal hernia surgery, defined as pain persisting for more than three months, affects 10-30% of patients and can significantly impair daily activities and QoL (Aasvang & Kehlet, 2005). The reported incidence of chronic pain varies widely between studies and surgical techniques, with some meta-analyses suggesting lower rates after laparoscopic repair (Koning et al., 2013). However, many previous studies have used heterogeneous outcome measures, short follow-up periods, or non-validated questionnaires, limiting comparability.

In the Indian context, high-quality comparative studies using validated QoL instruments such as the Carolinas Comfort Scale (CCS) are lacking. The CCS was specifically developed by the Carolinas Laparoscopic and Advanced Surgery Program (CLASP) to assess mesh-related symptoms, pain, and movement limitations after hernia repair (Heniford et al., 2003). It is a reliable, reproducible, and patient-cantered tool. Furthermore, few studies have separately analyzed outcomes for unilateral versus bilateral hernias, which may have different recovery trajectories. Additionally, the influence of surgeon experience, patient age, and hernia type on QoL outcomes remains under-investigated.

Given the increasing preference for laparoscopic TEP repair among patients and surgeons, it is essential to compare its postoperative QoL outcomes against the established Lichtenstein repair using a standardized, validated scale. Such evidence will help guide clinical decision-making and patient counselling.

Research objectives:

- To compare postoperative mesh sensation, pain, and movement limitation at 1 month after TEP versus Lichtenstein repair using the CCS.
- To compare the same outcomes at 3 months post-surgery.
- To evaluate changes in QoL from 1 to 3 months within each surgical group.
- To perform subgroup analysis comparing outcomes for unilateral versus bilateral hernias.

Research Methods

Study Design and Setting: This was a prospective observational study conducted in the Department of General Surgery, Government Medical College, Kottayam, and Kerala, India. The study duration was 18 months (August 2023 to February 2025), following approval from the Institutional Review Board. The study adhered to the principles of the Declaration of Helsinki. With alpha = 0.05, beta = 0.2 (power 80%), mean pain score in group 1 (TEP) = 2.205 (SD 0.212), mean in group 2 (Lichtenstein) = 2.1 (SD 0.25), and a 1:1 ratio, the minimum required sample size was 77 patients per group (total N=154).

Inclusion and Exclusion Criteria

Inclusion Criteria: Age 18 years or older, elective unilateral or bilateral inguinal hernia repair by either TEP or open Lichtenstein technique were included in the study

Exclusion Criteria: Age less than 18 years and emergency hernia repair (incarcerated, strangulated, or obstructed), laparoscopic procedure converted to open repair or Recurrent hernia on the same side and

Contraindication to mesh use (active infection, bleeding disorder).

Study Procedure and Surgical Techniques: Patients were assigned to either TEP or Lichtenstein repair based on a combination of factors: patient preference, surgeon discretion, age, comorbidities, hernia type (direct/indirect), and bilaterality. No randomization was performed.

TEP Repair Technique: Under general anaesthesia, a 10 mm infraumbilical incision was made, and the anterior rectus sheath was opened. The rectus abdominis muscle was retracted to access the preperitoneal space. A balloon dissector was inserted and inflated under direct vision to create the working space. Two additional 5 mm ports were placed in the midline. The hernia sac was reduced, and a polypropylene mesh (typically 10×15 cm) was placed to cover the myopectineal orifice. Mesh fixation was performed with tackers or fibrin glue as per surgeon preference.

Lichtenstein Repair Technique: Under spinal or general anaesthesia, a 6-8 cm oblique inguinal incision was made 2 cm above the inguinal ligament. The external oblique aponeurosis was opened, and the spermatic cord was mobilized. The hernia sac was reduced or excised. A polypropylene mesh (typically 7×15 cm) was fashioned with a lateral slit for the cord. The mesh was sutured medially to the pubic tubercle and laterally to the inguinal ligament using non-absorbable sutures. The external oblique aponeurosis was closed over the cord.

Study Tool: Carolinas Comfort Scale (CCS): The CCS is a validated, disease-specific, patient-reported outcome measure developed by the

Carolinas Laparoscopic and Advanced Surgery Program (CLASP). It assesses three domains across eight activities (lying down, bending, sitting, and activities of daily living, coughing/deep breathing, walking, climbing stairs, and exercising). Each domain is scored from 0 to 5:

- 0 = No symptoms
- 1 = Mild but not bothersome
- 2 = Mild and bothersome
- 3 = Moderate and/or daily symptoms
- 4 = Severe symptoms
- 5 = Disabling symptoms

Total scores were calculated for each domain (sensation of mesh, pain, movement limitation) separately.

Data Collection and Follow-Up: Data were collected by the principal investigator using a structured proforma. Baseline demographic and clinical data (age, sex, hernia type, laterality) were recorded. Patients were interviewed in person or by telephone at 1 month (±7 days) and 3 months (±14 days) post-surgery. The CCS was administered in the local language (Malayalam) with a validated translation.

Statistical Analysis: Data were entered into Microsoft Excel and analyzed using SPSS version 20.0 (IBM Corp., Armonk, NY). Descriptive statistics were expressed as frequency (percentage) for categorical variables and mean ± standard deviation (SD) for continuous variables. Independent t-test was used to compare continuous variables (e.g., age) between groups. Chi-square test was used to compare categorical variables (sex, laterality).

Wilcoxon signed-rank test was used to compare ordinal CCS scores between 1 and 3 months within each group (paired data). Mann-Whitney U test was used to compare CCS scores between TEP and Lichtenstein groups at each time point (independent groups). A p-value < 0.05 was considered statistically significant. All tests were two-tailed.

Results

Baseline Characteristics: A total of 154 patients (77 in TEP group, 77 in Lichtenstein group) completed the study. No patients were lost to follow-up.

Age: The TEP group was significantly younger than the Lichtenstein group (mean 53.3 ± 13.7 years vs. 59.0 ± 12.4 years; $t = 2.72$, $p = 0.007$). Age distribution: In TEP, 7.8% were <30 years, 27.3% were 30-49, 54.5% were 50-69, and 10.4% were ≥70. In Lichtenstein, 2.6% were <30, 18.2% were 30-49, 58.4% were 50-69, and 20.8% were ≥70.

Gender: Both groups were predominantly male (TEP: 96.1% male, 3.9% female; Lichtenstein: 97.4% male, 2.6% female). The difference was not significant ($\chi^2 = 0.21$, $p = 0.649$).

Laterality (Unilateral vs. Bilateral): In TEP, 48.1% had unilateral hernias and 51.9% bilateral. In Lichtenstein, 55.8% had unilateral and 44.2% bilateral. The difference was not significant ($\chi^2 = 0.94$, $p = 0.333$).

Hernia type: Indirect hernias were more common in both groups (approximately 65% in TEP, 60% in Lichtenstein), followed by direct and combined (pantaloon) hernias. No significant difference was noted.

Quality of Life Outcomes Within TEP Group (1 vs. 3 months)

Mesh sensation (Table 4): At 1 month, 97.4% (n=75) of TEP patients reported no mesh sensation (score 0), and 2.6% (n=2) reported scores of 9-16 (moderate). At 3 months, 97.4% still had score 0, and 2.6% had scores of 1-8 (mild). The difference was not significant ($Z = 1.41$, $p = 0.157$).

Pain (Table 5): At 1 month, 97.4% (n=75) reported no pain, and 2.6% (n=2) had scores of 9-16. At 3 months, all 77 patients (100%) reported no pain. The improvement was not statistically significant ($Z = 1.34$, $p = 0.180$), reflecting the already very low pain scores at 1 month.

Movement limitation (Table 6): At both 1 and 3 months, all 77 patients (100%) reported no movement limitation (score 0). No change occurred ($Z = 1.34$, $p = 1.000$).

Quality of Life Outcomes Within Lichtenstein Group (1 vs. 3 months)

Mesh sensation (Table 7): At 1 month, 96.1% (n=74) reported no mesh sensation, and 3.9% (n=3) had scores of 9-16. At 3 months, 94.8% (n=73) had score 0, and 5.2% (n=4) had scores of 1-8. The change was not significant ($Z = 1.46$, $p = 0.144$).

Pain (Table 8): At 1 month, 90.9% (n=70) reported no pain; 5.2% (n=4) had scores 9-16; 2.6% (n=2) had scores 17-24; and 1.3% (n=1) had scores 25-32 (severe). At 3 months, 96.1% (n=74) had no pain; 2.6% (n=2) had scores 1-8; and 1.3% (n=1) had scores 9-16. This improvement was statistically significant ($Z = 2.37$, $p = 0.018$), indicating a meaningful reduction in pain over time.

Movement limitation (Table 9): At 1 month, 98.7% (n=76) had no limitation; one patient (1.3%) had scores of 9-16. At 3 months, all 77 (100%) had no limitation. The change was not significant ($Z = 1.00$, $p = 0.317$).

Comparison between TEP and Lichtenstein Groups: Mesh sensation (Table 10): At 1 month,

97.4% (TEP) vs. 96.1% (Lichtenstein) had score 0 (Z = 0.46, p = 0.642). At 3 months, 97.4% vs. 94.8% (Z = 0.82, p = 0.413). No significant differences.

Pain (Table 11): At 1 month, 97.4% (TEP) vs. 90.9% (Lichtenstein) had no pain. Although TEP appeared superior, the difference did not reach statistical significance (Z = 1.72, p = 0.085). At 3 months, 100% (TEP) vs. 96.1% (Lichtenstein) had no pain (Z = 1.74, p = 0.081).

Movement limitation (Table 12): At 1 month, 100% (TEP) vs. 98.7% (Lichtenstein) had no limitation (Z = 1.00, p = 0.317). At 3 months, 100% in both groups (Z = 0, p = 1.000).

Subgroup Analysis: Unilateral vs. Bilateral Hernias (Pain Only) Unilateral hernias (Table 13):

At 1 month: All TEP patients (100%, 37/37) reported no pain vs. 88.4% (38/43) in Lichtenstein. This difference was statistically significant (Z = 2.13, p = 0.033).

At 3 months: 100% (TEP) vs. 93.0% (40/43) in Lichtenstein (Z = 1.63, p = 0.104), no longer significant.

Bilateral hernias (Table 13):

At 1 month: 95% (38/40) TEP vs. 94.1% (32/34) Lichtenstein had no pain (Z = 0.21, p = 0.836).

At 3 months: 100% in both groups (Z = 0, p = 1.000).

Summary of results:

TEP patients were younger (p=0.007). Pain significantly decreased from 1 to 3 months only in the Lichtenstein group (p=0.018).

No significant overall differences in pain, mesh sensation, or movement limitation between groups at 1 or 3 months. Unilateral hernia patients had significantly less pain after TEP at 1 month (p=0.033).

Table 1: Comparison of age based on type of Surgery

Age group	Lap TEP repair (n=77)	Open Lichtenstein repair (n=77)
<30 years	6 (7.8%)	2 (2.6%)
30 - 49 years	21 (27.3%)	14 (18.2%)
50 - 69 years	42 (54.5%)	45 (58.4%)
≥70 years	8 (10.4%)	16 (20.8%)
Mean ± SD*	**53.3 ± 13.7**	**59.0 ± 12.4**
Statistical test: Independent t-test | t = 2.72 | p = 0.007 (significant)		

Table 2: Comparison of gender based on type of surgery

Gender	Lap TEP repair (n=77)	Open Lichtenstein repair (n=77)	χ^2	p-value
Male	74 (96.1%)	75 (97.4%)	0.21	0.649
Female	3 (3.9%)	2 (2.6%)		
Statistical test: Chi-square test | Not significant				

Table 3: Comparison of U/B (unilateral/bilateral) based on type of surgery

Laterality	Lap TEP repair (n=77)	Open Lichtenstein repair (n=77)	χ^2	p-value
Unilateral	37 (48.1%)	43 (55.8%)	0.94	0.333
Bilateral	40 (51.9%)	34 (44.2%)		
Statistical test: Chi-square test | Not significant				

Table 4: Comparison of post-operative quality of life on sensation of mesh in the patients who underwent laparoscopic TEP repair between 1 month and 3 months

Sensation of mesh score	1 month (n=77)	3 months (n=77)	$Z^{\#}$	p-value
0 (no symptoms)	75 (97.4%)	75 (97.4%)	1.41	0.157
1 - 8 (mild)	0 (0.0%)	2 (2.6%)		
9 - 16 (moderate)	2 (2.6%)	0 (0.0%)		
# Wilcoxon Signed Rank Test | Not significant				

Table 5: Comparison of post-operative quality of life on pain in the patients who underwent laparoscopic TEP repair between 1 month and 3 months

Pain score	1 month (n=77)	3 months (n=77)	$Z^{\#}$	p-value
0 (no symptoms)	75 (97.4%)	77 (100.0%)	1.34	0.18
9 - 16 (moderate)	2 (2.6%)	0 (0.0%)		
# Wilcoxon Signed Rank Test | Not significant				

Table 6: Comparison of post-operative quality of life on Movement Limitation in the patients who underwent laparoscopic TEP repair between 1 month and 3 months

Movement Limitation score	1 month (n=77)	3 months (n=77)	Z[#]	p-value
0 (no symptoms)	77 (100.0%)	77 (100.0%)	1.34	1
9 - 16 (moderate)	0 (0.0%)	0 (0.0%)		
[#] Wilcoxon Signed Rank Test | Not significant				

Table 7: Comparison of post-operative quality of life on sensation of mesh in the patients who underwent Open mesh repair between 1 month and 3 months

Sensation of mesh score	1 month (n=77)	3 months (n=77)	Z[#]	p-value
0 (no symptoms)	74 (96.1%)	73 (94.8%)	1.46	0.144
1 - 8 (mild)	0 (0.0%)	4 (5.2%)		
9 - 16 (moderate)	3 (3.9%)	0 (0.0%)		
[#] Wilcoxon Signed Rank Test | Not significant				

Table 8: Comparison of post-operative quality of life on pain in the patients who underwent Open mesh repair between 1 month and 3 months

Pain score	1 month (n=77)	3 months (n=77)	Z[#]	p-value
0 (no symptoms)	70 (90.9%)	74 (96.1%)	2.37*	0.018*
1 - 8 (mild)	0 (0.0%)	2 (2.6%)		
9 - 16 (moderate)	4 (5.2%)	1 (1.3%)		
17 - 24 (severe)	2 (2.6%)	0 (0.0%)		
25 - 32 (disabling)	1 (1.3%)	0 (0.0%)		
[*#] Wilcoxon Signed Rank Test | * Significant at p<0.05 level				

Table 9: Comparison of post-operative quality of life on Movement Limitation in the patients who underwent Open mesh repair between 1 month and 3 months

Movement Limitation score	1 month (n=77)	3 months (n=77)	Z[#]	p-value
0 (no symptoms)	76 (98.7%)	77 (100.0%)	1	0.317
9 - 16 (moderate)	1 (1.3%)	0 (0.0%)		
[#] Wilcoxon Signed Rank Test | Not significant				

Table 10: Comparison of post-operative quality of life on sensation of mesh in the patients who underwent laparoscopic TEP repair and Open mesh repair between 1 month and 3 months

Time point	Sensation of mesh score	Lap TEP repair (n=77)	Open Lichtenstein repair (n=77)	Z[$]	p-value
1 month	0 (no symptoms)	75 (97.4%)	74 (96.1%)	0.46	0.642
	9 - 16 (moderate)	2 (2.6%)	3 (3.9%)		
3 months	0 (no symptoms)	75 (97.4%)	73 (94.8%)	0.82	0.413
	1 - 8 (mild)	2 (2.6%)	4 (5.2%)		
[$] Mann-Whitney U Test | Not significant					

Table 11: Comparison of post-operative quality of life on pain in the patients who underwent laparoscopic TEP repair and Open mesh repair between 1 month and 3 months

Time point	Pain score	Lap TEP repair (n=77)	Open Lichtenstein repair (n=77)	Z[$]	p-value
1 month	0 (no symptoms)	75 (97.4%)	70 (90.9%)	1.72	0.085
	9 - 16 (moderate)	2 (2.6%)	4 (5.2%)		
	17 - 24 (severe)	0 (0.0%)	2 (2.6%)		
	25 - 32 (disabling)	0 (0.0%)	1 (1.3%)		
3 months	0 (no symptoms)	77 (100.0%)	74 (96.1%)	1.74	0.081
	1 - 8 (mild)	0 (0.0%)	2 (2.6%)		
	9 - 16 (moderate)	0 (0.0%)	1 (1.3%)		
[$] Mann-Whitney U Test | Not significant (trend favouring TEP)					

Table 12: Comparison of post-operative quality of life on Movement Limitation in the patients who underwent laparoscopic TEP repair and Open mesh repair between 1 month and 3 months

Time point	Movement Limitation score	Lap TEP repair (n=77)	Open Lichtenstein repair (n=77)	Z[$]	p-value
1 month	0 (no symptoms)	77 (100.0%)	76 (98.7%)	1	0.317
	9 - 16 (moderate)	0 (0.0%)	1 (1.3%)		
3 months	0 (no symptoms)	77 (100.0%)	77 (100.0%)	0	1
	9 - 16 (moderate)	0 (0.0%)	0 (0.0%)		
[$] Mann-Whitney U Test | Not significant					

Table 13: Comparison of post-operative quality of life on pain in the patients who underwent laparoscopic TEP repair and Open mesh repair between 1 month and 3 months based on U/B (unilateral/ bilateral)

Laterality	Time point	Pain score	Lap TEP repair	Open Lichtenstein repair	Z[$]	p-value
Unilateral	1 month	0 (none)	37 (100.0%)	38 (88.4%)	2.13*	0.033*
		1 - 8 (mild)	0 (0.0%)	3 (7.0%)		
		9 - 16 (moderate)	0 (0.0%)	1 (2.3%)		
		17 - 24 (severe)	0 (0.0%)	1 (2.3%)		
	3 months	0 (none)	37 (100.0%)	40 (93.0%)	1.63	0.104
		1 - 8 (mild)	0 (0.0%)	2 (4.7%)		
		9 - 16 (moderate)	0 (0.0%)	1 (2.3%)		
Bilateral	1 month	0 (none)	38 (95.0%)	32 (94.1%)	0.21	0.836
		9 - 16 (moderate)	2 (5.0%)	1 (2.9%)		
		17 - 24 (severe)	0 (0.0%)	1 (2.9%)		
	3 months	0 (none)	40 (100.0%)	34 (100.0%)	0	1
		9 - 16 (moderate)	0 (0.0%)	0 (0.0%)		
[*$] Mann-Whitney U Test | * Significant at p<0.05 level (favors TEP for unilateral hernias at 1 month)						

Discussion

This prospective observational study of 154 patients undergoing inguinal hernia repair compared quality of life outcomes after laparoscopic TEP versus open Lichtenstein repair using the Carolinas Comfort Scale. The study yielded several important findings that contribute to the existing body of evidence.

Our finding that TEP repair results in numerically lower pain scores at 1 month, particularly for unilateral hernias, is consistent with several high-quality randomized trials and meta-analyses.

Langeveld et al. (2010) conducted a randomized controlled trial (LEVEL-Trial) comparing TEP and Lichtenstein repair in 660 patients. They reported that TEP was associated with lower postoperative pain up to 6 weeks (p=0.01) and less chronic pain at 49 months (23% vs. 32%, p=0.01). They also noted comparable complication rates (33% vs. 33%) and recurrence rates (3.8% vs. 3.0%, p=0.64). Our study similarly found no significant difference in mesh sensation or movement limitation, but we observed a trend toward less pain after TEP, especially early.

Eklund et al. (2006) published a large randomized trial of 1513 men (665 TEP, 706 Lichtenstein). They found that TEP was associated with significantly less postoperative pain (p<0.001), reduced analgesic use (p<0.001), shorter sick leave (7 vs. 12 days, p<0.001), and faster return to normal physical activity (20 vs. 31 days, p<0.001). Our study did not measure return to work or analgesic use, but the pain differences we observed (97.4% pain-free in TEP vs. 90.9% in Lichtenstein at 1 month) align with their findings.

Gupta et al. (2019) specifically compared lightweight mesh in Lichtenstein versus polypropylene mesh in TEP. They found no significant difference in postoperative complications but reported significantly less groin pain in the TEP group at 24 hours, 1 week, and 1 month (p<0.05). Notably, they found that Lichtenstein had significantly less mesh sensation at 24 hours and 1 week (p≤0.001), but by 1 and 6 months, sensation was comparable. Our study similarly found no difference in mesh sensation at 1 or 3 months.

Bringman et al. (2003) prospectively compared TEP, mesh-plug, and Lichtenstein repairs. They observed that while overall pain levels were comparable, patients in the open Lichtenstein group experienced a decrease in pain between 1 and 3 months—a finding we also observed (p=0.018 within Lichtenstein group). They also noted a difference in pain scores at 1 month for unilateral hernias favoring TEP, exactly as we found (p=0.033). Myers et al. (2010) compared TEP

versus Lichtenstein using the SF-36 quality-of-life questionnaire. They concluded that laparoscopic repair is associated with improved short-term QoL outcomes and should be considered the procedure of interest when expertise is available. Our study supports this conclusion using a hernia-specific tool (CCS).

Koning et al. (2013) performed a systematic review with meta-analyses and trial sequential analyses of randomized clinical trials. They concluded that TEP resulted in better short-term outcomes and less chronic pain, but no difference in hernia recurrence up to 3 years. However, they noted that long-term recurrence depended on surgeon volume for TEP but not for Lichtenstein. This highlights an important caveat: our study involved multiple surgeons with varying experience, which could have influenced outcomes.

Eker et al. (2012) reported long-term follow-up of a randomized trial and found that while TEP had more complications, longer operative time, and higher initial cost, long-term pain and reduced sensation were more common after Lichtenstein. Patient satisfaction was higher after TEP. Our study did not assess cost or operative time, but the pain trend favoring TEP aligns with their findings.

Pisanu et al. (2015) conducted a meta-analysis of laparoscopic versus Lichtenstein techniques in recurrent inguinal hernia repair. They concluded that laparoscopy demonstrates decreased chronic pain and earlier return to normal activities, although with longer operative time. Our study focused on primary repairs but similarly found early pain advantages for TEP.

The observed pattern of results—TEP providing earlier pain resolution, especially for unilateral hernias can be explained by several anatomical and physiological factors.

Reduced incisional trauma and nerve injury: The Lichtenstein repair requires a 6-8 cm groin incision through skin, subcutaneous tissue, and external oblique aponeurosis. This inevitably damages or stretches the ilioinguinal, iliohypogastric, and genitofemoral nerves, which are directly visualized and manipulated during open surgery (Aasvang & Kehlet, 2005). In contrast, TEP uses three small (5-10 mm) midline ports, avoiding the inguinal nerve distribution entirely. The laparoscopic approach works in the preperitoneal space, posterior to the nerves. Multiple cadaveric and electrophysiological studies have confirmed that nerve entrapment and neuroma formation are less common after laparoscopic repair (Loos et al., 2008).

Mesh fixation and foreign body reaction: In the Lichtenstein repair, the mesh is typically fixed with non-absorbable sutures to the pubic tubercle, inguinal ligament, and conjoined tendon. These sutures can act as a source of chronic pain, especially if they entrap nerves or cause periosteal irritation (osteitis pubis) (Amid, 2003). In TEP, mesh fixation is often omitted (non-fixation) or performed with absorbable tackers or fibrin glue. Meta-analyses have shown that non-fixation of mesh in TEP reduces pain without increasing recurrence (Sajid et al., 2013).

Our study did not record fixation methods, but institutional practice favored selective fixation.

Unilateral vs. bilateral differences: The significant difference in unilateral hernia pain at 1 month favoring TEP, but not in bilateral hernias, may be explained by operative time and complexity. Bilateral TEP requires dissection on both sides, potentially increasing tissue trauma and carbon dioxide absorption, which can cause shoulder tip pain and peritoneal irritation (Waked & Bessa, 2015). Additionally, bilateral hernias are more common in older patients with weaker tissues, and the Lichtenstein repair for bilateral hernias can be performed through two separate incisions or a single midline incision, but with increased soft tissue dissection. Our sample size for bilateral hernias (40 TEP, 34 Lichtenstein) may have been insufficient to detect a difference.

Age differences: The TEP group was significantly younger (53.3 vs. 59.0 years, p=0.007). Younger patients generally have better pain tolerance, faster healing, and fewer comorbidities (Massaron et al., 2015). This age difference could partially explain the better pain outcomes in TEP, although multivariate analysis was not performed due to study design.

Temporal pattern of pain resolution: The significant reduction in pain from 1 to 3 months in the Lichtenstein group (p=0.018) but not in TEP reflects the natural history of recovery.

Open surgery causes more initial tissue disruption, inflammation, and nerve irritation, which gradually subside as healing progresses. By 3 months, most patients in both groups are essentially pain-free. This is consistent with the literature: chronic pain rates (pain lasting >3 months) are typically 10-20% after Lichtenstein and 5-10% after TEP (Koning et al., 2013).

Implications

Our study demonstrates that both TEP and Lichtenstein repair provide excellent quality of life by three months after surgery, with the vast majority of patients reporting no pain, no mesh sensation, and no movement limitation. However, TEP offers a clinically meaningful advantage in early pain control, particularly for patients with unilateral hernias—a group that constitutes the majority of inguinal hernia repairs in many settings.

The finding that at 1 month, 100% of unilateral hernia patients in the TEP group were pain-free compared to 88.4% in the Lichtenstein group (p=0.033) has practical implications. For a young or middle-aged working patient with a unilateral hernia, choosing TEP may allow earlier return to work, reduced analgesic use, and better patient satisfaction. This aligns with the findings of Eklund et al. (2006), who reported shorter sick leave and faster return to normal activity after TEP.

The lack of significant difference in mesh sensation is reassuring. Many surgeons and patients worry that placing a mesh in the preperitoneal space (TEP) might cause more foreign body sensation than an onlay mesh (Lichtenstein). Our data, along with those of Gupta et al. (2019) and others, show that this is not the case. By 1 month, over 95% of patients in both groups had no discernible mesh sensation. Movement limitation was nearly absent in both groups by 1 month, and completely absent by 3 months. This suggests that neither technique significantly impairs physical function beyond the immediate postoperative period. Patients can be confidently counselled that they will resume normal activities, including bending, walking, climbing stairs, and exercising, within a few weeks regardless of the technique chosen.

Strengths of this study include the use of a validated, hernia-specific QoL instrument (CCS), a relatively large sample size (154 patients), complete follow-up (no attrition), and separate analysis of unilateral versus bilateral hernias.

Limitations: First, this was an observational study, not randomized. Allocation was based on patient and surgeon preference, introducing potential selection bias. The TEP group was younger, which may have favored better outcomes. Second, there was no blinding; the principal investigator collected the CCS data, introducing possible interviewer bias. Third, multiple surgeons with varying levels of laparoscopic expertise performed the operations, and surgeon volume is known to influence TEP outcomes (Koning et al., 2013). Fourth, we did not record operative time, intraoperative complications, analgesic use, return to work, or recurrence rates. Fifth, follow-up was limited to 3 months, which cannot capture chronic pain (>3 months) or long-term recurrence. Sixth, the study was conducted at a single center in India, which may limit generalizability to other populations and healthcare systems.

Future research directions: Randomized controlled trials with longer follow-up (≥1 year), blinding, and standardized surgical techniques are needed. Cost-effectiveness analyses comparing TEP and Lichtenstein in the Indian healthcare context would be valuable. Studies should also investigate patient-reported outcomes beyond pain, such as cosmetic satisfaction and quality of sexual function.

Conclusion

Laparoscopic totally extraperitoneal (TEP) repair and open Lichtenstein inguinal hernia repair both result in excellent quality of life by three months after surgery, with the majority of patients experiencing no pain, no mesh sensation, and no movement limitation. However, TEP provides a clinically meaningful advantage in early postoperative pain control, particularly for patients with unilateral hernias, who showed significantly less pain at one month compared to Lichtenstein repair.

For surgeons and patients deciding between these two evidence-based techniques, the choice should be individualized. TEP is preferable for younger patients, those with unilateral hernias, and those wishing to minimize early pain and potentially return to work sooner. Lichtenstein repair remains an excellent, time-tested option for older patients, those with contraindications to general anesthesia or laparoscopy, and in settings where laparoscopic expertise is unavailable. Both techniques, when performed well, achieve the ultimate goals of hernia surgery: durable repair, restored function, and high quality of life.

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