**ORIGINAL RESEARCH**

# Comparison of Surgical Outcomes between Onlay and Underlay Techniques for Ventral Hernia Repair at a Tertiary Centre

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**ABSTRACT**

**Background:** Ventral hernias represent a significant surgical challenge, affecting a considerable portion of the global population. This study aims to compare the surgical outcomes of onlay and underlay mesh placement techniques for ventral hernia repair, focusing on operative time, postoperative complications, pain scores, and long-term recurrence rates.**Materials and Methods:** This comparative study was conducted at a tertiary care hospital and included 140 patients diagnosed with ventral hernias. Patients were equally divided into two groups: onlay repair (n = 70) and underlay repair (n = 70). Both groups underwent standardized surgical procedures, and postoperative parameters such as complications, pain scores, hospital stay, and recurrence rates were recorded. Statistical analysis was performed using SPSS software (version 21.0), with a p-value < 0.05 considered statistically significant.**Results:** The mean operative time was significantly longer in the underlay repair group (92.3 ± 14.1 minutes) compared to the onlay repair group (85.6 ± 12.4 minutes; p = 0.03). However, hospital stay duration (4.2 ± 1.1 vs. 3.9 ± 1.0 days, p = 0.15) and return to normal activities (12.5 ± 2.8 vs. 11.7 ± 2.5 days, p = 0.21) were comparable between groups. The incidence of seroma was higher in the onlay group (14.29%) than in the underlay group (7.14%), though not statistically significant (p = 0.19). Wound infections, hematoma formation, and recurrence rates were similar in both groups. Postoperative pain scores showed slightly lower values in the underlay group, but differences were not statistically significant. Long-term outcomes at six months revealed comparable recurrence and mesh infection rates, with slightly lower chronic pain incidence in the underlay group.**Conclusion:** Both onlay and underlay mesh repair techniques for ventral hernias yield similar outcomes regarding postoperative complications, pain scores, and recurrence rates. The underlay repair requires a longer operative time but demonstrates a trend toward lower seroma formation and chronic pain. Given these findings, the choice of technique should be tailored based on patient-specific factors and surgeon expertise, as both methods are effective and safe.

**Keywords:** Ventral hernia, Onlay repair, Underlay repair, Surgical outcomes, Mesh placement



## INTRODUCTION

Ventral hernias represent a significant surgical challenge, affecting a considerable portion of the global population. These hernias occur due to a weakness or defect in the abdominal wall, allowing intra-abdominal contents to protrude through the weakened region. Common causes include previous surgical incisions, obesity, chronic coughing, pregnancy, and other conditions leading to increased intra-abdominal pressure. The treatment of ventral hernias primarily involves surgical intervention, with mesh reinforcement techniques being the standard approach to reduce recurrence rates and provide durable repairs. Among the various surgical techniques available, the onlay and underlay mesh placements are two commonly employed methods. However, the selection of the optimal technique remains a subject of debate among surgeons, as each approach presents

distinct advantages and potential complications.[1,2]

The onlay technique involves the placement of the mesh over the anterior fascia of the abdominal wall, external to the rectus sheath, after the hernia defect has been closed. This method is often favored for its relative simplicity and ease of mesh fixation, which reduces the need for extensive dissection. It allows for better visualization of the surgical site and can be performed with lower intra-abdominal risks. However, it carries concerns related to increased risk of surgical site infections, seroma formation, and potential mesh-related complications due to its superficial positioning. Despite these drawbacks, many surgeons prefer this technique for its shorter operative time and straightforward approach.[3]

In contrast, the underlay technique involves placing the mesh beneath the peritoneum or within the retrorectus space, allowing for better integration with the surrounding tissues. This method is believed to offer superior biomechanical support, as it effectively counteracts intra-abdominal pressure and minimizes the chances of recurrence. Additionally, the underlay placement reduces the risk of mesh exposure and infection, as it is well-protected by native tissue layers. However, this approach necessitates more extensive dissection and precise surgical technique, which can increase operative time and may pose a higher risk of visceral injuries. Furthermore, adhesion formation with intra-abdominal organs remains a concern, necessitating careful patient selection and surgical planning.[4-6]

The choice between onlay and underlay repairs depends on multiple factors, including patient characteristics, hernia size, surgeon expertise, and institutional preferences. Factors such as obesity, previous abdominal surgeries, and the presence of comorbidities influence the decision-making process. While some studies suggest that the underlay method provides better long-term durability, others highlight the advantages of the onlay approach in terms of reduced complexity and shorter recovery times. Therefore, a comparative study examining the surgical outcomes of these two techniques is crucial to guiding clinical decisions and improving patient care.[7-9]

Moreover, advancements in surgical techniques and biomaterials have contributed to improving the effectiveness of both approaches. Modern synthetic and biological meshes are designed to enhance tissue integration, reduce inflammation, and lower the risk of postoperative complications. Additionally, minimally invasive approaches such as laparoscopic and robotic-assisted hernia repairs have further expanded the options available for mesh placement, allowing surgeons to optimize outcomes based on patient-specific considerations. Despite these advancements, challenges such as mesh infection, chronic pain, and recurrence remain critical concerns, highlighting the need for ongoing research and innovation in hernia repair strategies.[10,11]

## AIM AND OBJECTIVES

This study aims to analyze the comparative effectiveness of onlay and underlay repairs for ventral hernias, evaluating parameters such as recurrence rates, surgical site infections, postoperative pain, operative time, and overall patient recovery. By systematically assessing these outcomes, this research seeks to provide valuable insights into the advantages and limitations of each technique, ultimately contributing to evidence-based surgical practice.

## MATERIALS AND METHODS

### Study Design

This was a prospective comparative study conducted to evaluate surgical outcomes following onlay and underlay repairs for ventral hernias.

### Study Population

A total of 140 patients diagnosed with ventral hernias were enrolled in the study. Patients were divided into two groups based on the type of surgical repair performed:

- **Onlay Repair Group (n = 70):** Patients undergoing onlay mesh placement.
- **Underlay Repair Group (n = 70):** Patients undergoing underlay mesh placement.

### Study Place

The study was conducted in the Department of General Surgery, Saraswathi Institute of Medical Sciences, Hapur, Uttar Pradesh, Indiawith specialized surgical facilities and experienced surgeons.

### Study Period

The study was conducted over a period of six months, from July 2015 to December 2016, including patient recruitment, surgery, and follow-up assessments.

### Ethical Considerations

Ethical approval was obtained from the institutional ethics committee. Written informed consent was obtained from all patients beforetheir inclusion in the study, ensuring

compliance with ethical guidelines for human research.

**Inclusion Criteria**

- Patients aged 18–75 years diagnosed with primary or recurrent ventral hernias.
- Patients who were fit for elective hernia repair under general anesthesia.

**Exclusion Criteria**

- Patients with active infections.
- Those with severe comorbidities, such as uncontrolled diabetes mellitus, liver cirrhosis, or severe cardiopulmonary diseases.
- Pregnant women.
- Patients undergoing emergency hernia repairs.

**Methodology**

All patients underwent a thorough preoperative assessment, including detailed history-taking, physical examination, laboratory investigations, and imaging studies (ultrasound and/or computed tomography scan) to evaluate the size and contents of the hernia defect.

**Surgical Techniques**

All procedures were performed under **general anesthesia** by experienced surgeons using a standardized technique.

- **Onlay Repair:**
  - The hernia sac was dissected and the defect was closed using absorbable sutures.
  - A polypropylene mesh was placed over the anterior rectus sheath and secured with interrupted sutures.
  - Subcutaneous drains were placed before closing the skin.
- **Underlay Repair:**
  - After hernia sac dissection, the posterior rectus sheath was opened and the defect was closed.
  - A mesh was placed in the preperitoneal space and fixed with absorbable sutures.
  - Drains were placed before closing the anterior rectus sheath and skin.

**Outcome Measures**

**Primary Outcomes**

- Postoperative complications (infection, seroma formation, wound complications, etc.).
- Recurrence rates.
- Duration of hospital stay.

**Secondary Outcomes**

- Operative time.
- Postoperative pain scores (assessed using Visual Analog Scale – VAS).
- Time to return to normal activities.

**STATISTICAL ANALYSIS**

All data were recorded and analyzed using SPSS software (15.0version). Categorical variables were compared using the Chi-square test, and continuous variables were analyzed using the independent t-test or Mann-Whitney U test, as appropriate. A p-value $< 0.05$ was considered statistically significant.

**RESULTS**

The study included 140 patients, divided equally into the Onlay and Underlay repair groups.

**Table 1: Demographic Characteristics**

| Variable | Onlay Repair (n=70) | Underlay Repair (n=70) | p-value |
|---|---|---|---|
| Age in years (Mean ± SD) | 52.4 ± 10.2 | 51.8 ± 9.8 | 0.76 |
| **Gender** | | | |
| Male (%) | 45 (64.29%) | 42 (60.00%) | 0.65 |
| Female (%) | 25 (35.71%) | 28 (40.00%) | |
| BMI $kg/m^2$(Mean ± SD) | 27.5 ± 3.4 | 27.3 ± 3.1 | 0.81 |

Table 1 shows that the mean age of patients in the Onlay Repair group was 52.4 ± 10.2 years, while in the Underlay Repair group, it was 51.8 ± 9.8 years ($p = 0.76$), indicating no significant difference between the groups in terms of age distribution. The gender distribution was also comparable, with 64.29% males and 35.71% females in the Onlay Repair group, whereas the Underlay Repair group had 60.00% males and 40.00% females ($p = 0.65$). The mean BMI was 27.5 ± 3.4 in the Onlay Repair group and 27.3 ± 3.1 in the Underlay Repair group ($p = 0.81$), showing that both groups had similar body mass index profiles. Since all p-values were above 0.05, there was no statistically significant difference in the demographic characteristics, confirming that both groups were well-matched.

**Table 2: Operative Outcomes**

| Variable | Onlay Repair (n=70) | Underlay Repair (n=70) | p-value |
|---|---|---|---|
| Operative Time (min, Mean ± SD) | 85.6 ± 12.4 | 92.3 ± 14.1 | 0.03 |
| Hospital Stay (days, Mean ± SD) | 4.2 ± 1.1 | 3.9 ± 1.0 | 0.15 |
| Return to Activity (days, Mean ± SD) | 12.5 ± 2.8 | 11.7 ± 2.5 | 0.21 |

Table 2 shows that the operative outcomes assessed included operative time, hospital stay, and time to return to normal activities. The mean operative time in the Onlay Repair group was 85.6 ± 12.4 minutes, while in the Underlay Repair group, it was significantly higher at 92.3 ± 14.1 minutes (p = 0.03), indicating that the Underlay technique required more time. The mean duration of hospital stay was slightly shorter in the Underlay Repair group (3.9 ± 1.0 days) compared to the Onlay Repair group (4.2 ± 1.1 days), but the difference was not statistically significant (p = 0.15). Similarly, the average time taken for patients to return to daily activities was 12.5 ± 2.8 days in the Onlay Repair group and 11.7 ± 2.5 days in the Underlay Repair group, with no significant difference (p = 0.21). Overall, the only statistically significant finding was the longer operative time for Underlay Repair.

**Table 3: Postoperative Complications**

| Complication | Onlay Repair (n=70) | Underlay Repair (n=70) | p-value |
|---|---|---|---|
| Seroma (%) | 10 (14.29%) | 5 (7.14%) | 0.19 |
| Wound Infection (%) | 6 (8.57%) | 4 (5.71%) | 0.50 |
| Hematoma (%) | 4 (5.71%) | 3 (4.29%) | 0.68 |
| Recurrence (%) | 3 (4.29%) | 2 (2.86%) | 0.64 |

**Figure I: Postoperative complications**

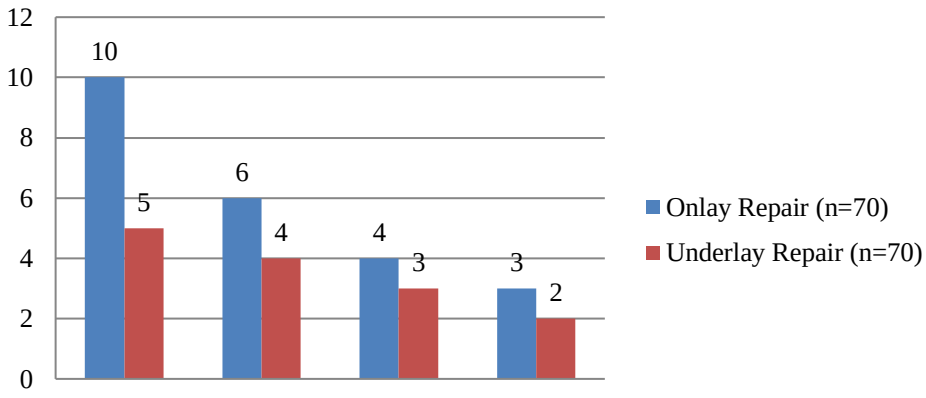


Table 3 and figure I, shows that the Postoperative complications such as seroma formation, wound infection, hematoma, and recurrence were compared between the two groups. The incidence of seroma was higher in the Onlay Repair group (14.29%) compared to the Underlay Repair group (7.14%), though the difference was not statistically significant (p = 0.19). Wound infections occurred in 8.57% of patients undergoing Onlay Repair and 5.71% in the Underlay group (p = 0.50), again showing no significant difference. Hematoma formation was slightly more frequent in the Onlay Repair group (5.71%) compared to the Underlay Repair group (4.29%) (p = 0.68). Recurrence was noted in 4.29% of Onlay Repair cases and 2.86% of Underlay Repair cases (p = 0.64), indicating no significant difference. Overall, while there were slightly higher complication rates in the Onlay Repair group, none of the differences reached statistical significance.

**Table 4: Pain Scores (VAS Scale)**

| Time Point | Onlay Repair (n=70) | Underlay Repair (n=70) | p-value |
|---|---|---|---|
| Post-op Day 1 (Mean ± SD) | 6.2 ± 1.3 | 5.8 ± 1.5 | 0.22 |
| Post-op Day 3 (Mean ± SD) | 4.8 ± 1.1 | 4.4 ± 1.2 | 0.17 |
| Post-op Day 7 (Mean ± SD) | 2.9 ± 0.9 | 2.6 ± 0.8 | 0.12 |

Table 4 shows that the Postoperative pain was assessed using the Visual Analog Scale (VAS) on postoperative days 1, 3, and 7. On day 1, the mean pain score in the Onlay Repair group was 6.2 ± 1.3, while in the Underlay Repair group, it was slightly lower at 5.8 ± 1.5 (p = 0.22). By day 3, the pain score had decreased to 4.8 ± 1.1 in the Onlay Repair group and 4.4 ± 1.2 in the Underlay Repair group (p = 0.17). By day 7, the pain levels had further reduced to 2.9 ± 0.9 in the Onlay group and 2.6 ± 0.8 in the Underlay group (p = 0.12). Although pain scores were consistently lower in the Underlay Repair group, the differences were not statistically significant at any time point.

**Table 5: Long-Term Outcomes at 6 Months**

| Outcome | Onlay Repair (n=70) | Underlay Repair (n=70) | p-value |
|---|---|---|---|
| Chronic Pain (%) | 8 (11.43%) | 5 (7.14%) | 0.37 |
| Recurrence (%) | 4 (5.71%) | 3 (4.29%) | 0.64 |
| Mesh Infection (%) | 3 (4.29%) | 2 (2.86%) | 0.68 |

Table 5 shows that the long-term complications such as chronic pain, recurrence, and mesh infection were assessed at six months postoperatively. Chronic pain was reported in 11.43% of patients in the Onlay Repair group and 7.14% in the Underlay Repair group (p = 0.37). The recurrence rate remained low in both groups, with 5.71% in the Onlay Repair group and 4.29% in the Underlay Repair group (p = 0.64). Mesh infections were slightly more common in the Onlay Repair group (4.29%) compared to the Underlay Repair group (2.86%), but the difference was not statistically significant (p = 0.68). These findings suggest that both repair techniques yielded similar long-term outcomes, with no significant advantage of one technique over the other.

## DISCUSSION

This study aimed to compare the surgical outcomes of onlay versus sublay (underlay) mesh placement techniques in ventral hernia repairs. Our findings indicate that both groups were demographically comparable, with no significant differences in age, gender distribution, or BMI.

In our study, the mean operative time was significantly longer in the sublay repair group (92.3 ± 14.1 minutes) compared to the onlay group (85.6 ± 12.4 minutes; p = 0.03). This observation is consistent with findings by Timmermans et al. (2014), who reported that the sublay technique often requires more meticulous dissection and mesh placement, leading to extended operative durations. However, despite the longer operative time, the sublay approach may offer benefits in terms of reduced postoperative complications.[12]

Our analysis revealed a higher incidence of seroma formation in the onlay group (14.29%) compared to the sublay group (7.14%), though this difference was not statistically significant (p = 0.19). This trend is supported by the meta-analysis conducted by Timmermans et al. (2014), which found a significantly higher rate of seroma formation in onlay repairs.[12] The increased seroma incidence in onlay repairs may be attributed to the more extensive dissection required, creating larger potential spaces for fluid accumulation. Regarding wound infections, our study observed rates of 8.57% in the onlay group and 5.71% in the sublay group (p = 0.50), indicating no significant difference. This finding aligns with the systematic review by Holihan et al. (2016), which reported comparable infection rates between the two techniques. Hematoma formation and recurrence rates were also similar between groups in our study, corroborating the results of previous research.[13]

The mean duration of hospital stay was slightly shorter in the sublay repair group (3.9 ± 1.0 days) compared to the onlay repair group (4.2 ± 1.1 days), but the difference was not statistically significant (p = 0.15). Similarly, the average time taken for patients to return to daily activities was 11.7 ± 2.5 days in the sublay group and 12.5 ± 2.8 days in the onlay group, with no significant

difference (p = 0.21). These findings suggest that, despite a longer operative time, the sublay technique does not adversely affect the overall recovery period. This is in line with the conclusions drawn by de VriesReilingh et al. (2004), who found that the sublay technique offers favorable outcomes without prolonging hospital stays.[14]

At the six-month follow-up, chronic pain was reported in 11.43% of patients in the onlay group and 7.14% in the sublay group (p = 0.37). Recurrence rates were low in both groups, with 5.71% in the onlay group and 4.29% in the sublay group (p = 0.64). Mesh infection rates were similarly low and not significantly different between groups. These outcomes are comparable to those reported by Venclauskas et al. (2010), who found no significant difference in recurrence rates between onlay and sublay repairs. The low recurrence and complication rates in both groups suggest that both techniques are effective for ventral hernia repair, with comparable long-term outcomes.[15]

## LIMITATIONS OF THE STUDY

The study was conducted at a **single-centre**, limiting the generalizability of the findings.The**sample size** of 140 patients may not be large enough to detect rare complications or long-term outcomes.**Short follow-up duration** (6 months) may not capture late recurrences or chronic complications.

## CONCLUSION

This comparative study on onlay and underlay mesh repair techniques for ventral hernias demonstrated that both approaches yield comparable outcomes in terms of postoperative complications, pain scores, and long-term recurrence rates. The underlay technique required significantly longer operative time but showed a lower incidence of seroma and chronic pain, though not statistically significant. Hospital stay and return to normal activities were similar in both groups. Given these findings, the choice of technique should be based on patient-specific factors and surgeon expertise, as both methods are effective and safe for ventral hernia repair.

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