

Evaluating the Efficacy and Outcomes of Open One-Inch Incision Mesh Plug Repair Versus Laparoscopic TAPP Approach for Primary Indirect Inguinal Hernia

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Abstract:

Background: Minimally invasive approaches such as laparoscopic TAPP (Transabdominal Preperitoneal) repair and modified open techniques like the one-inch incision mesh plug repair have both gained popularity for the management of primary indirect inguinal hernias. However, comparative evidence evaluating their operative and post-operative outcomes remains limited.

Aim: To compare intraoperative and postoperative outcomes of one-inch incision mesh plug repair versus laparoscopic TAPP repair in patients with primary indirect inguinal hernia.

Methods: A prospective comparative study was conducted on patients presenting with primary indirect inguinal hernia. Eligible patients were randomly allocated to two groups: Group A (n=XX) underwent one-inch incision mesh plug repair, while Group B (n=XX) underwent laparoscopic TAPP. Parameters such as operative time, intraoperative blood loss, post-operative pain (VAS score), duration of hospital stay, and complications were assessed. Statistical significance was established at $p < 0.05$.

Results: The mean operative time was significantly shorter in Group A compared to Group B. Group B showed lower postoperative pain scores and faster return to daily activities. Complication rates such as seroma and infection were comparable between groups. No significant recurrence was observed in either group within the follow-up period.

Conclusion: While both techniques are effective, laparoscopic TAPP offers better postoperative comfort and recovery, whereas the one-inch incision mesh plug method is more time-efficient and cost-effective. Surgical choice may depend on patient preference, surgeon expertise, and resource availability.

Keywords: Inguinal Hernia, Mesh Plug Repair, Laparoscopic TAPP, One-Inch Incision, Postoperative Outcomes, Hernia Recurrence.

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Introduction

Inguinal hernia remains one of the most prevalent general surgical conditions globally, accounting for a substantial proportion of elective and emergency surgical admissions. It occurs when abdominal contents protrude through a weakened area in the inguinal canal, and among its subtypes, the primary indirect inguinal hernia is the most frequently encountered, particularly in adult males [1]. The condition not only causes physical discomfort and visible swelling in the groin region but also carries the risk of life-threatening complications such as incarceration and strangulation if left untreated. As a result, surgical repair is universally recognized as the standard of care, and over the decades, various surgical techniques have been introduced and refined to improve clinical outcomes, reduce recurrence, and enhance postoperative recovery [2].

The open tension-free mesh repair, introduced by Lichtenstein, revolutionized inguinal hernia surgery

by significantly lowering recurrence rates. Over time, numerous modifications of the open approach have emerged, one of which is the mesh plug repair, which involves the insertion of a pre-shaped mesh plug into the hernial defect [3]. While this technique remains popular in many centers due to its simplicity, shorter learning curve, and cost-effectiveness, it has also undergone further refinements. A noteworthy advancement in this direction is the one-inch incision mesh plug repair, which is a minimally modified version of the conventional open repair, performed through a much smaller skin incision (approximately one inch). This approach has gained increasing attention owing to its advantages such as reduced operative trauma, shorter operative time, minimal postoperative pain, early ambulation, better cosmetic results, and shorter hospital stay. It also remains feasible in

resource-limited settings, without the need for laparoscopic infrastructure [4,5].

In contrast, the laparoscopic transabdominal preperitoneal (TAPP) repair, introduced in the early 1990s, offers a completely different route of access. TAPP involves entering the peritoneal cavity laparoscopically, dissecting the preperitoneal space, and placing a mesh to reinforce the myopectineal orifice. This technique is associated with certain advantages such as lower incidence of chronic groin pain, faster return to normal activities, reduced risk of wound infection, and the ability to simultaneously assess and repair contralateral or occult hernias. Moreover, it provides superior anatomical visualization [6,7]. However, these benefits come at the cost of longer operative time, need for general anesthesia, higher surgical expertise, and dependence on sophisticated laparoscopic equipment. Additionally, the learning curve associated with laparoscopic hernia repair is steeper, and its availability is often restricted to well-resourced tertiary centers.

Several studies have compared laparoscopic and open techniques for inguinal hernia repair, with most concluding that while laparoscopic repair offers better postoperative comfort, open mesh techniques are more accessible and equally effective in terms of recurrence prevention. However, there is limited literature comparing the one-inch incision mesh plug repair a novel refinement of the open method with laparoscopic TAPP, particularly in the Indian clinical setting [8,9]. Considering the socio-economic diversity of the Indian patient population and variable access to laparoscopic surgery, such comparative evaluations are critical for informing surgical decisions tailored to local needs.

Therefore, this prospective comparative study aims to comprehensively assess and compare the clinical outcomes of one-inch incision mesh plug repair and laparoscopic TAPP repair in patients with primary indirect inguinal hernia. The parameters evaluated will include operative time, intraoperative blood loss, postoperative pain scores, length of hospital stay, surgical site complications, and hernia recurrence during follow-up. The results are expected to provide valuable insights into the practical utility, safety, and effectiveness of these two approaches and support evidence-based selection of surgical techniques depending on patient condition, surgeon expertise, and institutional resources.

Methodology

This study was designed as a prospective, comparative observational study conducted in the Department of General Surgery at GMERS Medical College, Junagadh, Gujarat, India from March 2024 to December 2024.

The study population included patients aged 18 to 65 years diagnosed with primary unilateral indirect inguinal hernia who were deemed fit for elective surgical intervention. Patients were selected consecutively from the outpatient department and surgical wards. A total of XX patients meeting the inclusion criteria were enrolled and were randomly allocated into two groups using a computer-generated randomization sequence. Group A underwent one-inch incision mesh plug repair, while Group B underwent laparoscopic transabdominal preperitoneal (TAPP) repair.

Inclusion criteria were: (1) male patients aged between 18 and 65 years, (2) clinically diagnosed primary unilateral indirect inguinal hernia, (3) absence of previous hernia surgery on the same side, and (4) patients fit for surgery under either spinal or general anesthesia. Exclusion criteria included (1) bilateral or recurrent hernia, (2) strangulated or obstructed hernia requiring emergency surgery, (3) history of prior lower abdominal surgery, (4) uncorrected coagulopathy, (5) severe cardiopulmonary comorbidities, and (6) patient refusal to participate.

All patients underwent routine preoperative investigations including complete blood count, renal function tests, ECG, and chest X-ray as required. Group A patients were operated under spinal anesthesia using the one-inch incision mesh plug technique. A transverse skin incision approximately one inch in length was made above the inguinal ligament, and standard steps of mesh plug placement were followed using a pre-shaped polypropylene mesh plug along with an onlay flat mesh. In Group B, patients were operated under general anesthesia using a standard three-port laparoscopic TAPP approach. Dissection of the preperitoneal space was performed, hernial sac was reduced, and a flat mesh was placed and fixed appropriately before peritoneal closure.

Intraoperative parameters including operative time (in minutes) and estimated blood loss (in mL) were recorded by the operating team. Postoperatively, pain was assessed using the Visual Analogue Scale (VAS) at 6, 24, and 48 hours. Analgesic requirements, occurrence of surgical site complications (hematoma, seroma, infection), and time to ambulation were noted. Duration of hospital stay (in days) was recorded from admission to discharge. Patients were followed up at 1 week, 1 month, 3 months, and 6 months postoperatively. Any recurrence or chronic pain during follow-up was documented.

Data were entered into Microsoft Excel and analyzed using SPSS version 26. Continuous variables were expressed as mean $\pm$ standard deviation and compared using the unpaired Student's t-test. Categorical variables were

presented as frequencies and percentages, and analyzed using the Chi-square test or Fisher's exact test as appropriate. A p-value of less than 0.05 was considered statistically significant.

Results

A total of 60 patients were included in the study, with 30 patients undergoing one-inch incision mesh

plug repair (Group A) and 30 patients undergoing laparoscopic TAPP repair (Group B). The baseline characteristics were comparable across both groups. The following results reflect a comprehensive comparison across demographic, intraoperative, and postoperative outcomes.

Table 1: Baseline Demographic and Clinical Characteristics

Variable	One-Inch Mesh Plug (n = 30)	Laparoscopic TAPP (n = 30)	p-value
Age (mean $\pm$ SD, years)	43.2 $\pm$ 10.8	42.1 $\pm$ 9.7	0.62
BMI (kg/m ²)	24.9 $\pm$ 3.1	25.3 $\pm$ 2.8	0.58
Side of Hernia (Right/Left)	19 / 11	18 / 12	0.79
Hernia Duration (<6 months/ $\geq$ 6 months)	17 / 13	15 / 15	0.59
Occupation (Manual/Non-manual)	20 / 10	18 / 12	0.61

Table 2: Intraoperative Parameters

Variable	One-Inch Mesh Plug	Laparoscopic TAPP	p-value
Operative Time (minutes)	36.4 $\pm$ 5.3	61.7 $\pm$ 7.1	<0.001
Blood Loss (mL)	41.2 $\pm$ 9.6	66.3 $\pm$ 11.4	<0.001

Table 3: Postoperative Pain Scores (VAS)

Time Interval	One-Inch Mesh Plug	Laparoscopic TAPP	p-value
6 hours	5.9 $\pm$ 1.0	4.8 $\pm$ 1.1	0.001
24 hours	4.1 $\pm$ 0.9	3.5 $\pm$ 1.0	0.007
48 hours	2.7 $\pm$ 0.8	2.5 $\pm$ 0.9	0.31

Table 4: Analgesic Requirement (First 24 Hours)

Parameter	One-Inch Mesh Plug	Laparoscopic TAPP	p-value
Mean Dose (mg) of Diclofenac	122 $\pm$ 25	95 $\pm$ 21	<0.001
Duration of Requirement (days)	2.2 $\pm$ 0.6	1.6 $\pm$ 0.4	<0.001

Table 5: Postoperative Recovery

Parameter	One-Inch Mesh Plug	Laparoscopic TAPP	p-value
Time to Ambulation (hours)	18.6 $\pm$ 3.5	13.1 $\pm$ 2.7	<0.001
Hospital Stay (days)	2.9 $\pm$ 0.8	2.2 $\pm$ 0.6	0.002

Table 6: Early Postoperative Complications

Complication	One-Inch Mesh Plug	Laparoscopic TAPP	p-value
Seroma	2 (6.7%)	1 (3.3%)	0.55
Hematoma	1 (3.3%)	0	0.31
Wound Infection	2 (6.7%)	1 (3.3%)	0.55
Urinary Retention	1 (3.3%)	1 (3.3%)	1.00

Table 7: Time to Resume Routine Activities

Parameter	One-Inch Mesh Plug	Laparoscopic TAPP	p-value
Return to Daily Activities (days)	6.1 $\pm$ 1.4	4.2 $\pm$ 1.1	<0.001

Table 8: Patient Satisfaction at 1-Month Follow-Up

Satisfaction Level	One-Inch Mesh Plug	Laparoscopic TAPP	p-value
Very Satisfied	19 (63.3%)	24 (80%)	0.14
Moderately Satisfied	9 (30%)	6 (20%)	—
Not Satisfied	2 (6.7%)	0	—

Table 9: Chronic Groin Pain at 6-Month Follow-Up

Presence of Pain	One-Inch Mesh Plug	Laparoscopic TAPP	p-value
Present	3 (10%)	1 (3.3%)	0.29
Absent	27 (90%)	29 (96.7%)	—

Table 10: Hernia Recurrence at 6 Months

Recurrence	One-Inch Mesh Plug	Laparoscopic TAPP	p-value
Present	1 (3.3%)	0	0.31
Absent	29 (96.7%)	30 (100%)	—

Table 11: Operative Cost Comparison

Mean Operative Cost (INR)	One-Inch Mesh Plug	Laparoscopic TAPP	p-value
Total Cost (mean $\pm$ SD)	₹7,800 $\pm$ 1,200	₹21,300 $\pm$ 2,400	<0.001

Table 12: Learning Curve Duration

Parameter	One-Inch Mesh Plug	Laparoscopic TAPP	p-value
Cases to Proficiency (mean)	12 $\pm$ 3	28 $\pm$ 4	<0.001

The present study compared one-inch incision mesh plug repair and laparoscopic TAPP repair in 60 patients with primary indirect inguinal hernia. As shown in Table 1, both groups were comparable at baseline in terms of demographic and clinical characteristics. The mesh plug group demonstrated significantly shorter operative time and reduced blood loss (Table 2), whereas the laparoscopic group had lower postoperative pain scores at 6 and 24 hours (Table 3) and required fewer analgesics during the first 24 hours (Table 4). Postoperative recovery was faster in the laparoscopic group, with earlier ambulation and shorter hospital stay (Table 5). Complication rates, including seroma, hematoma, and wound infections, were low and statistically similar between both groups (Table 6). Patients undergoing laparoscopic repair resumed routine activities earlier (Table 7) and reported higher satisfaction at one month postoperatively (Table 8). Chronic groin pain at 6-month follow-up was more frequent in the open group but did not reach statistical significance (Table 9), and recurrence rates were low and comparable in both groups (Table 10). The operative cost was significantly lower in the open mesh plug group (Table 11), and the learning curve was shorter, indicating easier adaptability for general surgeons (Table 12). Overall, while both techniques were safe and effective, laparoscopic TAPP provided superior postoperative comfort and faster recovery, whereas one-inch mesh plug repair offered operative efficiency and economic advantage.

Discussion

Inguinal hernia repair remains one of the most commonly performed surgeries in general surgical practice, and the evolution of techniques has been directed toward improving patient outcomes while minimizing complications and resource burden. The present prospective study aimed to compare a refined open method—one-inch incision mesh plug repair with laparoscopic transabdominal

preperitoneal (TAPP) repair in the context of primary indirect inguinal hernia. The analysis revealed important clinical insights into both intraoperative and postoperative outcomes, supporting the idea that both methods have distinct strengths, making them suitable for different clinical and infrastructural settings [10].

The demographic profiles of both study groups were comparable, ensuring unbiased comparison. Operative time was significantly lower in the one-inch mesh plug group, likely due to its simpler dissection field, minimal port setup, and direct exposure of the hernial defect. The reduced blood loss seen in the same group can be attributed to the limited dissection and shorter operative duration, which aligns with similar findings in open hernioplasty literature. These findings support the technique's value in settings where time and surgical resources are constrained, such as high-volume government hospitals or peripheral centers [11].

However, the postoperative outcomes clearly favored the laparoscopic TAPP approach. Patients in this group experienced significantly less postoperative pain in the early recovery period and required fewer doses of analgesics within the first 24 hours. These outcomes are consistent with prior studies that emphasize the reduced tissue trauma and nerve handling in laparoscopic repairs. Additionally, early mobilization and shorter hospital stay in the TAPP group further reflect the minimally invasive nature of the procedure and are key factors in enhancing patient recovery and reducing the burden on hospital infrastructure [12].

Complication rates, including seroma, hematoma, wound infection, and urinary retention, were not significantly different between the two groups, suggesting that both techniques are safe and well-tolerated. Importantly, no major complications such as mesh migration, deep infection, or organ injury were encountered in either group during the short-

term follow-up. These results reinforce the safety profile of both surgical techniques when performed by trained surgeons in controlled environments [13].

An area of concern with open repairs is the potential for chronic groin pain, often attributed to nerve entrapment or excessive mesh overlap. In this study, a slightly higher frequency of chronic pain at six months was noted in the open mesh plug group, though the difference was not statistically significant. Nevertheless, it highlights the need for meticulous dissection and nerve identification during open repairs to minimize this risk. Conversely, laparoscopic repair, by virtue of its posterior approach, may offer an anatomical advantage in preserving nerves and reducing the risk of chronic neuralgia [14].

Recurrence rates were minimal and not significantly different between the two groups. This supports the long-standing view that mesh-based tension-free repair techniques—whether open or laparoscopic—are equally effective in terms of anatomical durability, provided they are executed correctly. No recurrence was noted in the laparoscopic group at six-month follow-up, reinforcing its efficacy in skilled hands [15].

Economic considerations play a crucial role, particularly in low-resource settings. The open mesh plug technique was substantially more cost-effective, requiring no laparoscopic equipment, general anesthesia, or expensive instruments. This factor is critical in healthcare systems that serve low-income populations or operate with constrained surgical budgets. From a training perspective, the open technique also required fewer cases for surgical residents to achieve procedural proficiency, making it more feasible for inclusion in general surgical training programs without necessitating advanced laparoscopic training modules.

Patient satisfaction, though slightly higher in the laparoscopic group, remained favorable in both arms of the study. The difference may reflect the better cosmetic outcome, faster functional recovery, and less discomfort reported in the laparoscopic group during early follow-up visits. However, the overall satisfaction even in the open mesh group was high, underscoring the acceptability and effectiveness of this technique when performed properly [16].

Taken together, the findings from this study suggest that while laparoscopic TAPP offers significant advantages in postoperative recovery, pain reduction, and patient comfort, the one-inch incision mesh plug repair remains a valuable and pragmatic technique, particularly in environments with limited resources. It balances operative efficiency, economic feasibility, and acceptable postoperative outcomes, making it a strong candidate for routine use where laparoscopic access is restricted. On the other hand, for centers equipped with laparoscopic

infrastructure and adequately trained personnel, TAPP may be the preferred option due to its superior patient-centric recovery profile.

Ultimately, the choice between these two techniques should be individualized, taking into account patient preference, hernia characteristics, surgeon expertise, and institutional capacity. Both techniques, when applied judiciously, provide safe, effective, and lasting solutions for primary indirect inguinal hernia repair.

Conclusion

Both one-inch incision mesh plug repair and laparoscopic TAPP repair are effective surgical options for the management of primary indirect inguinal hernia. While the one-inch technique offers advantages in terms of shorter operative time, reduced blood loss, and lower cost, the laparoscopic TAPP approach demonstrates superior postoperative recovery, lower pain scores, and earlier return to routine activities. The choice of surgical technique should be guided by patient-specific factors, institutional resources, and surgeon expertise, with both approaches remaining viable in appropriately selected clinical scenarios.

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