Section: Surgery

Original Research Article

COMPARATIVE EVALUATION OF LAPAROSCOPIC VERSUS OPEN MESH REPAIR FOR VENTRAL ABDOMINAL WALL HERNIAS: A PROSPECTIVE OBSERVATIONAL STUDY

Amit Goel[1], Ankit Garg[2], Ravi Kumar Meena[3], Ankit Bhati[4], Bhavya[5]

[1]*Associate professor Department of Surgery, NDMC Medical college Delhi.*
[2]*Assistant professor Department of Surgery, NDMC Medical college Delhi*
[3-5]*Post-Graduate Department of Surgery Hindu Rao Hospital.*
[4]*Senior resident Department of Surgery NDMC medical college Delhi.*

Received *: 12/04/2026*
Received in revised form *: 06/05/2026*
Accepted *: 06/06/2026*

Corresponding Author:
Dr. Amit Goel,
Department of General Surgery, Hindu Rao Hospital, Delhi, India.
Email: gamit1967@gmail.com

DOI: 10.70034/ijmedph.2026.2.523

Source of Support: Nil,
Conflict of Interest: None declared

Int J Med Pub Health
2026; 16 (2); 3164-3169

ABSTRACT

Background: Ventral abdominal wall hernias, encompassing primary and incisional defects, represent a substantial surgical workload globally. While conventional open mesh hernioplasty has long served as a standard therapeutic approach, it is frequently limited by notable wound-related morbidity and variable recovery periods. Laparoscopic ventral hernia repair (LVHR) has evolved as a minimally invasive alternative aimed at mitigating these complications. This study presents a head-to-head prospective observational comparison of clinical outcomes, operative metrics, and postoperative complication profiles between laparoscopic and open mesh hernia repairs performed at a single tertiary care center.

Materials and Methods: A prospective observational study was conducted on 30 adult patients diagnosed with primary ventral (umbilical, paraumbilical, epigastric) or incisional hernias who underwent elective surgical repair. Patients were partitioned into two cohorts based on the executed surgical approach and defect parameters (defect <5 cm planned for laparoscopic repair and >=5 cm planned for open repair): Laparoscopic Mesh Hernioplasty (n = 18) and Open Mesh Hernioplasty (n = 12). In both groups, standard macroporous polypropylene mesh was utilized. In the laparoscopic cohort, IPOM-Plus (intraperitoneal onlay mesh with fascial defect closure) was executed in 4 cases, while the remaining 14 cases underwent standard laparoscopic mesh placement with a minimum of 3 cm peripheral defect overlap secured utilizing helical tackers and transfascial sutures. The open cohort underwent standard sublay or onlay mesh hernioplasty. Intraoperative parameters (measured from skin incision to skin closure), postoperative complications, length of hospital stay, and short-term recurrence rates were tracked over a 5-month postoperative follow-up window. Statistical evaluation utilized Student's t-test for continuous metrics and Fisher's exact test for categorical proportions.

Results: The study population (N = 30) exhibited a mean age of 35 +/- 10 years with a definitive female predominance (18 females, 12 males). The structural presentation consisted of 10 umbilical (33.3%), 10 paraumbilical (33.3%), 5 epigastric (16.7%), and 5 incisional hernias (16.7%), with 2 incisional cases successfully managed laparoscopically. Laparoscopic repair demonstrated a statistically significant reduction in mean operative duration (36.1 +/- 6.2 minutes) compared to the open repair cohort (65.4 +/- 11.3 minutes; p<0.001). Furthermore, the laparoscopic approach significantly decreased the mean postoperative hospital stay to 2.1 +/- 0.3 days compared to 4.3 +/- 1.4 days in the open cohort (p<0.001). The overall complication

incidence across the study was 26.7% (n = 8). Strikingly, the laparoscopic group experienced only 2 complications (2/18, 11.1%), which manifested as superficial surgical site infections (SSI). Conversely, 6 complications occurred within the open mesh hernioplasty cohort (6/12, 50.0%), representing a statistically lower early localized morbidity profile for the laparoscopic arm (p = 0.038). At the conclusion of the 5-month follow-up period, there were zero documented clinical or radiological recurrences (0%) across either surgical cohort.

Conclusion: Laparoscopic ventral hernia repair utilizing polypropylene mesh represents a safe, highly effective, and clinically superior alternative to conventional open mesh repair for well-selected primary and incisional defects (<5 cm). It provides statistically sound advantages by substantially decreasing skin-to-skin operative duration, reducing the post-surgical hospital footprint, and significantly minimizing localized wound morbidity.

Keywords: Ventral Hernia, Incisional Hernia, Laparoscopic Hernioplasty, Open Mesh Repair, IPOM-Plus, Polypropylene Mesh, Fisher's Exact Test, Surgical Site Infection.

INTRODUCTION

Ventral hernias, which comprise primary defects of the anterior abdominal wall (including umbilical, paraumbilical, and epigastric hernias) alongside secondary incisional hernias, remain among the most frequent operations encountered in general surgery.

Incisional hernias routinely complicate approximately 10% to 20% of patients following a standard midline or paramedian laparotomy, representing an ongoing socioeconomic and clinical healthcare burden worldwide. The fundamental pathophysiology involves a progressive, structural mechanical failure of the fascial anatomy of the abdominal wall, which cannot be reliably counteracted by primary suture restoration alone. Historical series have established that conventional tension-driven suture repair of these defects results in unacceptably high long-term recurrence rates ranging between 24% and 54%.

The introduction of biocompatible prosthetic meshes shifted the surgical paradigm toward tension-free repairs, successfully driving historical recurrence rates down to a range of 2% to 10%. However, open abdominal wall dissection, particularly when managing expansive defects or performing wide retrorectus sublay or onlay mesh placement, requires extensive subcutaneous flap mobilization. This tissue disruption directly correlates with high rates of surgical site occurrences (SSO), including extensive seromas, hematomas, and debilitating superficial or deep wound infections.

Over the past three decades, the maturation of minimally invasive techniques has offered an alternative pathway. Laparoscopic ventral hernia repair (LVHR), pioneered utilizing intraperitoneal onlay mesh (IPOM) principles,[1] leverages intra-abdominal physics where natural intra-abdominal pressure pushes the prosthetic mesh securely against the posterior aspect of the anterior abdominal wall. Clinical guidelines frequently note that fascial defects exceeding 3 cm are highly amenable to laparoscopic intervention, whereas smaller defects are tailored individually based on body mass index (BMI), parity, and direct patient comorbidities.[2] However, recent paradigms advocate that while defects <5 cm are highly suitable for laparoscopic clearance and mesh reinforcement, larger defects (>=5 cm) often necessitate open structural restoration or advanced component separation.

The clear benefits of the laparoscopic approach include reduced disruption to the abdominal wall vasculature, lower rates of wound infection, shorter durations of hospitalization, and faster return to baseline functional activities. Furthermore, laparoscopy permits a complete, panoramic visualization of the entire internal surface of the abdominal wall, allowing the operating surgeon to identify synchronous occult or "swiss-cheese" fascial defects that could be easily overlooked during a localized open dissection.

This prospective observational study aims to directly evaluate and contrast the clinical efficacy, intraoperative performance metrics, and postoperative complication rates of laparoscopic versus conventional open mesh repairs within our clinical demographic, integrating standardized patient selection based on defect sizing and modern fixation principles.

MATERIALS AND METHODS

2.1 Study Design and Setting

This prospective observational study was carried out within the Department of General Surgery at Hindu Rao Hospital, Delhi, India. The clinical protocol tracked adult patients presenting with primary ventral or secondary incisional abdominal wall hernias who were sequentially admitted and prepared for elective surgical intervention over an institutional window spanning from March 2025 through May 2026.

2.2 Participant Selection and Sample Size

A cohort of 30 consecutive adult patients meeting all eligibility mandates was enrolled in the study.

The allocation of patients to either the laparoscopic or open mesh cohort was strictly determined based on individual fascial defect characteristics, baseline patient physiological co-morbidities, and direct operating surgeon clinical preference and expertise. Notably, standard preoperative planning dictated that patients presenting with a fascial defect size <5 cm were systematically planned for laparoscopic management, whereas patients presenting with larger defects measuring >=5 cm were planned for open surgical reconstruction.

Inclusion Criteria: Patients aged >=18 years presenting with clinically and/or radiologically confirmed primary ventral abdominal hernias (umbilical, paraumbilical, epigastric) or secondary incisional hernias, deemed physically fit to undergo elective general anesthesia and surgical intervention.

Exclusion Criteria: Patients presenting with complicated hernia dynamics requiring emergent surgical intervention (e.g., acute strangulation, mechanical bowel obstruction, or visceral perforation), patients with active intra-abdominal sepsis, and individuals who demonstrated incomplete or non-compliant postoperative follow-up records.

2.3 Surgical Techniques and Prosthetic Biomaterial

In both surgical cohorts, a standard heavyweight or midweight macroporous polypropylene mesh was utilized for the abdominal wall reinforcement, providing high tensile stability and optimal tissue integration.

2.4.1 Laparoscopic Mesh Hernioplasty (LVHR)

Under standard endotracheal general anesthesia, patients were positioned appropriately based on hernia location. Third-generation cephalosporin antibiotic prophylaxis was routinely administered intravenously within 60 minutes of skin incision. Pneumoperitoneum was established utilizing an open Hasson technique or a closed Veress needle approach to maintain a constant intra-abdominal pressure of 12 mmHg. Laparoscopic port configurations (typically one 10–12 mm camera port and two bilateral 5 mm working ports) were tailored to ensure optimal triangulation around the pathology. Sharp and careful blunt laparoscopic adhesiolysis was executed to completely clear the margins of the fascial defect of all adherent omental or loops of bowel. The hernia contents were completely reduced back into the peritoneal cavity.

Following clear boundary definition, the true longitudinal and transverse margins of the fascial defect were measured intra-abdominally to ensure accuracy. Out of the 18 cases in the laparoscopic arm, 4 cases with highly favorable fascial margins underwent full structural closure of the defect prior to mesh deployment using transfascial absorbable sutures (the IPOM-Plus technique) to completely obliterate the residual dead space. In the remaining 14 cases, a standard bridged laparoscopic configuration was used. The polypropylene mesh was customized to guarantee a baseline minimum of 3 cm radial overlap extending outwards from all margins of the defect. The mesh was oriented and introduced intraperitoneally through the widest port site. Fixation was systematically completed using a dual-crown framework consisting of mechanical helical tackers combined with cardinal transfascial non-absorbable sutures to provide uniform tension across the abdominal wall. Complete hemostasis was verified under direct vision, the abdominal cavity deflated, and the fascial layers of the 10–12 mm port sites closed securely using interrupted delayed-absorbable sutures.

2.4.2 Open Mesh Hernioplasty

The open repairs were conducted using a classical anterior approach tailored to the site of the hernia defect. Following appropriate anatomical incision and flap dissection, the hernia sac was isolated, opened carefully, and its contents reduced. The fascial architecture was prepared, and the standard macroporous polypropylene mesh was configured to achieve an optimal overlap beyond the defect boundaries. Depending on patient anatomy and fascial compliance, the mesh was secured in a retrorectus sublay or an onlay fashion using monofilament polypropylene sutures. Subcutaneous close-suction drains were placed over the mesh when deemed necessary due to extensive dead space. The skin and subcutaneous tissues were closed in standard anatomical layers.

2.5 Statistical Evaluation and Data Variables

The primary clinical endpoints collected during the study period included total operative duration—strictly measured from the initial skin incision to final skin closure (skin-to-skin duration)—total duration of postoperative hospital stay (measured in days), immediate and early postoperative complications (stratified according to seroma, surgical site wound infection, deep mesh infection, meshoma, and accidental visceral injury), and documentation of early structural recurrence. Continuous data variables were summarized as Mean +/- Standard Deviation (SD) along with associated range metrics, while categorical parameters were parsed as absolute values and percentages.

Statistical comparative analysis between the laparoscopic and open mesh cohorts was executed using specialized testing frameworks. For continuous variables (operative duration and hospital stay), the standard Student's t-test was utilized to calculate statistical variance and mean differences. For categorical proportions (complication incidence and cohort distributions), Fisher's exact test was performed due to its high precision in small sample cohorts (N = 30). A two-tailed p-value of <0.05 was defined as the threshold for statistical significance across all evaluated variables.

3. Baseline Demographics and Clinical Presentations

The study population (N = 30) comprised 18 females (60.0%) and 12 males (40.0%),

demonstrating a clear female predominance within this clinical demographic. The cohort exhibited a young-to-middle-aged distribution with a mean age of 35 +/- 10 years (range: 30–68 years). The exact anatomical distribution of the ventral hernias across the entire sample size was evenly split between umbilical and paraumbilical locations, followed by equal distributions of epigastric and incisional hernias: Umbilical (33.3%), Paraumbilical (33.3%), Epigastric (16.7%), and Incisional (16.7%).

Following the implementation of defect-size selection criteria (<5 cm for laparoscopic vs. >=5 cm for open), the exact distribution shifted. Crucially, 2 cases of incisional hernias presenting with localized defects measuring <5 cm were successfully managed via the laparoscopic approach, leaving 3 incisional cases in the open cohort. The total cohort sizes stood at n = 18 for Laparoscopic Mesh Hernioplasty and n = 12 for Open Mesh Hernioplasty. The cross-tabulation of primary and secondary hernia types across the two surgical arms is broken down in Table 1.

Table 1: Hernia Anatomical Type Cross-Tabulation

Hernia Anatomical Type	Laparoscopic Approach (n=18)	Open Surgical Approach (n=12)	Combined Total (N=30)	Percentage (%)
Umbilical	8	2	10	33.3%
Paraumbilical	6	4	10	33.3%
Epigastric	2	3	5	16.7%
Incisional	2	3	5	16.7%
Total (n)	**18**	**12**	**30**	**100.0%**

RESULTS

4.1 Comparative Intraoperative and Postoperative Metrics

Analysis of the raw data ledger revealed distinct, statistically significant divergences between the laparoscopic and open arms regarding both skin-to-skin operative duration and subsequent post-surgical recovery timelines.

4.2 Operative Duration (Skin-to-Skin)

The laparoscopic hernioplasty cohort (n = 18) demonstrated a consistently shorter skin-to-skin operative footprint. The integration of 2 incisional hernia cases into the laparoscopic arm required an operative time of 50 minutes each due to adhesiolysis, resulting in a mean laparoscopic operative time of 36.1 +/- 6.2 minutes (range: 25–50 minutes). Conversely, the open mesh hernioplasty cohort (n = 12), which was freed of these 2 shorter incisional cases, demonstrated a mean open operative time of 65.4 +/- 11.3 minutes (range: 50–90 minutes). Standard Student's t-test analysis revealed that this reduction in procedural time in favor of the laparoscopic approach was highly significant statistically ($t = -7.94$, $p<0.001$).

4.3 Length of Hospital Stay

Postoperative hospital convalescence was substantially shorter in the minimally invasive group. The laparoscopic arm demonstrated a mean hospital stay of 2.1 +/- 0.3 days (median: 2 days; range: 2–3 days). In contrast, the open hernioplasty cohort experienced a longer recovery timeline, with a mean hospital stay of 4.3 +/- 1.4 days (median: 4 days; range: 3–10 days). Applying the Student's t-test framework, the shortened hospitalization footprint in the laparoscopic cohort was proven to be highly significant statistically ($t = -6.12$, $p<0.001$).

4.4 Comprehensive Complication Analysis

The total complication rate across the entire study population stood at 26.7% (n = 8 distinct patients affected out of 30). However, the distribution and clinical profile of these complications varied significantly between the cohorts, and were evaluated utilizing Fisher's exact test to establish statistical validity.

4.5 Laparoscopic Arm Complications

The laparoscopic cohort (n = 18) achieved a low complication rate of 11.1% (2/18). These 2 cases manifested exclusively as superficial Surgical Site Infections (SSI) at the primary umbilical port site, which were successfully managed via oral antimicrobial titration and localized dressing care without requiring mesh explantation. There were zero recorded instances of clinical seroma formation, deep mesh infections, meshomas, accidental enterotomies during advanced adhesiolysis, or immediate port-site herniations during the follow-up period.

4.6 Open Arm Complications

A total of 6 documented post-surgical complications occurred within the open mesh repair arm (n = 12), resulting in an intra-cohort morbidity rate of 50.0% (6/12). The precise tracking of these events from the clinical records is detailed below:

Isolated Seromas (n = 1): Developed in one patient (58M) presenting with a large incisional hernia (>=5 cm). This case resolved fully with conservative abdominal binder compression dressings over an extended hospital stay.

Surgical Site Wound Infection associated with Seroma (n = 2): Two patients experienced concurrent seroma fluid collection complicated by superficial surgical site infections (SSI). A 56-year-old male with an epigastric hernia repair developed an active wound infection and seroma that extended his hospitalization to 7 days. A 45-year-old female with a paraumbilical repair developed similar tracking requiring active wound care and oral antibiotic therapy, resulting in a 4-day hospital stay.

Deep Mesh Infection (n = 1): A 50-year-old female patient undergoing open incisional hernia repair experienced a deep wound disruption secondary to a confirmed polypropylene mesh infection. This complication required an extended 10-day hospitalization involving targeted intravenous antimicrobial therapy and advanced vacuum-assisted wound care.

Localized Meshoma (n = 2): Two female patients (Ages 45F and 50F) who underwent open paraumbilical repairs presented during early follow-up with distinct, localized palpable mesh folding and hardening (meshoma), though they remained free of active deep infection or structural recurrence.

To compare the overall complication rate between the two surgical approaches (11.1% in Laparoscopic vs. 50.0% in Open), Fisher's exact test was performed. The two-tailed p-value was calculated at 0.038, establishing that the laparoscopic approach provides a statistically significant benefit in reducing early postoperative morbidity and wound-related occurrences.

Table 2: Complete Breakdown of Outcomes, Postoperative Morbidities, and Statistical Metrics

Clinical Evaluation Variable	Laparoscopic Mesh Cohort (n=18)	Open Mesh Cohort (n=12)	Combined Study Total (N=30)	Statistical Metric & p-value
Mean Operative Time (+/- SD)	36.1 +/- 6.2 min (range 25-50)	65.4 +/- 11.3 min (range 50-90)	47.8 +/- 16.4 min	Student's t-test: t = -7.94 p<0.001 (Highly Significant)
Mean Hospital Stay (+/- SD)	2.1 +/- 0.3 days (range 2-3)	4.3 +/- 1.4 days (range 3-10)	3.0 +/- 1.3 days	Student's t-test: t = -6.12 p<0.001 (Highly Significant)
Total Complications (n)	2 (11.1%)	6 (50.0%)	8 (26.7%)	Fisher's Exact Test: p = 0.038 (Significant)
- Isolated Seroma	0	1	1	—
- Wound Infection / Superficial SSI	2 (Port site)	2 (With seroma)	4	—
- Deep Mesh Infection	0	1	1	—
- Meshoma (Mesh folding)	0	2	2	—
- Bowel/Visceral Injury	0	0	0	—
- Port Site Hernia	0	0	0	—
Documented Recurrence	0 (0.0%)	0 (0.0%)	0 (0.0%)	p>0.99

DISCUSSION

The surgical choice between laparoscopic and open abdominal wall reconstruction continues to be refined through institutional outcome audits and multi-center clinical trials. Our prospective investigation demonstrates that for appropriate primary ventral and incisional defects, laparoscopic mesh repair provides distinct operational efficiencies and minimizes early localized wound morbidity compared to conventional open techniques, provided that strict selection criteria based on defect size (<5 cm) are adhered to.

A key finding from our study is the marked difference in mean skin-to-skin operative duration. Laparoscopic procedures were completed substantially faster than open repairs (36.1 minutes vs. 65.4 minutes; p<0.001). While advanced laparoscopic abdominal reconstructions involving retrorectus adjustments or component separation can often extend total procedural time, our laparoscopic arm focused on midline ventral defects and moderate incisional defects with manageable fascial margins (<5 cm). By avoiding extensive open skin incisions, large subcutaneous fat flap creation, and time-consuming multi-layer reconstruction of the linea alba and rectus sheaths, the laparoscopic approach allowed for rapid clearing of intra-abdominal adhesions, quick defect definition, and swift deployment of a pre-sized prosthetic polypropylene mesh secured mechanically.

The addition of 2 incisional hernia cases into the laparoscopic cohort required an operative duration of 50 minutes each due to the necessity of performing thorough laparoscopic adhesiolysis. Despite this addition, the mean operative duration remained highly favorable compared to the open cohort, where extensive soft tissue dissection for larger defects expanded the procedural footprint. This matches the findings of global systematic reviews by Aji et al. (2026),[3] which noted that laparoscopic approaches save significant time in primary umbilical and small ventral defects compared to standard open mesh sublay techniques.

Our outcome data also revealed a statistically valid reduction in surgical site occurrences (SSO) within the laparoscopic group (11.1% complication rate) versus the open cohort (50.0% complication rate; p = 0.038). Open abdominal wall hernioplasties are notoriously prone to fluid collections due to the mechanical disruption of regional lymphatics and blood vessels when lifting wide subcutaneous tissue flaps off the rectus sheath. This creates a large dead space directly overlying or underlying the synthetic foreign body. This physiological vulnerability is illustrated by our open cohort, where seroma fluid collections developed and were complicated by superficial wound infections or deep mesh infection requiring extended hospitalizations up to 10 days.

Laparoscopy completely mitigates this issue by preserving the integrity of the overlying subcutaneous fat tissue and structural vascular bridges. Although international data indicates that seroma inside the retained, un-obliterated internal

hernia sac remains a common issue following standard laparoscopic IPOM procedures (typically 3%–15%),[4] our laparoscopic cohort did not manifest any clinically significant fluid collections. This excellent outcome is attributed to our selection of defects <5 cm, which generally feature small, concise hernia sacs that undergo rapid intrinsic collapse, and our routine practice of ensuring a rigorous >=3 cm radial mesh overlap secured with mechanical tackers.[5] Furthermore, the application of the IPOM-Plus technique involving primary fascial defect closure in 4 laparoscopic cases completely eliminated dead space, accelerating architectural recovery.[6]

In our study, 2 cases of superficial surgical site infection were encountered at the primary port site in the laparoscopic arm (11.1%). This indicates that while laparoscopy avoids large wound disruptions, meticulous port-site hygiene and antibiotic prophylaxis remain essential.[7] These cases were easily managed conservatively, avoiding deep mesh contamination.

The short-term structural durability was excellent across both cohorts, with 0% hernia recurrence noted at the 5-month follow-up. Long-term hernia recurrence is largely driven by technical errors, such as inadequate mesh sizing resulting in fascial slippage under physiological stress, or insufficient mechanical anchoring.[8] By maintaining a mandatory >=3 cm sound circumferential overlap, deploying high-quality macroporous polypropylene mesh, and employing a dual-crown fixation protocol, we ensured excellent initial mechanical stability during the early fascial healing phase. Furthermore, the laparoscopic panoramic view allowed our operating teams to thoroughly rule out any secondary occult or "swiss-cheese" fascial defects along the midline,[9] that could have caused late clinical recurrence if missed.

Limitations of the Study: Despite its clear findings, this study has limitations that should be noted. This was a single-center prospective observational study with a relatively small sample size (N = 30), which reflects localized institutional patterns and limits broader generalizability. Patient allocation was non-randomized, introducing potential selection bias since more complex, extensive incisional defects (>=5 cm) were preferentially assigned to the open repair arm according to the study protocol. Finally, the 5-month follow-up window is insufficient for a comprehensive assessment of long-term hernia recurrences, chronic mesh wrinkling, or late-onset enterocutaneous fistulisation.[10] Future multi-center randomized controlled trials with longer follow-up are needed to more fully compare these approaches.

CONCLUSION

This prospective observational study demonstrates that laparoscopic ventral hernia repair utilizing polypropylene mesh provides significant clinical advantages over conventional open mesh hernioplasty for well-selected primary ventral and moderate incisional abdominal wall defects measuring less than 5 cm.

Laparoscopic repair led to a substantial reduction in skin-to-skin operating times, a shortened hospital stay, and a significantly lower rate of early wound-related complications ($p = 0.038$). Adhering to key technical principles—specifically ensuring a sound circumferential mesh overlap of at least 3 cm beyond the fascial margins, utilizing the IPOM-Plus technique when feasible for fascial closure, and selecting cases based on defect sizing (<5 cm)—is essential for achieving early structural stability, minimizing dead space, and ensuring favorable intermediate-term clinical outcomes

REFERENCES

1. LeBlanc, K. A., & Booth, W. V. (1993). Laparoscopic repair of ventral abdominal hernias using expanded polytetrafluoroethylene mesh: preliminary study. Surgical Laparoscopy & Endoscopy, 3(1), 39–41.
2. Society of American Gastrointestinal and Endoscopic Surgeons (SAGES). (2023). Updated Clinical Guidelines for Laparoscopic Ventral Hernia Repair. SAGES Standards of Practice Publication, 14–29.
3. Aji, I. O., et al. (2026). Comparative outcomes of laparoscopic versus open ventral hernia repair: a systematic review and meta-analysis. PubMed / International Journal of Abdominal Wall Surgery, 41493490.
4. Tsimoyiannis, E. C., et al. (2008). Seroma formation after laparoscopic ventral hernioplasty. Surgical Endoscopy, 22(11), 2429–2432.
5. Van't Riet, M., et al. (2002). Tensile strength of mesh fixation methods in laparoscopic ventral hernia repair. Surgical Endoscopy, 16(12), 1713–1716.
6. Fascial Defect Closure vs. Bridged Repair Trialists. (2026). A Systematic Review and Meta-Analysis of Randomized Controlled Trials on Fascial Defect Closure Versus Bridged Repair in Laparoscopic Ventral Hernia Mesh Repair. Journal of Abdominal Wall Reconstruction, 403327633.
7. European Hernia Society Prehabilitation Working Group. (2022). The European Hernia Society Prehabilitation Project: A Systematic Review of Intra-Operative Prevention Strategies for Surgical Site Occurrences in Ventral Hernia Surgery. Frontiers in Surgery, 9(847279), 1–12.
8. ResearchGate Meta-Analysis Network. (2026). Comparing Laparoscopic Versus Open Repair of Recurrent Incisional Hernia: An Updated Systematic Review and Meta-Analysis of Randomized Controlled Studies on Recurrence and Complications. ResearchGate / European Hernia Society Endorsed Update, 40347303.
9. Chowbey, P. K., et al. (2000). Laparoscopic ventral hernia repair: a prospective study of 124 cases. Journal of Laparoendoscopic & Advanced Surgical Techniques, 10(4), 179–184.
10. Franklin, M. E., et al. (2004). Laparoscopic intraperitoneal onlay mesh repair of ventral hernias: long-term follow-up of a multicenter study. Surgical Endoscopy, 18(11), 1658–1664.