e-ISSN: 0975-9506, p-ISSN: 2961-6093

Available online on www.ijpqa.com doi: 10.25258/ijpqa.16.9.91

International Journal of Pharmaceutical Quality Assurance 2025; 16(9); 540-546

Original Research Article

Comparative Study of Laparoscopic and Open Mesh Repair Techniques in Inguinal Hernia Management

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Received: 04-08-2025 / Revised: 10-09-2025 / Accepted: 28-09-2025
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Conflict of interest: Nil

Abstract:

Background: Inguinal hernia repair is one of the most common surgical conditions encountered worldwide. The emergence of Minimal Access techniques, particularly laparoscopic repair, has revolutionized hernia repair approaches. However, debate remains about optimal techniques.

Aim: We aim to compare the operative outcomes and postoperative recovery between laparoscopic total extraperitoneal (TEP) repair of inguinal hernia versus open Lichtenstein mesh repair.

Methodology: We conducted a prospective comparative study of 76 patients at Netaji Subhas Medical College and Hospital, Jamshedpur, Jharkhand, India. Patients were equally divided into two groups (open mesh repair-group A and laparoscopic TEP repair -group B). Operative outcome measures included operative time, postoperative pain (visual analogue scale), seroma, wound infection, duration of hospital stay, and return to work or normal activities. All data was analyzed using SPSS v16.

Results: Operative time was longer for laparoscopic repair, however pain (VAS ≥4 (10.5% vs 31.6%), complications, duration of hospitalization (1.8 ± 0.4 vs 2.3 ± 0.5 days) and duration of returning to activity (6.9 ± 1.6 vs 13.8 ± 1.9 days) were all significantly less for laparoscopic repair.

Conclusion: Laparoscopic mesh repair is technically difficult and time-consuming, but results in better postoperative outcomes and faster recovery, making it the technique of choice where expertise and facilities exist.

Keywords: Inguinal hernia, Laparoscopic repair, Open mesh repair, TEP, Lichtenstein technique, Postoperative outcomes.

Introduction

Inguinal hernias are one of the most common surgical diagnoses within health care settings and still one of the major morbidity factors of the world. Their management has changed significantly within the recent few decades, and the change has been largely explained by the revolution of surgical methods and the introduction of minimally invasive procedures [1] into practice. The two major categories of groin hernias are the femoral hernias and the inguinal hernias that further fall under the categories of direct and indirect hernia according to the pathways they follow [2]. Indirect inguinal hernia an indirect hernia develops when a patent internal inguinal ring permits the protrusion of the peritoneum including the contents or none at all to lateralize to the inferior epigastric vessels. In surgical practice, this type is the most common form of inguinal hernia.

Hernioplasty has historically been considered as one of the most common operations in the field of general surgery. The open repair technique was the conventional method of inguinal hernia repair over a long period of decades. Nevertheless, within the past twenty years, the development of laparoscopic or minimally invasive procedures has transformed the nature of hernia surgery to a great extent [3,4]. These new methods have a potential of less pain after surgery, faster recovery, and more cosmetic outcomes, thus changing the preferences of patients and surgeons.

Anatomical and physiological features of inguinal hernias are gender related. In men, the hernia can take the course of the spermatic cord and in severe cases, it can move into the scrotum. On the other hand, the hernia can follow the round ligament and extend into labia majora [5] in females. The rate of abdominal wall hernias in general is estimated at 1.7 percent in the general population and increases to about 4 percent in persons aged above 45 years. In these, approximately 75 percent of all abdominal wall hernias include inguinal and with a lifetime incidence of 27 percent in men and 3 percent in women [6]. These statistics highlight the significance of effective and long-lasting hernia repair measures in the context of community health.

Lichtenstein tension-free mesh repair is still considered to be the gold standard in open inguinal hernia repair. In this length, a man-made net is placed in front of the external and internal oblique aponeuroses, hence strengthening the back wall of the inguinal canal but without straining the tissues [7]. The tension-free idea by Lichtenstein transformed the procedure of hernia repairing with a tremendous decrease in the prevalence of recurrence rates than the older forms of hernia repair which used tissues, e.g., the Bassini or Shouldice techniques.

There have also been other open mesh techniques that have been formulated such as the plug and patch repair, Gilbert Prolene Hernia System (PHS) bilayer-linked device repair and the open preperitoneal mesh placement via an inguinal cut after hernia repair. Much as these approaches have demonstrated certain benefits in specific situations, most of the existing clinical guidelines do not consider them a standard approach since the results are inconsistent and the long-term data are not determined [8,9]. Consequently, Lichtenstein technique has been by far the most regularly exercised open technique in the developed and developing surgical environments.

Similar to the open mesh repair, laparoscopic surgery has become a trend within the wider wave of a minimally invasive surgery. The Transabdominal Preperitoneal (TAPP) and the Totally Extraperitoneal (TEP) are the two most popular laparoscopic inguinal hernia repair practices. The two procedures entail insertion of a prosthetic mesh onto the preperitoneal space to support the Myo pectineal orifice, hence lowering chances of recurrence. The TAPP technique requires the use of a peritoneal incision and inserting the mesh into the peritoneal cavity, whereas the TEP technique does not violate the peritoneum at all, working in the preperitoneal space.

Some have shown that laparoscopic repair has some advantages such as reduced postoperative pain, decreased hospitalization and recovery to usual activities, and fewer wound infections than open surgery. In addition, laparoscopic surgery permits the bilateral repair of hernias and the detection of the occult contralateral defects, which is also a particular benefit over the open surgery. Nevertheless, laparoscopic repairs demand very high levels of technical expertise and equipment, which can impose a higher learning curve and increase the operation time of inexperienced operators. There are also fears that she may redevelop hernia, especially after TEP repair, and the possibility of visceral or vascular injury during laparoscopic access [10].

The controversy over what the best surgical option should be is still there even though open and laparoscopic surgeries are used widely. The decision made between laparoscopic and open repair is usually dependent on the experience of the surgeon, resource availability, patient preference and whether the patient has any comorbidities. Although open Lichtenstein repair is a valid and economical approach, especially in the low-resource environment, laparoscopic repair is gaining popularity in operation facilities with modern surgical facilities and skills.

The relative performances of the two methods are still the focus of current research. The major parameters of concern are the time of operation, pain after operation, presence of seroma, hospitalization, restoration of normal functioning, and recurrence in the long term. Other meta-analyses have found better short-term recovery rates with laparoscopy repair, but others have found no significant difference in recurrence rates between the two procedures when done by highly experienced surgeons. Besides, the economic aspects, including the cost of the hospital and the time that the patient will be healed also bring another aspect to the comparative analysis of these processes.

It will be important to conduct a thorough comparative analysis to shed more light on the benefits and drawbacks of laparoscopic and open mesh repair in the treatment of inguinal hernias. A study of this sort can offer some valuable insights to inform the evidence-based decision-making in surgery and serve as the basis of the introduction of changes into the clinical practice guidelines in the future.

Thus, the purpose of the current study is to critically compare and assess the results of the open and laparoscopic mesh repair approaches to the management of the inguinal hernia. There are specific parameters of evaluation such as time on surgery, development of serma, length of stay in the hospital, and the time to resume normal functions. Through these results, the research will add to the existing amount of literature that validates best surgical practice, patient recovery and use of healthcare resources in the management of inguinal hernias.

Methodology

Study Design: This was a prospective comparative study conducted to evaluate and compare the outcomes of laparoscopic (TEP) and open mesh repair techniques in the management of inguinal hernia.

Study Area: The study was carried out in the Department of General Surgery, Netaji Subhas Medical College and Hospital, Jamshedpur, Jharkhand, India.

Study Duration: The study was conducted over a six months period

Sample Size: A total of 76 patients were included in the study, divided equally into two groups:

- **Group A:** 38 patients undergoing open mesh repair (Lichtenstein technique).

- **Group B:** 38 patients undergoing laparoscopic total extraperitoneal (TEP) repair.

Sample Population: The study population consisted of patients diagnosed with uncomplicated unilateral or bilateral inguinal hernias who were admitted to the Department of General Surgery during the study period and met the inclusion criteria.

Inclusion Criteria

- Patients aged >12 years with a clinically diagnosed unilateral or bilateral inguinal hernia.
- Patients who consented to undergo either laparoscopic (TEP) or open mesh repair.
- Patients who provided written informed consent to participate in the study.

Exclusion Criteria

- Patients younger than 12 years of age.
- Patients with complicated hernias (strangulated, obstructed, or recurrent).
- Patients with significant comorbid conditions such as Type 2 diabetes mellitus, hypertension, coronary artery disease, or pulmonary tuberculosis.
- Patients who refused surgery or declined participation.

Data Collection: The pre-designed proforma was used to collect data that contained demographic information, clinical findings, type of hernia, surgical findings, postoperative pain evaluation, hospital stay and postoperative complications (e.g., seroma formation, wound infection, time-to-normal-activity). On Day 2 and 1 and 4 weeks after the operation, pain was measured using the Visual Analogue Scale (VAS).

Procedure: All the patients that fit the inclusion criteria were further subdivided into two groups according to the nature of surgical technique applied. Group A represented patients undergoing open mesh repair, the Lichtenstein technique and Group B comprised of patients undergoing laparoscopic total extraperitoneal (TEP) repair. All patients were given prophylactic antibiotics before surgery according to the institutional guidelines in order to reduce the chances of postoperative infection. The two procedures were executed under general anesthesia, which was done by an anesthesia team that included an anesthesiologist and nurse anesthetists.

A regular inguinal incision was done in the open mesh repair group to reveal the inguinal canal. A hernia sac was dissected, reduced, and polypropylene mesh of the inguinal canal was put over the posterior wall of the inguinal canal in accordance with the principles of the Lichtenstein tension-free repair. Non-absorbable sutures were used to fix the mesh and layers of the wound were closed using the standard methods of wound closure.

Balloon dissection was employed to form the preperitoneal space in the laparoscopic group, and the trocar ports were placed based on the traditional laparoscopic method. The hernia sac was corrected, and an appropriate polypropylene mesh was placed in the preperitoneal area which was afterwards fixed using self-fixing mesh or tack fixation technique. Mesh had been placed accordingly, and trocar incisions were closed.

All the patients were given the freedom to take in some food for about four hours after surgery, depending on their tolerance. Analgesia was administered mostly using nonsteroid anti-inflammatory drugs (NSAIDs), unless otherwise. Visual Analogue Scale (VAS) was used to measure pain levels at two days, one week and four weeks after the surgery. The first follow-up visit was done around one week following the surgery where sutures were removed. Patients were also advised to be up on their feet and engage in some light exercise as early as possible. A six-month follow-up was administered to all the participants to observe the outcomes upon a postoperative period such as wound infection, seroma formation, and time to resume normal activities.

Statistical Analysis: All data collected were tabulated in the Microsoft Excel (Microsoft Corporation, Redmond, Washington, USA) and calculated using SPSS statistics windows, Version 16.0 (SPSS Inc., Chicago, USA). Quantitative variables, including the operative time, postoperative pain score, and hospital stay duration were described in terms of mean +- standard deviation (SD) whereas qualitative variables (e.g. postoperative complications and recurrence) were presented by means of frequencies and percentages. The chi-square test was used to test categorized variables between the two study groups whereas the unpaired version of Student t-test was used in testing the differences in continuous variables. All tests adopted a p-value of less than 0.05 to establish statistical significance so that the results obtained could be trusted to have a 95% confidence level."

Result

The table 1 indicates demographic features of the patients that were recruited, with 76 patients, mostly males (94.7) against a small percentage of females (5.3). The age group with the highest number of patients was 56-70 years (30.3%), 41-55 years (26.3), and 71-85 years (21.0). The age segments below 26 years and 11 years recorded 13.2 and 3.9 percent of men respectively, and very few females formed the 11-55 years group. This distribution reveals the strong predominance of the male population and the concentration of cases in the middle-aged and older adults.

Table 1: The demographic characteristics of the recruited patients		
Age in groups (years)	**Female n (%)**	**Male n (%)**
11 – 25	1 (1.3)	3 (3.9)
26 – 40	2 (2.6)	10 (13.2)
41 – 55	1 (1.3)	20 (26.3)
56 – 70	0 (0.0)	23 (30.3)
71 – 85	0 (0.0)	16 (21.0)
Total	**4 (5.3)**	**72 (94.7)**

Table 2 shows inguinal hernia types and mean operative time (laparoscopic (TEP) and open (Lichtenstein)) of the operations needed to repair the hernia. The most commonly observed type of hernia was the right indirect (35.5 percent) and then the left indirect (23.7 percent), then the right direct, bilateral direct, left direct, and bilateral indirect (10.5, 7.9 and 3.9 percent respectively). The average interval of operation time was more often during laparoscopic repairs in all types of hernias than open surgery. Bilateral indirect hernias (110.2 +- 6.7 minutes) and the right direct hernias (83.7 +- 11.2 minutes) took the longest and shortest time respectively. By contrast, open Lichtenstein repairs took much less time, and took 46.9 +- 6.4 minutes to right direct hernias and 62.1 +- 5.2 minutes to bilateral indirect hernias. These results suggest that laparoscopic repairs are time consuming although they might have other clinical advantages that could warrant increased operation time.

Table 2: Inguinal hernia classifications with associated operative times for open and laparoscopic procedures			
Type of hernia	**n (%)**	**Operation time (minutes) (mean ± SD)**	**p-value**
		Laparoscopic surgery (TEP)	**Open surgery (Lichtenstein)**
Bilateral direct	8 (10.5)	105.6 ± 8.4	59.3 ± 6.1
Bilateral indirect	3 (3.9)	110.2 ± 6.7	62.1 ± 5.2
Right direct	14 (18.4)	83.7 ± 11.2	46.9 ± 6.4
Left direct	6 (7.9)	85.1 ± 10.5	48.3 ± 7.1
Right indirect	27 (35.5)	88.5 ± 9.8	51.7 ± 6.2
Left indirect	18 (23.7)	87.2 ± 8.9	50.9 ± 5.8

Table 3 presents post-operative complications observed during follow-up among patients undergoing laparoscopic and open hernia repair. At week 1, pain (VAS ≥ 4) was reported in 10.5% of laparoscopic cases compared to 31.6% in the open group, while seroma formation occurred in 7.9% and 18.4%, respectively. Wound infection was noted only in one patient (2.6%) from the open surgery group. By week 4, complications had substantially resolved, with only one case (2.6%) of mild pain and no seroma or wound infections in the laparoscopic group, indicating faster recovery and fewer long-term complications following laparoscopic repair.

Table 3: Post-operative complications reported during follow-up			
Post-operative complications	**At week 1, n (%)**	**At week 4, n (%)**	**p-value**
	Laparoscopy	**Open**	**Laparoscopy**
Pain (VAS ≥ 4)	4 (10.5)	12 (31.6)	1 (2.6)
Seroma formation	3 (7.9)	7 (18.4)	0
Wound infection	0	1 (2.6)	0

Table 4 shows comparison of postoperative outcomes of recovery in patients who underwent laparoscopic (TEP) and open (Lichtenstein) hernia repair. Mean hospital stay in the laparoscopy group (1.8 +- 0.4 days) was also much shorter than the open repair group (2.3 +- 0.5 days). Likewise, the patients who underwent laparoscopic surgery took a shorter time (6.9 +- 1.6 days) to resume normal life activities compared to the patients who underwent open repair (13.8 +- 1.9 days) and thus it can be said that laparoscopic surgery has a faster rate of recovery.

Table 4: Days of hospitalization after surgery and return to normal life activities		
Type of surgery undergone	**Days (mean ± SD)**	**p-value**
	Hospitalization	**Returned to normal life activities**
Laparoscopy (TEP)	1.8 ± 0.4	6.9 ± 1.6
Open repair (Lichtenstein)	2.3 ± 0.5	13.8± 1.9

Discussion

The present comparative study on laparoscopic (TEP) and open (Lichtenstein) repairs in the treatment of inguinal hernias, has demonstrated demographic, operative and the post-surgery differences that are consistent with other research and in other instances contradictory. In our analysis, the great majority were males (94.7) and only a small percentage of 5.3 were females. This is consistent with the earlier reports by Charles et al. (2013) [11] who stated that 93.2 percent of inguinal hernia cases are males and Gupta and Rohatgi (1993) who stated that inguinal hernias are found in males' 96 percent more often than in females. These similarities confirm the knowledge that inguinal hernia is mainly a male disease especially because of anatomical and physiological factors i.e. a larger inguinal canal and more physical activity of men. Our cohort was composed of 49.2 +- 13.6 years, and this is comparable to other studies that found that the highest incidence was seen to be in middle-aged and elderly men (Sudarshan et al., 2017) [13]."

The distribution of hernia types as analyzed by us showed that right-sided hernias were predominant with right indirect hernias being 35.5 percent of the cases. This trend is not new because Galeti et al. (2016) [14] and Garg et al. (2018) [15] both indicated that right-sided hernias were predominant in their samples. This tendency can be explained by the fact that right testis is not descended promptly, which predisposes the continuation of a patent processus vaginalis, which further makes the right side more vulnerable to herniation. Bilateral hernias were less prevalent in our study (14.4%), which was also in agreement with McCormack et al. (2003) [16] where bilateral hernias were found to represent a minor percentage of the total cases.

One of the most controversial factors of laparoscopic and open hernia repair is the operative time. The average time taken to perform laparoscopic repair of direct hernias on the right with direct hernia and bilateral indirect hernia on both sides was 83.7 +- 11.2 and 110.2 +- 6.7 respectively which was significantly longer than the open Lichtenstein repair which ranged between 46.9 +- 6.4 and 62.1 +- 5.2 respectively. This long operation time laparoscopic repair is consistent with McCormack et al. (2003), Galeti et al. (2016), and Murthy and Ravalia (2018) [16,14,17] as they all indicated a significant high time of operation laparoscopic repair because of the complexity of the technical procedure, the requirements of the set up, and the steep learning curve related to the use of the minimally invasive procedures. On the other hand, Eklund et al. (2006) [18] and Mehmood et al. (2014) [19]] didn't identify a significant difference in operative time under laparoscopic or open surgery, which was explained by experience and mastery of laparoscopic equipment by the surgeons. These differences reinforce the role of surgical skills and institutional forces on the efficiency of the operation.

The results of the postoperative pain in our study were clearly in favor of laparoscopic repair, with the minimal level of moderate pain (VAS [?]) being only 10.5% of the patients. 4) in the first postoperative week, this was better compared to 31.6% in the open repair group. Only 2.6 of laparoscopic patients experienced residual pain by the fourth week. This is aligned with the results of Shah et al. (2011) [20] who concluded that laparoscopic repair is much more effective in reducing postoperative agony and discomfort, allowing patients to be mobilized earlier and feel satisfied. Likewise, Wellwood et al. (1998) [21] found that minimal postoperative pain was a significant benefit of laparoscopic repair that improves the recovery and the quality of life. These outcomes are probably due to the decreased tissue dissection and minimized incisions in laparoscopic repair.

On the subject of postoperative complications, the presence of seroma was more prevalent in open group (18.4) than laparoscopy repair (7.9) and wound infection in only one of the open cases (2.6) and none of laparoscopic cases. Similar findings were reported by Choudhary et al. (2021) [22] who observed that seroma formation in 9 cases out of 42 open cases and 3 cases in the laparoscopic group. Even though this difference was not found to be statistically significant, it gave an indication that laparoscopic repair has better wound healing results since the incision size is less, and tissue trauma is minimal. The advantages of laparoscopic groups were also found by Murthy and Ravalia (2018) [17] and Garg et al. (2018) [15] with reduced complication rates in the postoperative period.

Mean length of stay of laparoscopic patients in our research was lower (1.8 +- 0.4 days) than that of open repair patients (2.3 +- 0.5 days), which is consistent with the works of Sudarshan et al. (2017) and Choudhary et al. (2021) [13,22], who have reported the same tendencies. The mean stay in the hospital of laparoscopic repair was found as 1.56 days and that of open repair was 1.9 days (statistically significant, $p = 0.002$) (Choudhary et al., 2021) [22]. This is due to the reduced pain, wound care needs, and short hospitalization time that are associated with laparoscopic surgeries.

Regarding the recovery of their normal activities our study revealed that laparoscopic repaired patients quickly resumed their normal operations (6.9 +- 1.6 days) compared to their open repaired counterparts (13.8 +- 1.9 days). These results are in line with those reported by Liem et al. (2003) [23] who also found that laparoscopic hernia repair is associated with a significantly faster recovery to work and normalcy. Equally, Wellwood et al. (1998) [21] observed that the following are the main advantages of

minimally invasive hernia surgery: early mobilization and rapid functional recovery that make the procedure more beneficial to working-age persons. Hamza et al. (2010) [24] however gave contrasting results, indicating that socioeconomic aspects and the level of patient activity can also determine the recovery times after surgery.

Comprehensively, the current results support the accumulated data that laparoscopic repair of hernias is better than open Lichtenstein repair in regard to a decrease in postoperative pain, reduction in hospitalization period, and the speed of recovery, even though there is longer operative time. These findings are consistent with those of previous studies and are indicative of the clinical applicability of laparoscopic repair as a safe and effective method of repair, compared to open surgery. Nonetheless, according to Hamza et al. (2010) and Eklund et al. (2006), the choice of patients, surgeon experience, and resources of the institution are critical in defining outcomes. Future studies with larger sample sizes and longer follow-up periods are necessary to further evaluate long-term outcomes such as recurrence rates and chronic postoperative pain.

Conclusion

The comparative evaluation between laparoscopic techniques and open mesh repair for the treatment of inguinal hernias demonstrated that while both procedures were effective, they differed greatly with respect to operative characteristics and postoperative outcomes. Laparoscopic repair had longer operative times for each type of hernia, but fewer early postoperative events including reduced pain levels, less seroma formation, and no wound infection were seen with laparoscopic repair compared to open repair. Patients treated with laparoscopic repair had shorter lengths of hospital stay and returned to normal daily life activities sooner, emphasizing improved recovery and wellbeing. Even with longer operative times, the laparoscopic approach had clear advantages regarding recovery, a lower postoperative morbidity experience, and improved quality of life during follow-up. These results show that while laparoscopic hernia repair (although a technically challenging procedure) has a more favorable perioperative profile compared to open repair, therefore when situation allows, laparoscopic mesh repair should be considered the intervention of choice where surgical expertise and facilities exist.

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