International Journal of Life Sciences, Biotechnology and Pharma Research Vol. 14, No. 5, May 2025 Online ISSN: 2250-3137
Print ISSN: 2977-0122

DOI: 10.69605/ijlbpr_14.5.2025.22

Original Research

Onlay Versus Sublay Mesh Repair For Uncomplicated Ventral Abdominal Wall Hernias

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Received: 11 March, 2025 Accepted: 26 April, 2025 Published: 03 May, 2025

Abstract

Background and Aim: Ventral abdominal wall hernias are a common surgical condition that significantly impacts patient morbidity and healthcare resources. The management of these hernias often involves mesh repair techniques, with onlay and sublay approaches being widely used. This study aimed to compare the outcomes of these two techniques in terms of postoperative recovery, complication rates, and recurrence.

Material and methods: A prospective observational study was conducted at the National Institute of Medical Sciences & Research Hospital, Jaipur. A total of 140 patients were randomized into two groups: onlay (n=70) and sublay (n=70) mesh repair. Data were collected on operative time, postoperative complications (pain, wound infections, seroma, hematoma), length of hospital stay, and recurrence.

Result: The sublay repair technique demonstrated several advantages over the onlay approach. Seroma formation was significantly lower in the sublay group (10.8%) compared to the onlay group (29.3%). ASEPSIS scores showed satisfactory wound healing in 90.0% of sublay patients versus 70.0% of onlay patients. Hospital stay was shorter in the sublay group (3.60 ± 1.63 days vs. 4.16 ± 1.72 days; $p = 0.047$), and recurrence rates were also lower (2.7% vs. 7.3%). While sublay repair required longer operative times, it resulted in better pain management, with fewer patients reporting severe pain ($p = 0.001$).

Conclusion: Sublay mesh repair offers significant advantages in reducing postoperative complications, enhancing wound healing, and lowering recurrence rates compared to the onlay technique. Despite its longer operative time, sublay repair emerges as a preferred approach for ventral hernia management, emphasizing the importance of personalized surgical planning.

Keywords: Ventral hernia, Sublay repair, Onlay repair, Mesh repair, Postoperative outcomes, Recurrence

Introduction

The word “hernia” is derived from the Latin word meaning rupture [1]. A hernia is a medical condition where an organ or fatty tissue pushes through a weakness or opening in the muscle or surrounding connective tissue that normally holds it in place. Most commonly, hernias occur in the abdominal area**,** but they can also develop in the upper thigh, groin, and belly button [2]. A hernia is often not immediately life-threatening, but it can lead to complications if left untreated, including pain, discomfort, and, in some cases, incarceration or strangulation of internal organs, which can be life-threatening [3].

The abdominal wall consists of several layers of muscles, fascia, and tissues that protect internal organs [4]. When there is an abnormality or weakness in any of these layers, it can cause a protrusion of an organ or tissue through the opening. This protrusion forms the hernia**.** Hernias can be congenital, meaning they are present at birth, or acquired, resulting from factors such as aging, surgery, or trauma [5].The management of ventral abdominal wall hernias includes both non-surgical and surgical strategies, tailored to the patient’s symptoms, hernia characteristics, and overall health. Non-surgical options, such as watchful waiting or abdominal binders, are typically reserved for asymptomatic patients or those unfit for surgery, though they carry risks like incarceration. Definitive treatment involves surgical repair, with open or laparoscopic techniques chosen based on hernia size and complexity. Mesh reinforcement has significantly reduced recurrence, with sublay and onlay methods offering distinct benefits and drawbacks. Advanced techniques are used in complex or recurrent cases for optimal outcomes [6].

DOI: 10.69605/ijlbpr_14.5.2025.22

Materials and methods

This prospective observational study was conducted in the Department of General Surgery at the National Institute of Medical Sciences & Research Hospital, Jaipur, Rajasthan, over a period of 18 months. The primary aim was to compare clinical outcomes between patients undergoing sublay versus onlay mesh repair for ventral abdominal hernias.To accommodate for an estimated 20% attrition rate, the calculated sample size was adjusted to include 70 patients in each group. A total of 140 patients were finally enrolled and equally divided into:

Group A: Sublay mesh repair (n = 70)

Group B: Onlay mesh repair (n = 70)

Inclusion Criteria

All radiologically proven cases of Ventral abdominal hernias reporting and getting operated in the department of general surgery in NIMS hospital.

Hernias with defect of >2cm.

Exclusion Criteria

Cases of strangulated and obstructed hernias.

Patients of <18years of age.

Cases of recurrent hernias.

Patient refusing consent.

Patient Enrollment and Initial Assessment: Eligible participants were recruited consecutively. Each patient underwent detailed clinical history taking with emphasis on comorbidities, lifestyle factors, and symptom duration. A thorough physical examination was conducted followed by routine laboratory investigations including complete blood count, liver and renal function tests, lipid profile, ESR, blood glucose levels, and electrocardiogram.

Radiological Evaluation: Ultrasonography was performed initially, and contrast-enhanced computed tomography (CECT) was used when detailed anatomical assessment of the hernia defect was necessary.

Group Allocation and Randomization: After initial evaluation, patients were randomly assigned to either Group A or Group B using the Sequentially Numbered, Opaque, Sealed Envelope (SNOSE) technique to ensure unbiased allocation.

Surgical Intervention: The operating technique was determined by the randomization group:

Sublay Mesh Repair: The mesh was placed in the retromuscular (preperitoneal or retrorectus) plane beneath the rectus abdominis muscle.

Onlay Mesh Repair: The mesh was positioned above the anterior rectus sheath after closure of the hernia defect.

All procedures were carried out by experienced surgeons following standard operative protocols.

Intra operative and Perioperative Data Collection: Details such as operative duration, intraoperative bleeding, and immediate surgical complications were recorded. Anesthetic parameters and need for conversion or adjunctive procedures were also documented.

Postoperative Management: Patients were monitored in the postoperative unit until they regained bowel and bladder function and were ambulatory. Postoperative analgesia, antibiotics, and wound care protocols were standardized. Complications such as surgical site infection, seroma, hematoma, and early recurrence were assessed during the hospital stay.

Follow-upand Outcome Evaluation: Participants were followed at 1 week, 1 month, 3 months, and 6 months post-surgery. Each visit included physical examination of the operative site, pain assessment using the Visual Analogue Scale (VAS), and evaluation for wound complications. The ASEPSIS wound scoring system was employed to quantify wound healing. Any signs of recurrence were documented and confirmed by ultrasonography if clinically suspected.

Statistical Analysis

Collected data were compiled in Microsoft Excel and analyzed using IBM SPSS Statistics software version 28.0 (Chicago, IL, USA). Categorical variables were expressed as frequencies and percentages, while continuous variables were reported as mean ± standard deviation or median with interquartile range depending on normality. Group comparisons were conducted using the Chi-square test for categorical variables and independent samples t-test or Mann–Whitney U test for continuous data. The Kolmogorov–Smirnov test was used to assess normal distribution. A p-value of <0.05 was considered statistically significant.

Results

The comparison of baseline demographic characteristics between the Sublay and Onlay hernia mesh repair groups showed no significant difference in age distribution, with patients evenly distributed across age groups in both cohorts ($p=0.911$). However, a notable disparity was observed in gender distribution, where males were significantly more represented in the Onlay group (62.9%) compared to the Sublay group (34.1%; $p=0.027$). Body Mass Index (BMI) was significantly higher in the Onlay group (25.54 ± 2.76 kg/m²) than in the Sublay group (24.38 ± 2.52 kg/m²; $p<0.001$). Social habits differed significantly between the two groups. Smoking was reported by 25.7% of patients in the Onlay group compared to only 11.4% in the Sublay group

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(p=0.008). Alcohol consumption followed a similar trend, with 30.0% of Onlay patients reporting alcohol use compared to 8.6% in the Sublay group (p=0.001). The presence of comorbid conditions such as diabetes, hypertension, chronic obstructive pulmonary disease (COPD), and coronary artery disease (CAD) was significantly higher in the Onlay group. For example, diabetes was reported in 25.7% of Onlay patients compared to 5.7% in the Sublay group (p=0.001). In contrast, 68.6% of Sublay patients had no chronic diseases compared to 35.7% in the Onlay group, indicating a healthier baseline profile in the Sublay cohort (**Table 1**).

The operative time was significantly longer for the Sublay group, averaging 48.31 ± 8.58 minutes, compared to 40.64 ± 4.62 minutes in the Onlay group (p<0.001). However, the length of hospital stays (LHS) was shorter for Sublay patients (3.60 ± 1.63 days) compared to Onlay patients (4.16 ± 1.72 days; p=0.047). These results reflect a trade-off between operative duration and recovery time, potentially favouring Sublay for faster recovery
(**Table 2**).

Postoperative pain severity, measured by the Visual Analog Scale (VAS), revealed significant differences between groups. The Sublay group had fewer cases of severe and worst pain compared to the Onlay group. Notably, 42.9% of Sublay patients reported moderate pain, while the Onlay group had a slightly higher prevalence of mild pain (48.6%; p=0.001). This suggests that while both techniques achieve effective pain management, Sublay may offer better outcomes in reducing extreme pain experiences (**Table 3**).

Postoperative complications were more common in the Onlay group. Wound infections occurred in 15.7% of Onlay patients compared to 5.7% in the Sublay group, though this difference was not statistically significant (p=0.057). ASEPSIS scoring showed a higher rate of satisfactory healing in the Sublay group (90.0%) compared to the Onlay group (70.0%; p=0.005). Additionally, hematoma formation was similar in both groups (p=0.314), but the overall trend indicates better postoperative wound healing outcomes with Sublay (**Table 4**).

At 3- and 6-month follow-up, seroma formation was significantly more frequent in the Onlay group (29.3%) compared to the Sublay group (10.8%; p=0.045). This difference highlights a potential advantage of the Sublay technique in minimizing fluid accumulation post-surgery, which is critical for long-term recovery .Recurrence rates were low for both groups and showed no significant difference. In the Sublay group, recurrence was 2.70%, while in the Onlay group, it was 7.31% (p=0.359). (**Table 5**).

Table 1: Comparison of Baseline Characteristics of Sublay and Onlay Hernia Mesh Repair Groups (N = 140)

Variables	Sublay (n = 70)	Onlay (n = 70)	p-value
Age (years), n (%):			0.911
≤ 36	17 (19.3%)	22 (31.4%)	
37 to 47	18 (20.5%)	9 (12.9%)	
48 to 68	18 (20.5%)	24 (34.3%)	
≥ 69	17 (19.3%)	15 (21.4%)	
Gender, n (%):			0.027
Male	30 (34.1%)	44 (62.9%)	
Female	40 (45.5%)	26 (37.1%)	
BMI (kg/m²), Mean ± SD	24.38 ± 2.52	25.54 ± 2.76	<0.001
Smoking, n (%):			0.008
Yes	8 (11.4%)	18 (25.7%)	
No	62 (88.6%)	52 (74.3%)	
Alcohol, n (%):			0.001
Yes	6 (8.6%)	21 (30.0%)	
No	64 (91.4%)	49 (70.0%)	
Comorbidities, n (%):			0.001
Diabetes	4 (5.7%)	18 (25.7%)	
Hypertension	8 (11.4%)	11 (15.7%)	
COPD	6 (8.6%)	10 (14.3%)	
CAD	4 (5.7%)	6 (8.6%)	
None	48 (68.6%)	25 (35.7%)	

Table 2: Outcome Variable Comparison between Sublay and Onlay Hernia Mesh Repair Groups (N = 140)

Variables	Sublay (n = 70)	Onlay (n = 70)	p-value
Length of Hospital Stay (LHS) (days), Mean ± SD	3.60 ± 1.63	4.16 ± 1.72	0.047
Types of Hernias, n (%):			0.524
Epigastric	9 (12.9%)	3 (4.3%)	

DOI: 10.69605/ijlbpr_14.5.2025.22

Incisional	5 (7.1%)	17 (24.3%)	
Paraumbilical	27 (38.6%)	20 (28.6%)	
Supraumbilical	6 (8.6%)	16 (22.9%)	
Umbilical	23 (32.9%)	14 (20.0%)	
Defect Size (cm), Mean ± SD	4.73 ± 1.15	4.70 ± 1.25	0.835
Operative Time (min), Mean ± SD	48.31 ± 8.58	40.64 ± 4.62	<0.001

Table 3: Comparison of Post-Operative Pain Severity between Sublay and Onlay Hernia Mesh Repair (N = 140)

VAS Pain Category, n (%)	Sublay (n = 70)	Onlay (n = 70)	p-value
No pain	12 (17.1%)	4 (5.7%)	
Mild pain	26 (37.1%)	34 (48.6%)	
Moderate pain	30 (42.9%)	27 (38.6%)	
Severe pain	2 (2.9%)	4 (5.7%)	
Worst pain	0 (0.0%)	1 (1.4%)	0.001

Table 4: Comparison of Post-Operative Complications between Sublay and Onlay Hernia Mesh Repair (N = 140)

Variables	Sublay (n = 70)	Onlay (n = 70)	p-value
Wound Infection, n (%):			0.057
Yes	4 (5.7%)	11 (15.7%)	
No	66 (94.3%)	59 (84.3%)	
ASEPSIS Category, n (%):			0.005
Satisfactory healing (0–10)	63 (90.0%)	49 (70.0%)	
Disturbance healing (11–20)	4 (5.7%)	12 (17.1%)	
Minor wound infection (21–30)	3 (4.3%)	6 (8.6%)	
Moderate wound infection (31–40)	0 (0.0%)	2 (2.9%)	
Severe wound infection (>40)	0 (0.0%)	1 (1.4%)	
Hematoma Formation, n (%):			0.314
Yes	7 (10.0%)	11 (15.7%)	
No	63 (90.0%)	57 (84.3%)	

Table 5: Comparison of Post-Operative Seroma Formation and Recurrence between Sublay and Onlay Hernia Mesh Repair at 3- and 6-Month Follow-Up

Variables	Sublay (n = 37)	Onlay (n = 41)	p-value
Seroma Formation, n (%):			0.045
Yes	4 (10.8%)	12 (29.3%)	
No	33 (89.2%)	29 (70.7%)	
Recurrence, n (%):			0.359
Yes	1 (2.70%)	3 (7.31%)	
No	36 (97.30%)	38 (92.69%)	

Discussion

The comparative evaluation of Onlay and Sublay mesh repair techniques for ventral abdominal wall hernias reveals notable differences in their application and outcomes. The similarity in age distribution between the two groups underscores that both methods can be applied across a wide range of age groups, making them versatile choices for ventral hernia repair. However, the predominance of males in the Onlay group suggests that certain anatomical or procedural preferences might influence the selection of this technique [7]. Additionally, the Onlay group demonstrated a higher average body mass index (BMI), suggesting its adaptability in patients with elevated BMI levels. This observation aligns with existing evidence by Clark et al., 2017 indicating that increased abdominal wall tension due to adiposity may make the Onlay method more practical [8].

Patients undergoing Onlay repair displayed higher prevalence rates of comorbid conditions, such as diabetes and hypertension, compared to those in the Sublay group. This higher overall risk profile could partially explain the choice of the Onlay technique in this population, as it may offer a simpler and faster surgical approach. Notably, the prevalence of diabetes in the Onlay group was approximately 26% compared to only 6% in the Sublay group, while hypertension affected about 16% of the Onlay group compared to 11% of the Sublay group contrasting with a literature by Pereira C et al., 2018 [9]. These disparities highlight the importance of tailoring surgical techniques to the unique clinical presentations and risk factors of individual patients.

DOI: 10.69605/ijlbpr_14.5.2025.22

Operative time emerged as a distinguishing factor between the two techniques. The Sublay technique, characterized by the placement of the mesh beneath the abdominal muscles, required a longer operative time due to its technical complexity. This increased duration reflects the meticulous dissection and precise placement involved in Sublay repairs, making them more demanding for surgeons [10].

Postoperative recovery outcomes favoured the Sublay approach in several key aspects. Patients who underwent Sublay repair experienced shorter hospital stays [11], indicating a faster overall recovery process. This benefit is likely attributable to the deeper placement of the mesh, which minimizes irritation to superficial tissues and nerves, leading to reduced postoperative pain and quicker mobilization. The assessment of pain using the Visual Analog Scale (VAS) revealed that patients in the Sublay group reported less severe pain compared to those in the Onlay group. These findings are consistent with prior studies that have demonstrated reduced nerve irritation and improved pain management outcomes with deep mesh placement techniques [9].

The frequency of wound-related complications also varied between the two methods. While both techniques demonstrated a commendable safety profile, the Sublay group exhibited lower rates of complications such as seroma formation and wound infections. Seroma, characterized by fluid accumulation at the surgical site, was observed in approximately 10% of Sublay repairs compared to nearly 30% of Onlay repairs [12]. This significant reduction underscores the advantage of Sublay mesh placement in minimizing fluid-related complications. Similarly, wound infection rates, although not statistically significant, were slightly higher in the Onlay group, suggesting that the Sublay technique may create a more favourable environment for wound healing. These observations align with findings from Clark et al., who noted reduced infection rates and better healing outcomes with deeper mesh placement techniques [8].

The occurrence of hematoma, although relatively uncommon, was slightly higher in the Onlay group. This could be attributed to the superficial placement of the mesh, which may disrupt smaller blood vessels and increase the likelihood of localized bleeding. In contrast, the deeper placement in Sublay repairs appears to mitigate this risk. The implications of these differences extend beyond immediate postoperative care, as reduced complications translate into improved patient satisfaction and lower healthcare costs [13].

The assessment of recurrence rates provided additional insights into the long-term effectiveness of both techniques. Recurrence, a critical outcome measure in hernia repair, was low in both groups, indicating the durability of both methods when applied to uncomplicated cases. Specifically, the Sublay group reported a recurrence rate of approximately 2.7%, compared to 7.3% in the Onlay group. Although this difference was not statistically significant, it underscores the potential of the Sublay technique to provide a more robust and lasting repair.

Several studies showed recurrence after inguinal hernia (IH) repair is influenced by several factors. Patient-related factors include advanced age, elevated BMI, the presence of chronic illnesses, diabetes mellitus, and engaging in early physical activity post-surgery [14].

Hospital stay duration, an important measure of recovery efficiency, also favoured the Sublay approach. Patients in the Sublay group typically required fewer days of hospitalization, with most being discharged within three to four days post-surgery. In contrast, patients in the Onlay group often required longer stays, averaging four to five days. This difference underscores the economic and logistical advantages of the Sublay technique, as shorter hospital stays reduce healthcare costs and improve patient turnover rates [11].

Conclusion

The comparative analysis of Sublay and Onlay hernia mesh repair techniques highlights distinct differences in outcomes, with the Sublay technique demonstrating several advantages over the Onlay approach. Sublay repair resulted in better postoperative outcomes, including significantly reduced seroma formation, fewer wound infections, and higher rates of satisfactory healing. Additionally, patients in the Sublay group experienced shorter hospital stays, less severe postoperative pain, and lower recurrence rates, indicating a faster, less painful recovery process with better long-term outcomes.

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DOI: 10.69605/ijlbpr_14.5.2025.22

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