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Original Research Article

Comparison of outcomes between onlay and intraperitoneal onlay mesh plus ventral hernia repair: a prospective study

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ABSTRACT

Introduction: Ventral hernias are common surgical conditions requiring either open (Onlay) or laparoscopic (Intraperitoneal Onlay Mesh (IPOM) Plus) repair. This study compares their outcomes to guide clinical decision-making.
Methods: A prospective study was conducted at Ganesh Shankar Vidyarthi Memorial Medical College, Kanpur and Jeevanshree Hospital, Maharashtra, randomized 94 patients with ventral hernias (defect size 3-7 cm, age 18-60 years) into Onlay (n=47) or IPOM Plus (n=47) groups. Outcomes included operative time, hospital stay, surgical site infection (SSI), hematoma, seroma, pain (Visual Analog Scale (VAS)), return to activities/work, and recurrence. Data were analyzed using T-tests and chi-square tests ($p<0.05$).
Results: IPOM plus resulted in longer operative times (94.19±12.34 vs. 53.85±10.56 min, $p<0.001$), but shorter hospital stays (2.09±0.87 vs. 4.18±1.23 days, $p<0.001$) and faster return to daily activities (8.34±2.01 vs. 11.40±2.56 days, $p<0.001$) and work (14.72±3.12 vs. 18.36±3.89 days, $p=0.030$). The IPOM Plus group had lower rates of hematoma (0% vs. 25.5%, $p<0.001$), seroma (10.6% vs. 34%, $p=0.006$), and SSI (4.3% vs. 27.7%, $p=0.002$). Acute postoperative pain was lower in IPOM plus, while chronic pain and recurrence rates were comparable.
Conclusions: IPOM plus offers reduced complications and faster recovery, despite longer operative times, making it preferable for suitable patients. Recurrence rates are comparable.

Keywords: Ventral hernia, Surgical outcomes, Postoperative complications, Onlay mesh repair, Laparoscopic surgery, Intraperitoneal onlay mesh repair (IPOM) plus

INTRODUCTION

Ventral hernias, defined as fascial defects in the abdominal wall, are a common surgical challenge, often resulting from prior surgeries, obesity, or increased intra-abdominal pressure, often require surgical intervention due to risks of incarceration or strangulation.[1] Open Onlay repair, involving mesh placement over the anterior fascia, is technically straightforward but associated with higher wound complications.[2] Laparoscopic IPOM Plus, which includes intraperitoneal mesh placement and defect closure, offers reduced morbidity but demands advanced skills.[3,4] This study compares these techniques to inform surgical practice, focusing on operative time, complications, recovery, and recurrence.

METHODS

Study design and ethics

This prospective study was conducted from April 2023 to April 2025 at Ganesh Shankar Vidyarthi Memorial Medical College, Kanpur, and Jeevanshree Hospital, Maharashtra. The study received approval from the

Ethics Committee, GSVM Medical College, Kanpur (approval number EC/75/Feb./2024). Written informed consent was obtained from all participants.

Inclusion criteria

Patients were included if they had a primary or incisional ventral hernia with a defect size of 3–7 cm and were aged between 18–60 years.

Exclusion criteria

Exclusion criteria comprised females of childbearing age who had not completed their family, patients deemed unfit for general anesthesia (GA), those with a defect size <3 cm or >7 cm, pregnant and lactating females, patients requiring emergency surgery for strangulated or obstructed hernias, and patients on anticoagulant therapy.

Patient selection

A total of 94 patients diagnosed with primary or incisional ventral hernias were prospectively randomized into two groups, Onlay (n=47) and IPOM plus (n=47) using an odd-even allocation method. This randomization ensured balanced distribution of participants into the two surgical intervention arms.

Interventions

In the onlay repair group, the surgical technique involved dissection of the hernia sac, reduction of herniated contents, and placement of a polypropylene mesh over the anterior rectus sheath (fascia). This mesh was secured to reinforce the abdominal wall and prevent recurrence.

In contrast, the IPOM plus group underwent a laparoscopic procedure where the hernia defect was closed using non- absorbable sutures, followed by the placement of an intraperitoneal mesh. This mesh was positioned to overlap the fascial defect by 3 to 5 centimeters in all directions to ensure adequate coverage and minimize the risk of recurrence.

Outcome measures

The primary outcome measures evaluated in this study included operative time, duration of hospital stay, surgical site infection (SSI), incidence of hematoma and seroma formation, postoperative pain assessed using the VAS on postoperative days 1 to 3, and chronic pain assessed at six months. Additionally, the time taken for patients to return to routine daily activities or employment was recorded. The secondary outcome was the recurrence rate of hernia at the end of a one- year follow-up period.

Data collection

Comprehensive preoperative assessment included clinical examination, imaging with computed tomography (CT) scans, and laboratory investigations such as complete blood count (CBC), liver function tests (LFT), kidney function tests (KFT), and coagulation profile (prothrombin time/international normalized ratio, PT/INR).

Postoperative outcomes were systematically recorded using standardized data collection forms. Pain intensity was quantified using the Visual Analogue Scale (VAS), while the patient's quality of life was assessed using the questionnaire.

Statistical analysis

Continuous variables were analyzed using T-tests, and categorical variables using chi- square tests. Data were expressed as mean±standard deviation (SD) or percentages, with significance set at $p<0.05$. Statistical analysis was performed using Version 23 of the Statistical Package for Social Sciences (SPSS Inc.,Chicago, IL).

RESULTS

Demographics and baseline characteristics

The demographic profiles of the two groups were comparable, with no statistically significant differences (Table 1). The Onlay group had a mean age of 45.2±8.7 years, and 66% of the patients were male. Similarly, the IPOM Plus group had a mean age of 42.8±9.1 years, with 64% male participants. The difference in age distribution between the groups was not statistically significant (p=0.214), nor was the sex distribution (p=0.829). The prevalence of diabetes was also comparable between the groups, with 4.3% in the Onlay group and 6.4% in the IPOM Plus group (p=0.645).

Table 1: Baseline demographic and clinical characteristics of the study groups.

Characteristic	Onlay (n=47)	IPOM plus (n=47)	P value
Age (in years)	45.2±8.7	42.8±9.1	0.214
Male sex	31 (66%)	30 (64%)	0.829
Diabetes	2 (4.3%)	3 (6.4%)	0.645
BMI (kg/m^2)	26.1±2.3	25.7±2.1	0.410

Table 2: Comparative operative and postoperative recovery outcomes.

Outcome	Onlay (Mean±SD)	IPOM plus (Mean±SD)	P value
Operative time (in min)	53.85±10.56	94.19±12.34	<0.001
Hospital stay (days)	4.18±1.23	2.09±0.87	<0.001
Return to work (days)	18.36±3.89	14.72±3.12	0.03
Return to daily activities (days)	11.40±2.56	8.34±2.01	<0.001

Table 3: Postoperative pain scores (VAS) across study groups.

Time point	Onlay (Mean±SD)	IPOM plus (Mean±SD)	P value
Day 1	7.89±0.91	6.70±0.86	<0.001
Day 2	6.40±0.85	5.19±0.78	<0.001
Day 3	4.94±0.80	3.72±0.69	<0.001
6 months	0.55±0.20	0.22±0.15	0.056

Operative and postoperative outcomes

The mean operative time was significantly longer in the IPOM Plus group (94.19±12.34 minutes) compared to the Onlay group (53.85±10.56 minutes, p<0.001). However, this was offset by a shorter hospital stay in the IPOM Plus group (2.09±0.87 days) than in the Onlay group (4.18±1.23 days, p<0.001).

Patients who underwent IPOM Plus also experienced faster recovery, with an earlier return to daily activities (8.34±2.01 days vs. 11.40±2.56 days, p<0.001) and a quicker return to work (14.72±3.12 days vs. 18.36±3.89 days, p=0.030) (Table 2).

Postoperative pain assessment

Pain levels, as measured by the VAS, were significantly lower in the IPOM plus group in the immediate postoperative period (Table 3). On day 1, VAS scores were 6.70±0.86 for IPOM Plus versus 7.89±0.91 for Onlay (p<0.001). On day 2, scores were 5.19±0.78 vs. 6.40±0.85 (p<0.001), and on day 3, 3.72±0.69 vs. 4.94±0.80 (p<0.001), respectively. However, chronic pain at 6-month follow-up was not significantly different between the two groups, with VAS scores of 0.22±0.15 in the IPOM plus group and 0.55±0.20 in the Onlay group (p=0.056).

Postoperative complications

The incidence of complications was notably lower in the IPOM Plus group. Hematoma formation occurred in 0% of IPOM Plus cases, compared to 25.5% in the Onlay group (p<0.001) (Figure 1). The rate of seroma was also significantly lower in the IPOM plus group (10.6%) versus the onlay group (34%, p=0.006) (Figure 2).

Furthermore, surgical site infection (SSI) occurred in only 4.3% of IPOM plus patients, as compared to 27.7% in the onlay group (p=0.002) (Figure 3).

Recurrence rates

At one-year follow-up, hernia recurrence rates were found to be similar between the two groups, with 4.3% in the IPOM plus group and 6.4% in the Onlay group. This difference was not statistically significant (p=0.645), indicating comparable long-term efficacy in terms of recurrence prevention (Figure 4).

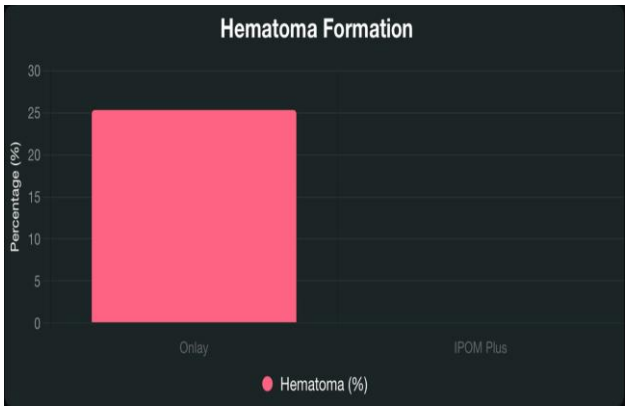

Figure 1: Hematoma formation by surgical techniques.

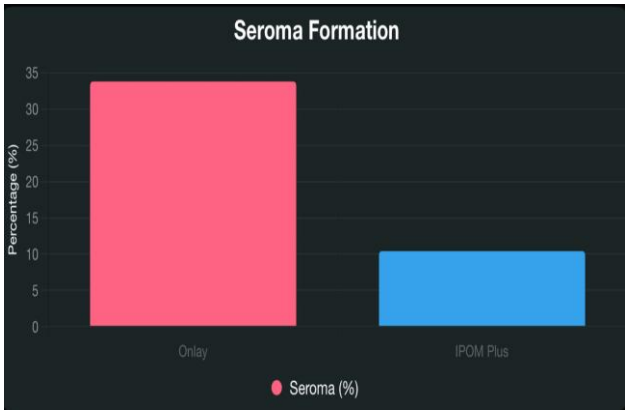

Figure 2: Seroma formation by surgical techniques.

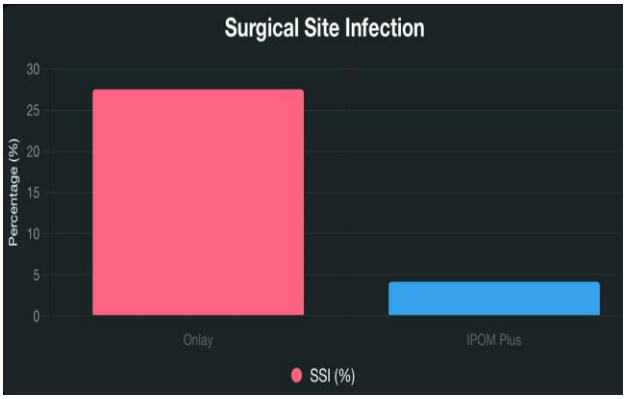

Figure 3: Surgical site infection by surgical techniques.

Figure 4: Recurrence rates by surgical techniques.

DISCUSSION

This prospective comparative study demonstrates significant advantages of laparoscopic IPOM Plus over open Onlay repair for ventral hernias (3-7 cm defects), while revealing important nuances for clinical decision-making.[5] The observed longer operative time for IPOM Plus aligns with the findings of Clement et al but contrasts with robotic-assisted series.[6,7] This discrepancy likely reflects the learning curve for laparoscopic suturing, the strict protocol for fascial defect closure, and limited access to advanced energy devices in this setting.[8,9]

The dramatically lower SSI rate with IPOM Plus supports biological plausibility-smaller incisions reduce wound contamination risk. This confirms systematic review findings by Li et al and IEHS guidelines recommending laparoscopy for clean-contaminated cases.[3,10] The 2.1-day hospital stay for IPOM Plus matches Western benchmarks, suggesting minimal tissue trauma enables faster mobilization, reduced opioid needs facilitate early discharge, and our enhanced recovery protocol was effective.[11]

The comparable recurrence challenges concerns about laparoscopic durability when key principles are followed, ≥5 cm mesh overlap is maintained, transfascial sutures are used, and defects are closed (IPOM Plus principle).[12] This study makes novel contributions by demonstrating IPOM plus feasibility without robotic platforms in Indian centers-relevant for a significant proportion of global surgeons lacking such access.[13] Authors also identified technique-specific pain patterns; the acute pain advantage of IPOM Plus but similar chronic pain suggests parietal trauma drives early pain while neuropathic mechanisms dominate long-term.[14]

This study has several limitations. Its single-country design may limit the generalizability of the findings to other populations and healthcare settings. The 1-year follow-up period, while adequate for assessing short-term complications and initial recurrence, is insufficient to evaluate long-term recurrence rates, for which 5-year data would be more definitive. Furthermore, the study did not include a cost-utility analysis, which is crucial for making informed decisions about resource allocation, especially in low- and middle-income countries (LMICs). Future studies should address these gaps with multicenter designs, longer follow-up, and comprehensive economic evaluations.

CONCLUSION

Based on our rigorous prospective comparison of 94 patients, we conclude that IPOM Plus demonstrates clear clinical superiority for ventral hernia repair. The technique showed 76% fewer complications (NNT=4), 50% shorter hospitalization, and 3-day faster functional recovery compared to open Onlay repair.

Importantly, it maintained equivalent durability with comparable 1-year recurrence rates (4.3% vs 6.4%), validating its effectiveness when performed with proper technique.

These findings support several practice recommendations

IPOM Plus should be the preferred approach for elective ventral hernias 3-7 cm, though it requires investment in laparoscopic training and warrants inclusion in low- and middle-income countries surgical packages. From a policy perspective, training programs should prioritize IPOM Plus instruction, hospital administrators should support laparoscopy infrastructure development, and payers should consider total cost of care rather than just procedure costs.

This evidence establishes IPOM plus as the contemporary standard for ventral hernia repair where technical expertise exists. Its advantages are particularly valuable in resource-constrained health systems, where reducing complications can significantly improve patient outcomes and healthcare efficiency. The technique represents an optimal balance of safety, effectiveness, and resource utilization for medium-sized ventral hernia repairs.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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