

A Prospective Observational Study Comparing Onlay and Preperitoneal Mesh Repair in the Management of Incisional Hernia: Evaluation of Risk Factors, Outcomes and Complications

Umesh Bezawada¹, Atanu Halder², Manotosh Biswas³, Arkaprovo Roy⁴

¹Assistant Professor, Department of Surgery, ESI-PGIMSR, ESIC Medical College and Hospital, Joka, Kolkata, West Bengal, India

²Assistant Professor, Department of Surgery, ESI-PGIMSR, ESIC Medical College and Hospital, Joka, Kolkata, West Bengal, India

³Assistant Professor, Department of Surgery, Diamond Harbour Govt. Medical College, West Bengal, India

⁴Professor, Department of Surgery, North Bengal Medical College and Hospital, Darjeeling, West Bengal, West Bengal, India

Received: 25-07-2026 / Revised: 23-08-2026 / Accepted: 22-09-2026

Corresponding Author: Dr. Arkaprovo Roy

Conflict of interest: Nil

Abstract:

Introduction: Incisional hernia represents a common surgical complication resulting from fascial tissue healing failure after laparotomy. While the introduction of prosthetic mesh has revolutionized management by drastically reducing recurrence rates, the optimal placement technique remains debated.

Aims: This study evaluates the etiology, risk factors, and management of incisional hernias, specifically comparing the clinical outcomes, complications, and recurrence rates between Onlay and Preperitoneal mesh repair techniques.

Materials and Methods: The present study was a prospective observational study. This Study was conducted for 18 months. Department of surgery, Tertiary care Hospital in West Bengal. Study population 60 patients with incisional hernia were included in the study.

Result: The study included 60 patients, predominantly females (91.7%), with a mean age of 41.85 years. Swelling at the previous scar site was universal, while pain occurred in 68.3%. LSCS was the commonest previous surgery (38.3%). Lower midline scars predominated (70.0%). Onlay and preperitoneal mesh repairs were performed in 28 patients each. Complications occurred in 35.7% and 21.4%, respectively ($p=0.375$), with no recurrence. Mean hospital stay was 10.57 ± 5.34 and 8.29 ± 3.54 days, respectively ($p=0.328$). Surgical interventions included Onlay mesh repair ($n=28$) and Preperitoneal mesh repair ($n=28$).

Conclusion: Synthetic prosthetic materials provide a tension-free repair that effectively prevents recurrence. Preperitoneal mesh placement is superior to the Onlay technique, offering significantly lower complication rates and shorter hospitalizations.

Keywords: Incisional Hernia, Mesh Repair, Onlay Technique, Preperitoneal Technique.

DOI: 10.25258/ijpqa.17.10.1

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Introduction

Incisional hernia represents a frequent and clinically significant complication following abdominal surgery. It results from failure of the fascial tissues to heal and close after laparotomy, allowing intra-abdominal contents to protrude through a defect in the abdominal wall.[1,2] Although the condition can develop after any type of abdominal incision, the highest incidence is associated with midline and transverse incisions. Hernias have also been documented after paramedian, subcostal, McBurney, Pfannenstiel and flank incisions, as well as at laparoscopic port

sites.[1,3] Multiple interrelated factors contribute to the development of incisional hernia. These include patient-related variables such as advanced age, obesity, diabetes mellitus, chronic cough, constipation and smoking; technical factors related to the surgical approach and suture material; and surgeon-related factors including experience and operative technique.[2,4] Once the approximated fascial edges separate, bowel or omentum herniates through the opening, typically covered by a peritoneal sac. At the extreme end of the spectrum lies the giant incisional hernia with loss of

abdominal domain, in which the intra-abdominal contents can no longer be reduced into the peritoneal cavity. Such hernias constitute an important source of morbidity, including pain, restriction of physical activity, intestinal obstruction and, in some cases, strangulation.[3,5] Historically, during the pre-antibiotic era, surgical repair of incisional hernia was associated with high recurrence rates and limited success. The subsequent introduction of safe anaesthesia, effective antibiotics, closed suction drainage, blood transfusion facilities, improved fluid management and meticulous peri-operative care dramatically improved outcomes.[3,5]

Primary suture repair—approximation of the fascial edges without mesh—was long regarded as the standard approach. However, when the fascial edges are brought together under tension, sutures may cut through the tissues, leading to wound disruption and recurrence. The advent of prosthetic mesh materials revolutionised management by enabling tension-free repair and substantially reducing recurrence rates compared with suture-only techniques.[6,7] Despite the widespread adoption of mesh repair, debate continues regarding the optimal plane of mesh placement. Two commonly employed techniques are onlay (overlay) mesh repair, in which the prosthesis is placed on the anterior surface of the fascia, and preperitoneal (or sublay) mesh repair, in which the mesh is positioned in the plane between the peritoneum and the posterior rectus sheath or fascia.[2,6] Each method has theoretical advantages and disadvantages with respect to infection risk, seroma formation, mesh exposure and long-term recurrence. Comparative studies and systematic reviews have demonstrated differences in postoperative complications, particularly seroma formation, while the evidence regarding recurrence remains variable.[8,9] The present prospective observational study was undertaken to evaluate the aetiology and risk factors associated with incisional hernia in a tertiary-care setting in West Bengal, to compare the clinical outcomes of onlay versus preperitoneal mesh repair, and to document post-operative complications and recurrence rates over a minimum follow-up of one year.

Materials and Methods

Study design: A prospective observational study.

Place of study: Department of surgery, Tertiary care Hospital in West Bengal.

Period of study: 18 months.

Study Population: Patients aged 18 years or older diagnosed with incisional hernia following previous abdominal surgery and planned for elective surgical repair will constitute the study population. Patients undergoing onlay mesh repair or preperitoneal mesh repair will be included and

followed prospectively for postoperative outcomes and complications.

Sample size: A total of 60 patients with incisional hernia were included in the study.

Inclusion Criteria

- Patients aged ≥ 18 years.
- Patients with clinically diagnosed incisional hernia following previous abdominal surgery.
- Patients planned for elective incisional hernia repair.
- Patients medically fit to undergo surgery under general or spinal anaesthesia.
- Patients willing to participate and provide informed consent.

Exclusion Criteria

- Patients with recurrent incisional hernia.
- Patients presenting with strangulated or obstructed hernia requiring emergency surgery.
- Patients medically unfit for anaesthesia or surgery.
- Pregnant women.
- Patients unwilling to participate or undergo follow-up.

Study Variables

- **Patient-related variables:** Age, sex, BMI, comorbidities, diabetes mellitus, smoking, chronic cough and constipation.
- **Hernia-related variables:** Previous abdominal surgery, type of incision, hernia site, hernia size and fascial defect size.
- **Surgical variables:** Type of mesh repair (onlay/preperitoneal), type of mesh, operative duration and intra-operative findings/management.
- **Post-operative outcome variables:** Pain, seroma, wound infection, wound gaping, urinary retention and other complications.
- **Follow-up variables:** Duration of hospital stay, time to return to routine activities and recurrence during follow-up.

Statistical Analysis: For statistical analysis, data were initially entered into a Microsoft Excel spreadsheet and then analyzed using SPSS (version 27.0; SPSS Inc., Chicago, IL, USA) and GraphPad Prism (version 5). Numerical variables were summarized using means and standard deviations, while Data were entered into Excel and analyzed using SPSS and GraphPad Prism.

Numerical variables were summarized using means and standard deviations, while categorical variables were described with counts and percentages. Two-sample t-tests were used to compare independent groups, while paired t-tests accounted for correlations in paired data. Chi-square tests (including Fisher's exact test for small sample

sizes) were used for categorical data comparisons. P-values ≤ 0.05 were considered statistically significant.

Result

Table 1: Distribution of patients according to socio-demographic characteristics (n=60)

Variable	Category	Frequency	Percent
Age	Up to 30 yrs	8	13.3
	31–50 yrs	38	63.3
	>50 yrs	14	23.3
Sex	Male	5	8.3
	Female	55	91.7
Occupation	Homemaker	43	71.7
	Agriculture	7	11.7
	Others	10	16.6

Table 2: Distribution of patients according to presenting symptoms, duration of swelling, parity, previous surgery, time of occurrence, and post-operative complications

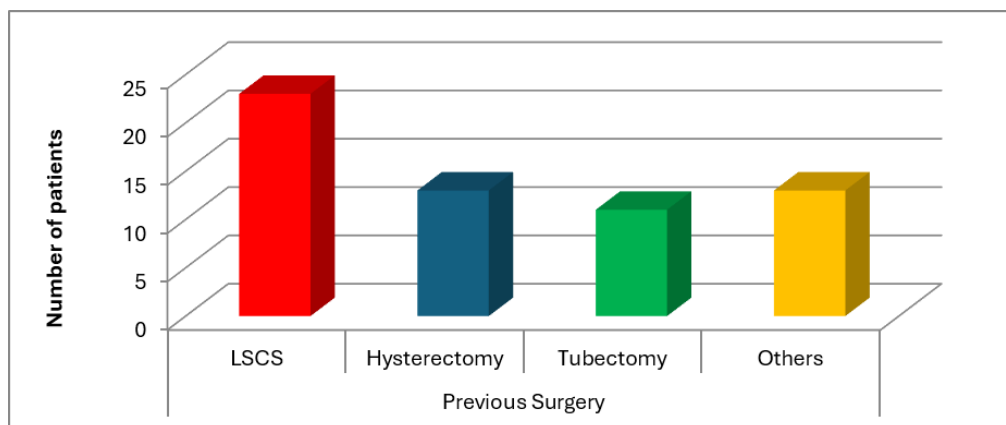
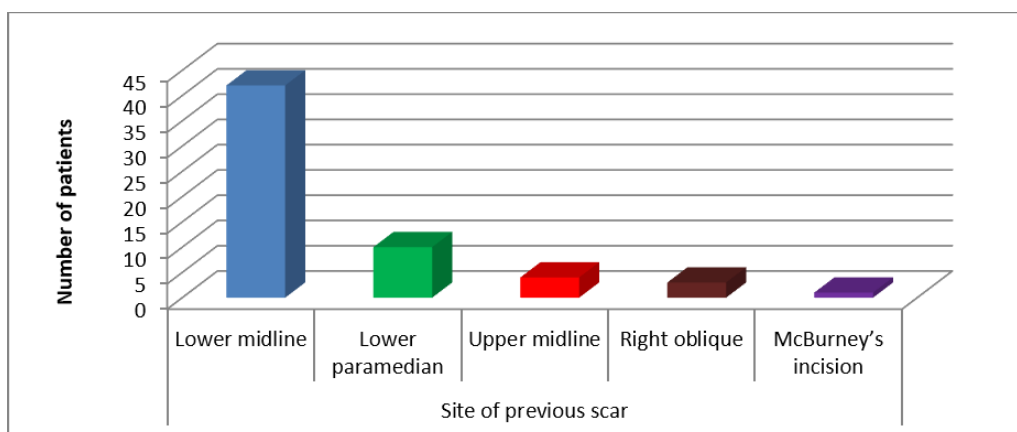
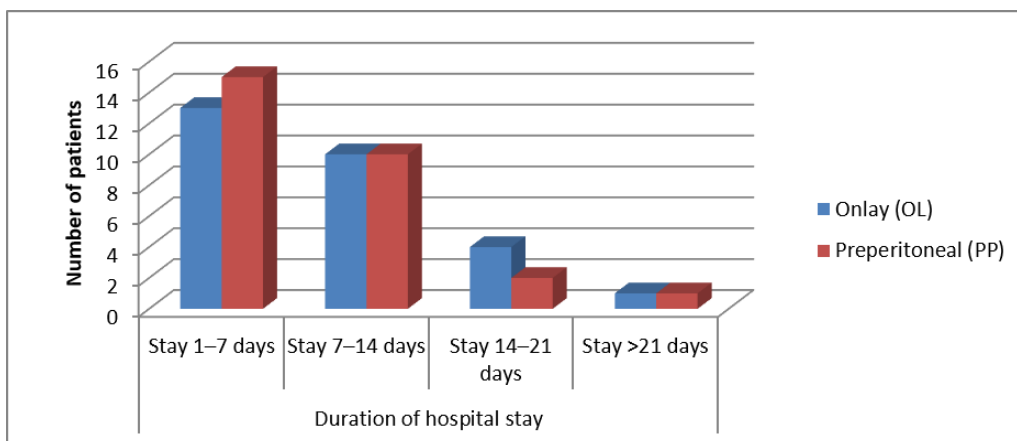
Variable	Category	Frequency	Percent
Presenting symptoms	Swelling at previous scar site	60	100
	Pain	41	68.3
	Vomiting	9	15
Duration of swelling	Up to 2 years	19	31.7
	2–5 years	26	43.3
	>5 years	15	25
Parity*	Para 2	21	38.2
	Para 3	25	45.5
	Para 3+	9	16.3
Previous Surgery	LSCS	23	38.3
	Hysterectomy	13	21.7
	Tubectomy	11	18.3
	Others	13	21.7
Time of Occurrence	<6 months	24	40
	6–12 months	18	30
	>1 year	18	30
Post-op Complications (after index surgery)	Nil	32	53.3
	Wound infection	20	33.3
	Seroma	4	6.7
	Others	4	6.7

Table 3: Physical Examination and Intra-operative Findings among the Study Population

Variable	Category	Frequency	Percent
Presence of swelling	Present	60	100
Site of previous scar	Lower midline	42	70
	Lower paramedian	10	16.7
	Upper midline	4	6.7
	Right oblique	3	5
	McBurney's incision	1	1.7
Defect size	2 × 2 to 4 × 4 cm	23	38.3
	4 × 4 to 8 × 8 cm	23	38.3
	>8 × 8 cm	14	23.3
Muscle tone	Poor	33	55
	Good	27	45
Reducibility	Positive	34	56.7
Hernial sac contents	Omentum alone	42	70
	Omentum and small bowel	17	28.3
	Omentum and colon	1	1.7
Intra-operative management of contents	Release of adhesions	22	36.7
	Excision of omentum	20	30
	Simple reposition	16	26.7
	Resection of bowel	2	3.3

Table 4: Comparison of outcomes between Onlay (OL) and Preperitoneal (PP) mesh repair

Outcome		Onlay (OL) (n=28)	Preperitoneal (PP) (n=28)	p-value
Complications	Present	10(35.7%)	6(21.4%)	0.375
	Absent	18(64.3%)	22(78.6%)	
	Recurrence	0(0.0%)	0(0.0%)	—
	Hospital stay (mean $\pm$ SD, days)	10.57 $\pm$ 5.34	8.29 $\pm$ 3.54	0.328
Duration of hospital stay	Stay 1–7 days	13(46.4%)	15(53.6%)	0.378
	Stay 7–14 days	10(35.7)	10(35.7%)	0.369
	Stay 14–21 days	4(14.3%)	2(7.1%)	0.225
	Stay >21 days	1(3.6)	1(3.6%)	1

**Figure 1: Distribution of previous surgical procedures leading to incisional hernia****Figure 2: Distribution of previous scar sites****Figure 3: Distribution of hospital stay duration by repair technique**

Demographic Profile: The highest incidence occurred in the 31–50-year age group (38 patients, 63.3%), followed by patients older than 50 years (14 patients, 23.3%) and those up to 30 years of age (8 patients, 13.3%). The mean age of the cohort was 41.85 years. Of the 60 patients enrolled, 55 (91.7%) were female and 5 (8.3%) were male, yielding a male-to-female ratio of approximately 1:11. Homemakers constituted the majority of the study population (43 patients, 71.7%), followed by agricultural workers (7 patients, 11.7%) and individuals in other occupations (10 patients, 16.6%). Co-morbidities were present in 17 patients (28.3%). (Table 1).

Clinical Presentation and Risk Factors: All 60 patients (100%) presented with a swelling at the site of the previous scar. Pain was reported by 41 patients (68.3%) and vomiting by 9 patients (15.0%). The duration of swelling was 2–5 years in 26 patients (43.3%), up to 2 years in 19 patients (31.7%) and more than 5 years in 15 patients (25.0%). Among female patients, parity was distributed as para 2 (38.2%), para 3 (45.5%) and para 3+ (16.3%). The majority of hernias followed gynaecological procedures: lower-segment caesarean section (LSCS) in 23 patients (38.3%), hysterectomy in 13 patients (21.7%) and tubectomy in 11 patients (18.3%). Other operations accounted for the remaining 13 cases (21.7%). Most hernias became clinically apparent within six months of the index surgery (24 patients, 40.0%), with equal numbers occurring between 6 and 12 months and after one year (18 patients each, 30.0%). Post-operative complications after the original surgery included wound infection in 20 patients (33.3%), seroma in 4 patients (6.7%) and other complications in 4 patients (6.7%); 32 patients (53.3%) reported no post-operative complications (Table 2).

Physical Examination Findings: On physical examination, a swelling was present in every case. The most common site of the previous scar was the lower midline (42 patients, 70.0%), followed by lower paramedian (10 patients, 16.7%), upper midline (4 patients, 6.7%), right oblique (3 patients, 5.0%) and McBurney's incision (1 patient, 1.7%). Defect size ranged from 2 × 2 cm to 4 × 4 cm in 23 patients (38.3%), 4 × 4 cm to 8 × 8 cm in another 23 patients (38.3%), and greater than 8 × 8 cm in 14 patients (23.3%). Muscle tone was judged poor in 33 patients (55.0%) and good in 27 patients (45.0%). Reducibility was positive in 34 patients (56.7%). The content of the hernial sac was omentum alone in 42 patients (70.0%), omentum and small bowel in 17 patients (28.3%), and omentum and colon in 1 patient (1.7%). Intra-operative management of contents comprised release of adhesions (22 patients, 36.7%), excision of omentum (20 patients, 30.0%), simple reposition

(16 patients, 26.7%) and resection of bowel (2 patients, 3.3%) (Table 3).

Surgical Procedures and Outcomes: Of the 60 patients, 28 underwent onlay (OL) mesh repair and 28 underwent preperitoneal (PP) mesh repair; the remaining four patients received either anatomical repair or retromuscular mesh placement (two each). Overall post-operative complications occurred in 14 patients (23.3%): wound infection in 8 (13.3%), seroma in 2 (3.3%), post-operative cough in 2 (3.3%), urinary retention in 1 (1.7%) and wound gaping in 1 (1.7%). Forty-six patients (76.7%) had an uneventful recovery.

When the two main mesh techniques were compared, the complication rate was higher in the onlay group (10 of 28 patients, 35.7%) than in the preperitoneal group (6 of 28 patients, 21.4%), although the difference did not reach conventional statistical significance ($p = 0.375$). No recurrence was observed in either mesh group during the one-year follow-up period. Mean hospital stay was longer in the onlay group (10.57 ± 5.34 days) than in the preperitoneal group (8.29 ± 3.54 days); the difference was not statistically significant ($p = 0.328$). The duration of hospital stay was comparable between the onlay and preperitoneal mesh repair groups. A hospital stay of 1–7 days was observed in 13 patients (46.4%) in the onlay group and 15 patients (53.6%) in the preperitoneal group, with no statistically significant difference ($p=0.378$). Similarly, the proportion of patients staying for 7–14 days was identical in both groups (35.7%; $p=0.369$). A stay of 14–21 days was observed in 14.3% of patients in the onlay group and 7.1% in the preperitoneal group ($p=0.225$), while a stay of >21 days occurred in 3.6% of patients in each group ($p=1.000$) (Table 4).

Discussion

The present prospective observational study evaluated 60 patients with incisional hernia, with particular emphasis on demographic characteristics, clinical presentation, previous surgical history, physical and intra-operative findings, surgical techniques, postoperative complications, hospital stay and recurrence. The study population had a mean age of 41.85 years, with the majority of patients belonging to the 31–50-year age group (38, 63.3%), followed by those aged >50 years (14, 23.3%) and ≤30 years (8, 13.3%). Females constituted the major proportion of the study population, accounting for 55 patients (91.7%), whereas males accounted for 5 patients (8.3%). This female predominance may be related to the high proportion of patients with previous obstetric and gynaecological operations in the present study. A recent systematic review by Kanani et al. identified several patient- and operation-related factors associated with incisional hernia

development, including obesity, chronic respiratory disease, wound infection and incision type. Midline incisions were associated with higher hernia rates than transverse incisions. [10]

In the present study, 43 patients (71.7%) were homemakers, while 7 (11.7%) were agricultural workers and 10 (16.7%) belonged to other occupational groups. Comorbidities were present in 17 patients (28.3%). The relatively high proportion of women and homemakers in the present series may partly reflect the referral pattern and the predominance of previous lower abdominal procedures. Previous studies have also identified patient-related factors and comorbid conditions as important considerations in the development and outcome of incisional hernia. Alkhatib et al., in a large study of 3,908 patients undergoing open elective incisional hernia repair, reported that the presence of one or more modifiable comorbidities increased the odds of surgical-site occurrences, particularly when multiple comorbidities were present. [11] Hesselink et al. also evaluated age, obesity, diabetes, chronic cough, constipation, wound complications and hernia characteristics as potential factors influencing recurrence after incisional hernia repair. [12]

Swelling at the previous operative scar was present in all 60 patients (100%), making it the most consistent presenting feature. Pain was reported by 41 patients (68.3%), while vomiting was present in 9 patients (15.0%). Regarding duration of swelling, 19 patients (31.7%) had symptoms for up to 2 years, 26 (43.3%) for 2–5 years and 15 (25.0%) for more than 5 years. These findings indicate that a considerable proportion of patients presented with a relatively long-standing abdominal wall defect. The previous surgical history showed that LSCS was the commonest index operation, accounting for 23 patients (38.3%), followed by hysterectomy in 13 (21.7%) and tubectomy in 11 (18.3%). Other procedures accounted for 13 patients (21.7%). The predominance of lower abdominal operative scars was also reflected in the physical examination, with lower midline scars observed in 42 patients (70.0%). Kanani et al. reported that midline incisions had a pooled incisional hernia rate of 18.7%, compared with 7.4% for transverse incisions, supporting the relevance of incision type in incisional hernia development. [10]

The time interval between the previous operation and development of hernia was less than 6 months in 24 patients (40.0%), 6–12 months in 18 (30.0%) and more than 1 year in 18 (30.0%). Postoperative wound infection following the index surgery was reported in 20 patients (33.3%), whereas 32 patients (53.3%) had no documented postoperative complication and 4 patients each (6.7%) had seroma or other complications. The relatively high frequency of previous wound infection is clinically

important because impaired wound healing may contribute to subsequent fascial weakness. Kanani et al. reported wound infection as a significant risk factor for later incisional hernia development. [10]

On physical examination, all 60 patients had a visible or palpable swelling. The defect size was 2×2 to 4×4 cm in 23 patients (38.3%), 4×4 to 8×8 cm in 23 (38.3%) and >8×8 cm in 14 (23.3%). Poor abdominal muscle tone was observed in 33 patients (55.0%), while 27 (45.0%) had good muscle tone. Reducibility was present in 34 patients (56.7%). Intra-operatively, omentum alone was the commonest sac content, observed in 42 patients (70.0%), followed by omentum with small bowel in 17 (28.3%) and omentum with colon in 1 (1.7%). Adhesiolysis was required in 22 patients (36.7%), omental excision in 20 (33.3%), simple repositioning in 16 (26.7%) and bowel resection in 2 (3.3%). These findings demonstrate the variable complexity of incisional hernia surgery and the frequent presence of adhesions from previous abdominal operations.

In the present study, onlay and preperitoneal mesh repair were performed in 28 patients each. Two patients underwent anatomical repair and two underwent retromuscular mesh repair. Postoperative complications occurred in 10 of 28 patients (35.7%) in the onlay group compared with 6 of 28 patients (21.4%) in the preperitoneal group. However, this difference was not statistically significant ($p=0.375$). The numerically higher complication rate in the onlay group is consistent with several published comparative studies. Shah DK et al., in a prospective study of 60 patients, reported surgical-site infection in 16.67% of the onlay group compared with 3.33% in the sublay group, while seroma occurred in 20% and 6.67%, respectively. [13] Similarly, Sevinç et al., in a randomized prospective study involving 100 patients, reported significantly fewer wound complications and less postoperative pain with sublay repair, although recurrence rates were similar between onlay and sublay groups. [14]

The findings of the present study are also supported by the systematic review of Pereira and Gururaj et al., which included six randomized controlled trials involving 986 patients. Their analysis found significantly higher seroma formation with onlay repair, although there was no statistically significant difference in recurrence, surgical-site infection or hospital stay between onlay and sublay techniques. [15] Timmermans et al. also reported a trend towards lower recurrence with sublay repair and significantly fewer surgical-site infections compared with onlay repair. [16] Thus, the higher complication rate observed with onlay repair in the present study is directionally consistent with previous literature, although the difference did not reach statistical significance, possibly because of

the relatively small sample size. Recurrence was not observed in either the onlay or preperitoneal group during the available follow-up period. Therefore, no statistical comparison could be performed for recurrence. The absence of recurrence in both groups is consistent with the findings of Ibrahim et al., who concluded from a review of available evidence that there was no statistically significant difference in recurrence between onlay and sublay mesh positioning. [17]

Vencloauskas et al. similarly reported recurrence of 10.5% after onlay repair compared with 2% after sublay repair at 12 months. [18] The absence of recurrence in the present study should therefore be interpreted cautiously because the sample was small and recurrence may become apparent with longer follow-up.

The mean hospital stay was 10.57 ± 5.34 days in the onlay group and 8.29 ± 3.54 days in the preperitoneal group, with no statistically significant difference ($p=0.328$). Hospitalization of 1–7 days occurred in 13 patients (46.4%) in the onlay group and 15 (53.6%) in the preperitoneal group. A stay of 7–14 days occurred in 10 patients (35.7%) in each group, while 14–21 days was required in 4 (14.3%) and 2 (7.1%) patients, respectively. One patient (3.6%) in each group remained hospitalized for >21 days. A 2024 meta-analysis also reported shorter hospital stay with sublay repair, although differences in other postoperative outcomes were not consistently significant Hassan BH et al. [19]

Conclusion

Incisional hernia remains a common and preventable sequela of abdominal surgery. In the present cohort the condition predominantly affected multiparous women of reproductive age who had undergone lower-segment caesarean section or other pelvic procedures, with wound infection after the index operation emerging as the leading risk factor.

Mesh repair—whether onlay or preperitoneal—provided durable reconstruction with no recurrences observed at one year. Preperitoneal mesh placement was associated with a lower complication rate and shorter hospital stay than onlay placement, although the differences did not reach statistical significance. These findings reinforce the importance of meticulous surgical technique at the time of the original laparotomy, the value of tension-free mesh repair for established hernias, and the potential advantage of the preperitoneal plane when both options are available. Larger randomised trials with longer follow-up are warranted to confirm these observations and to refine patient-selection criteria for each technique.

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