

Sublay or Onlay? A Comparative Evaluation of Mesh Placement Techniques in Ventral Hernia Repair

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Abstract: Background: Ventral hernia repair is a common surgical procedure. Prosthetic mesh reinforcement has substantially reduced recurrence rates. However, the optimal anatomical plane for mesh placement- onlay versus sublay- remains controversial. This study aimed to compare surgical outcomes and complication rates between onlay and sublay mesh repair in ventral hernia at Dr. Vitthalrao Vikhe Patil Foundation Medical College and Hospital. Methods: A prospective comparative study was conducted over 6 months with 20 adult patients diagnosed with uncomplicated ventral hernias. Participants were randomly allocated into two groups: Group A (Onlay mesh repair) and Group B (Sublay mesh repair), with 10 patients in each. Primary outcomes included operative time, postoperative pain (VAS score), hospital stay duration, wound complications, seroma/hematoma formation, and early recurrence within 6 months. Results: The mean operative time was significantly longer in sublay compared to onlay repairs. Sublay repair demonstrated lower rates of wound infection and seroma formation. Hospital stay was shorter in sublay group. Recurrence at 6 months was zero in both groups. Overall complication rates were higher in the onlay group. Statistical significance was analyzed using chi-square and t-tests, with p-value <0.05 considered significant. Conclusion: Sublay mesh repair offers superior surgical outcomes with lower postoperative complications and shorter hospitalization compared to onlay mesh repair for ventral hernia. Based on this comparative analysis, sublay technique may be recommended as a preferred approach in elective ventral hernia repairs.

Keywords: Ventral hernia, Onlay mesh repair, Sublay mesh repair, surgical outcomes, complication rates

1. Introduction

Ventral hernia is a common surgical condition characterized by a defect in the anterior abdominal wall through which intra-abdominal contents protrude. It includes a variety of hernias, such as incisional hernias, which account for a significant percentage of instances, umbilical, paraumbilical, and epigastric hernias. Because of their high frequency, negative effects on quality of life, and requirement for surgery, ventral hernias represent a substantial worldwide health burden.[1] The integrity of the abdominal wall fascia is compromised by a number of factors that affect the lifetime risk of developing a ventral hernia, including prior abdominal surgeries, obesity, ageing, multiparity, chronic cough, poor nutritional status, and underlying connective tissue disorders. [2]

In the past, primary suture procedures were used to repair ventral hernias; however, these approaches were linked to unacceptably high recurrence rates, ranging from 30% to 50%, especially in bigger defects and incisional hernias.[3] The widespread use of prosthetic mesh reinforcement, which has transformed ventral hernia surgery, resulted from the realisation of these limits. By offering a tension-free repair and strengthening weak fascial planes, mesh dramatically decreased recurrence rates to less than 10% in the majority of recent investigations. [4, 5] Consequently, mesh repair has emerged as the global standard of therapy for the majority of ventral hernias.

The best anatomical plane for mesh implantation is still up for dispute, even though mesh use is widely accepted. Onlay and sublay mesh placements are among the most often used

methods in open ventral hernia repair, according to a number of approaches that have been documented. After the fascial defect is closed, the mesh is positioned superficially to the anterior rectus sheath using the onlay method. This method is attractive in ordinary surgical practice since it is technically simple, needs less extensive dissection, and results in shorter operating durations.[6] Onlay implantation, however, requires extensive subcutaneous dissection, which raises the possibility of wound-related problems such flap necrosis, surgical site infection, and seroma development.[7]

Sublay mesh repair, on the other hand, entails placing the mesh between the rectus muscle or peritoneum and the posterior rectus sheath in the retromuscular or preperitoneal plane. By using intra-abdominal pressure to hold the mesh against the abdominal wall, this method reduces stress on the repair and offers superior biomechanical reinforcement. Sublay mesh installation has been linked to reduced rates of surgical site infection, seroma development, and long-term recurrence, according to many studies. [8, 9] However, it is more difficult to do technically, necessitates careful dissection, and frequently results in longer operating times, all of which might prevent it from being widely used, particularly in environments with limited resources.

Despite the fact that onlay and sublay mesh repairs have been compared in several randomised trials, observational studies, and meta-analyses, the findings are still inconsistent, and there is still no agreement on which method is better. [10, 11] These discrepancies are caused by differences in patient selection, hernia features, surgeon skill, and institutional resources. More comparative research from various clinical contexts is therefore crucial.

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In order to provide useful information to support surgical decision-making, the current study was conducted in a tertiary care teaching hospital to evaluate surgical results and complication rates between onlay and sublay mesh repair procedures in ventral hernia patients.

Objectives

- To compare operative time between onlay and sublay mesh repairs.
- To evaluate postoperative complications including wound infection, seroma, hematoma, and pain.
- To assess differences in hospital stay and early recurrence.

2. Materials and Methods

Study Design and Setting

This was a prospective comparative study conducted in the Department of General Surgery at Dr. Vithalrao Vikhe Patil Foundation Medical College and Hospital over a 6-month period (from July to December 2025).

Sample Size and Selection

A total of 20 patients diagnosed with ventral hernias were enrolled after obtaining informed consent. Patients were assigned into two equal groups using simple randomization:

- Group A (Onlay mesh repair): 10 patients
- Group B (Sublay mesh repair): 10 patients

Inclusion Criteria

- Age 18–70 years
- Primary ventral hernia (umbilical, paraumbilical, or incisional)
- Elective surgery candidates
- ASA physical status I–III

Exclusion Criteria

- Emergency presentations (e.g., strangulated hernia)
- Recurrent ventral hernias
- Severe comorbid conditions (e.g., uncontrolled diabetes, cardiac failure)
- Immunocompromised states

Pre-operative Assessment

All patients underwent thorough clinical evaluation, baseline investigations (CBC, renal and liver function tests), imaging where needed (ultrasound/CT abdomen), and anaesthetic assessment. Preoperative optimization included glucose control and prophylactic antibiotics (third-generation cephalosporin 30 minutes prior to incision).

Surgical Techniques

Onlay Mesh Repair (Group A):

- Standard elliptical incision over hernia
- Hernia sac reduction
- Closure of fascial defect with non-absorbable sutures
- Placement of polypropylene mesh on anterior rectus sheath
- Mesh fixation with interrupted non-absorbable sutures
- Subcutaneous drain placement

Sublay Mesh Repair (Group B):

- Midline incision
- Dissection to expose hernia sac and abdominal wall musculature
- Reduction of hernia contents
- Creation of retromuscular/preperitoneal space
- Defect closure
- Placement of mesh in sublay position
- Mesh fixation
- Closure of posterior sheath and muscle layers
- Subcutaneous drain

Post-operative Care

- Analgesia with NSAIDs ± opioids as needed
- Early mobilization and diet advancement
- Drain removal when output <30 mL/day
- Pain assessment using Visual Analog Scale (VAS)
- Follow-up at 1, 4, 12, and 24 weeks

Outcome Measures

Primary outcomes included:

- Operative time (minutes)**
- Hospital stay (days)**
- Postoperative pain (VAS)**
- Complications:** wound infection, seroma, hematoma, mesh infection, recurrence

Statistical Analysis

Data were analysed using statistical software (e.g., SPSS). Continuous variables were expressed as mean ± SD and compared using Student's t-test. Categorical variables were compared using Chi-square test or Fisher's exact test. A p-value <0.05 was considered statistically significant.

3. Results

Table 1: Demographic Characteristics of Study Participants

Variable	Group A – Onlay Mesh (n = 10)	Group B – Sublay Mesh (n = 10)	p-value
Age (years, mean ± SD)	45.6 ± 11.2	47.8 ± 10.5	0.68
Gender (Male: Female)	6: 4	7: 3	0.62
Body Mass Index (kg/m ² , mean ± SD)	27.3 ± 3.4	26.8 ± 3.1	0.74
Hernia Type (Incisional: Umbilical: Paraumbilical)	4: 3: 3	3: 4: 3	0.91

Table 1 summarizes the baseline demographic and clinical characteristics of patients in both study groups. The mean age of patients in the onlay mesh group was 45.6 ± 11.2 years, while that in the sublay mesh group was 47.8 ± 10.5 years, with no statistically significant difference between the groups (p = 0.68). Male predominance was observed in both groups, with a male-to-female ratio of 6:4 in the onlay group and 7:3 in the sublay group (p = 0.62). The mean body mass index was comparable between the two groups (27.3 ± 3.4 kg/m² vs 26.8 ± 3.1 kg/m²; p = 0.74). The distribution of hernia types, including incisional, umbilical, and paraumbilical hernias, was also similar across groups (p = 0.91), indicating homogeneity of the study population.

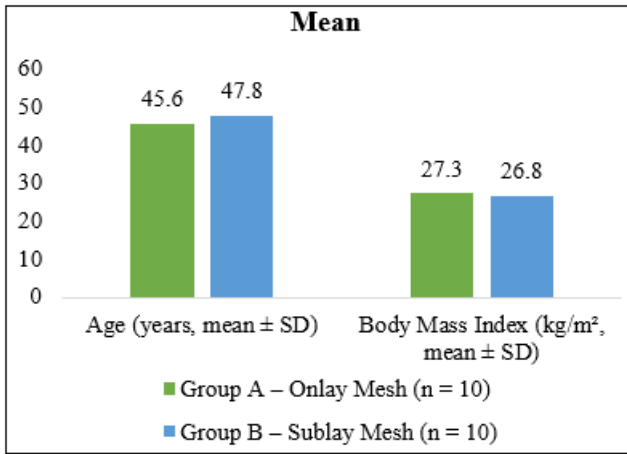


Figure 1A

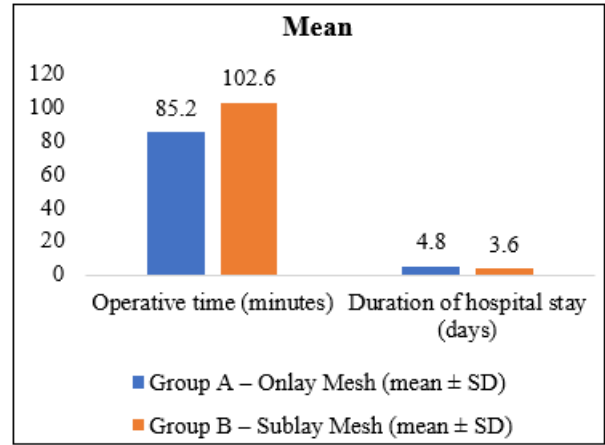


Figure 2A

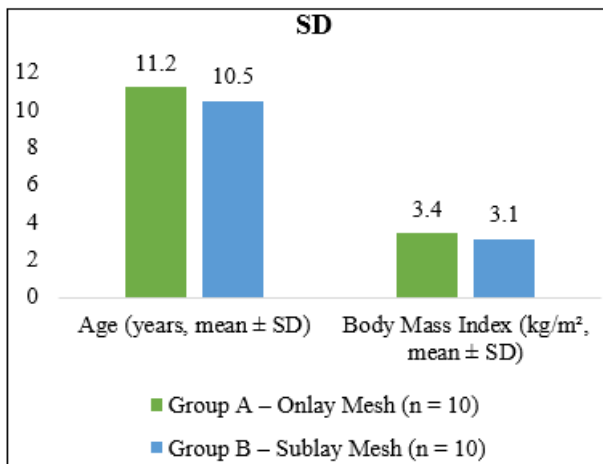


Figure 1B

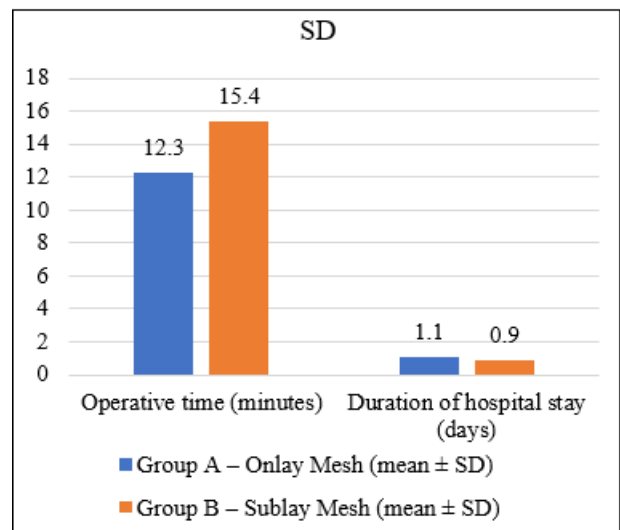


Figure 2B

Table 2: Comparison of Operative Time and Hospital Stay

Outcome Parameter	Group A – Onlay Mesh (mean ± SD)	Group B – Sublay Mesh (mean ± SD)	p-value
Operative time (minutes)	85.2 ± 12.3	102.6 ± 15.4	0.02*
Duration of hospital stay (days)	4.8 ± 1.1	3.6 ± 0.9	0.01*

*Statistically significant (p < 0.05)

Table 2 compares operative time and duration of hospital stay between the two surgical techniques. The mean operative time was significantly longer in the sublay mesh group (102.6 ± 15.4 minutes) compared to the onlay mesh group (85.2 ± 12.3 minutes), and this difference was statistically significant (p = 0.02). Conversely, the mean duration of hospital stay was significantly shorter in the sublay group (3.6 ± 0.9 days) compared to the onlay group (4.8 ± 1.1 days) (p = 0.01). These findings suggest that although sublay repair requires more operative time, it facilitates faster postoperative recovery.

Table 3: Postoperative Pain Assessment Using Visual Analog Scale (VAS)

Postoperative Day	Group A – Onlay Mesh (Mean VAS ± SD)	Group B – Sublay Mesh (Mean VAS ± SD)	p-value
Day 1	6.1 ± 0.8	5.4 ± 0.7	0.04*
Day 3	4.2 ± 0.6	3.8 ± 0.5	0.10
Day 7	2.5 ± 0.5	2.3 ± 0.4	0.32

*Statistically significant (p < 0.05)

Table 3 illustrates postoperative pain scores assessed using the Visual Analog Scale. On postoperative Day 1, patients in the onlay mesh group reported significantly higher pain scores (6.1 ± 0.8) compared to the sublay group (5.4 ± 0.7) (p = 0.04). However, pain scores on postoperative Day 3 and Day 7 were comparable between the two groups, with no statistically significant differences observed (p = 0.10 and p = 0.32, respectively). This indicates that the increased pain associated with onlay repair was limited to the immediate postoperative period.

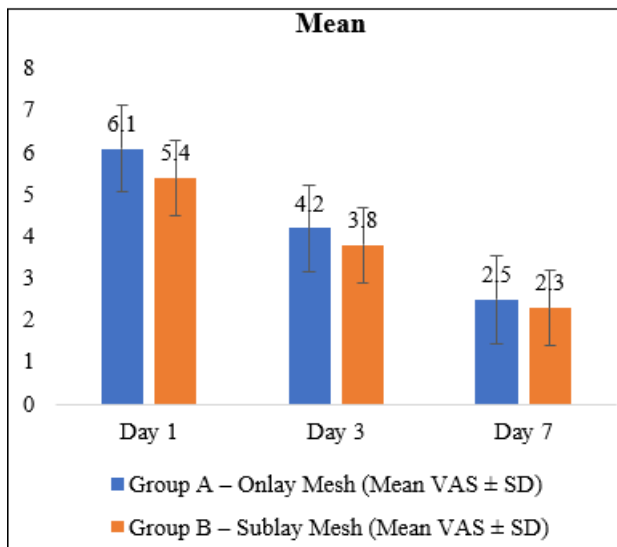


Figure 3A

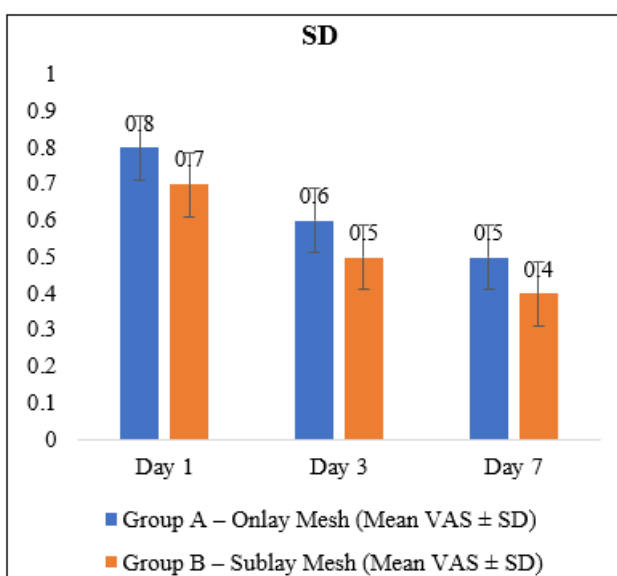


Figure 3B

Table 4: Postoperative Complication Profile

Complication	Group A – Onlay Mesh (n = 10)	Group B – Sublay Mesh (n = 10)	p-value
Wound infection	3 (30%)	1 (10%)	0.27
Seroma formation	2 (20%)	0	0.14
Hematoma	1 (10%)	0	0.31
Mesh infection	1 (10%)	0	0.31

Table 4 presents the postoperative complications observed in both groups. The incidence of wound infection was higher in the onlay mesh group (30%) compared to the sublay group (10%). Seroma formation, hematoma, and mesh infection were observed only in the onlay group. Although the overall complication rate was higher in the onlay group, none of the differences reached statistical significance, likely due to the small sample size.

Table 5: Early Recurrence Rate at 6-Month Follow-up

Outcome	Group A – Onlay Mesh (n = 10)	Group B – Sublay Mesh (n = 10)
Early recurrence (within 6 months)	0	0

Interpretation: No early recurrences were observed in either group during the 6-month follow-up period.

Table 5 depicts early hernia recurrence during the 6-month follow-up period. No recurrence was observed in either the onlay or sublay mesh groups. This suggests that both techniques were effective in preventing early recurrence in the short-term postoperative period.

4. Discussion

In this study, onlay and sublay mesh repair methods for ventral hernias were evaluated in terms of operating parameters, postoperative discomfort, comorbidities, and early recurrence. Both groups' demographics were similar (Table 1), suggesting that surgical technique rather than confounding patient-related variables might be the primary cause of outcome discrepancies. In investigations on ventral hernias, same baseline comparability has been highlighted as crucial for a reliable comparison. Öberg S *et al.* [1]

In comparison to the onlay group, the sublay mesh group's operating duration was noticeably longer (Table 2). This result is in line with previous research, which acknowledges sublay repair as a more difficult surgery that necessitates careful dissection of the retromuscular or preperitoneal plane. Berger D. *et al.* [11] Sublay repair led to a much shorter hospital stay even though the procedure took longer. This points to a more seamless recovery following surgery, perhaps as a result of fewer wound-related issues and improved biomechanical stability of the repair. Similar findings, which demonstrate the therapeutic benefit of sublay mesh installation despite higher operational complexity, have been documented in randomised trials and meta-analyses. Sevinç B *et al.* [9] Soare AM *et al.* [10]

On the first postoperative day, the onlay group had substantially greater pain levels, according to the postoperative pain evaluation (Table 3). Increased inflammatory response and nerve irritation may result from extensive subcutaneous tissue incision and mesh installation in the superficial plane. Olsen MA *et al.* [6] But between Day 3 and Day 7, the two groups' pain assessments were equal, suggesting that the difference was only present during the first few days following surgery. De Vries *et al.* showed similar findings, finding no long-term difference but greater early pain scores with onlay repair. Sevinç B *et al.* [9]

Wound infection, seroma, haematoma, and mesh infection were among the postoperative sequelae that were more common in the onlay mesh group (Table 4). The trend is consistent with the available data even though these changes did not reach statistical significance—possibly because of the limited sample size. Due to substantial flap development and decreased vascularity in the subcutaneous plane, onlay mesh installation is linked to increased rates of wound-related problems. Maskal SM *et al.* [12] Sublay mesh, on the other hand, benefits from being placed in a well-vascularized area, which reduces the risk of infection and seroma. Shaukat W *et al.* [8]

During the six-month follow-up period, neither group saw an early recurrence (Table 5). Although this result is promising, lengthier follow-up is necessary to reach firm conclusions

because recurrence following ventral hernia surgery is known to be time-dependent. Droeser RA *et al.* [3] Overall, the results of this study corroborate previous research indicating that, while being technically more difficult, sublay mesh repair provides superior short-term surgical results and fewer problems than onlay mesh repair.

5. Limitations of the Study

When evaluating the results, it is important to take into account the limitations of the current study. First, the study's statistical power is limited by the small sample size ($n = 20$), which may have contributed to the lack of significance in several outcome comparisons, especially those involving postoperative problems. Second, the evaluation of long-term outcomes including chronic pain and late hernia recurrence, which are crucial markers of surgical effectiveness, is limited by the brief 6-month follow-up period. Third, the results may not apply to other institutions with different patient demographics or surgical specialities because this was a single-center research. Furthermore, although being reduced, differences in surgeon experience could not be completely eradicated. To verify these results, larger, multicentric investigations with longer follow-up are needed.

6. Conclusion

This comparative study evaluated the outcomes of onlay and sublay mesh repair techniques in the management of ventral hernia. During the 6-month follow-up period, no early recurrences were seen, and both methods were successful in repairing the hernia. Despite needing a longer operating time, sublay mesh repair showed definite benefits in terms of less early postoperative discomfort, fewer wound-related problems, and a much shorter hospital stay. The mesh's anatomical placement in a well-vascularized retromuscular plane, which offers superior biomechanical support and less tissue stress, is responsible for the better results linked to sublay repair. Sublay mesh repair may be the preferable method for elective ventral hernia repair since it seems to provide better brief clinical results while being more difficult technically. To validate these results and evaluate long-term recurrence rates, larger studies with longer follow-up are advised.

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