DOI: https://doi.org/10.54393/pjhs.v6i4.2901

PAKISTAN JOURNAL OF HEALTH SCIENCES
(LAHORE)
https://thejas.com.pk/index.php/pjhs
ISSN (E): 2790-9352, (P): 2790-9344
Volume 6, Issue 04 (April 2025)

Original Article

OPEN ACCESS

Comparison of the Outcomes of On-Lay and Sub-Lay Mesh Repair in Patients with Ventral Abdominal Wall Hernias

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ARTICLE INFO

Keywords:
Ventral Hernia, Abdominal Wall Hernia, Mesh Repair, On-Lay Technique, Sub-Lay Technique

How to Cite:
Tahir, A. A., Subhan, A., Bakhtiar, N., Ishfaq, M., Farooq, M., & Tayyeb, M. (2025). Comparison of the Outcomes of On-Lay and Sub-Lay Mesh Repair in Patients with Ventral Abdominal Wall Hernias:On-Lay and Sub-Lay Repair in Ventral Hernias.Pakistan Journal of Health Sciences, 6(4), 210-215. https://doi.org/10.54393/pjhs.v6i4.2901

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Received date: 23rd February, 2025
Revised date: 26th March, 2025
Acceptance date: 23rd April, 2025
Published date: 30th April, 2025

ABSTRACT

Hernias of the ventral abdominal wall are a frequent surgical problem that has to be repaired well to reduce complications and recurrence. **Objective:** To determine which method yields better clinical outcomes. **Methods:** In two groups of 40 individuals, 80 patients with ventral abdominal wall hernias had the results of Onlay and Sublay mesh repair compared. This prospective study, conducted at Prime Teaching Hospital/Kuwait Teaching Hospital (Peshawar Medical College) from June to December 2024. Data analysis was conducted using SPSS version 23.0 with a significance level of $p < 0.05$. **Results:** The mean age of patients was 43.13 ± 11.76 years, among them 62.5% were male. Among this 64% had midline ventral hernias. Patients undergoing Sublay mesh repair experienced significantly lower wound infections (5% vs. 15%, $p < 0.05$) and less seroma formation (4.61% vs. 20%, $p < 0.05$) as compared with the Onlay group, notably, the study also found that the duration of hospital stay was significantly longer for the Onlay group compared to the Sublay group ($p < 0.05$). The sublay technique showed zero recurrence cases (0%), while the On-lay technique had six cases (15%) with statistically significant ($p < 0.05$). **Conclusions:** Sublay mesh repair demonstrates distinguishing clinical outcomes over Onlay mesh repair, with lower infection rates, less seroma formation, and shorter hospital stays. The findings suggest that Sublay mesh repair should be preferred for ventral abdominal wall hernias to minimize patient morbidity and improve recovery.

INTRODUCTION

Hernia is a considerable most common surgical conditions, potentially leading to impairment, hospitalization, and the need for surgery [1]. An incisional hernia in the ventral abdominal wall is a defect in the abdominal wall's musculoskeletal layers along the surgical scar [2]. Abdominal content protrusion is a result of weakening muscles along prior surgical scars, which causes incisional hernias, a kind of ventral abdominal wall hernia. These hernias may cause strangling, infection, intestinal blockage, and persistent discomfort, all of which call for prompt surgical surgery. Although mesh-based treatments have advanced, the recurrence rate following surgical repair is still a significant issue, ranging from 10% to 30% [2, 3]. This covers epigastric, para-umbilical, inguinal, and umbilical hernias. Incisional hernias are another forms of ventral hernia that affects 15-20% of patients undergoing laparotomy [3]. Despite the increasing incidence of surgical repair, surgeons continue striving to reach "perfect results," and the rate of surgical failure remains significant 10 to 30 percent [4]. A growing amount of controversy surrounds the optimal incisional hernia repair technique [5]. In surgical clinics, ventral hernias are diagnosed most frequently. According to a Danish study, 0.53% of prevalence of an umbilical hernia within five years. Incisional hernias can occur up to 11% of the time following major abdominal surgery [6]. According to their site infection specifically on these abnormalities of the abdominal wall might be classified as congenital,

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acquired, or spontaneous. As a result, umbilical hernias happen at the umbilicus, whereas epigastric hernias happen from the xiphoid process to the umbilicus. The least common spontaneous hernias that occur below the navel in the midline are paraumbilical and hypogastric hernias [7]. One of the most major problems in mesh repair is mesh placement. According to reports, certain procedures are linked to notably elevated incidence of certain consequences, including wound infection, fistula, and recurrence [8]. After incisional ventral hernias are repaired, there is still a significant chance of infection and recurrence, even with advancements in surgical technique and prosthetic technologies [ ]. Although many methods for hernioplasty and repair have been identified, tension-free mesh insertion is currently a common procedure with two types of mesh plasty: Onlay and Sublay [9]. The surgical results are greatly impacted by the decision between these two methods. Seroma development, recurrence, and wound infection have all been linked to Onlay mesh repair, in which the mesh is positioned above the rectus sheath. By placing the mesh in the preperitoneal area, Sublay mesh repair, on the other hand, offers superior reinforcement and reduces postoperative problems. The best method for repairing a ventral hernia must be determined by comparing various options [10]. The incidence of mesh repair-related wound complications and post-operative wound infections is intended to further investigate the most effective way to manage these hernias [11]. Whereas Onlay mesh repair places the replacement mesh between the anterior rectus sheath and the abdominal wall's subcutaneous tissues, Sublay mesh repair places it in the preperitoneal plane created between the rectus muscle and the posterior rectus sheath [12]. According to a number of studies, the mesh's placement has a significant impact on the results of surgery. Because Onlay mesh is positioned closer to subcutaneous tissues, research suggests that it is linked to an increased risk of wound infection, seroma development, and recurrence. On the other hand, Sublay mesh repair provides superior strengthening, a decreased risk of infection, and a lower recurrence rate since the mesh is placed in the preperitoneal area. Comparative research has demonstrated that the Sublay approach improves long-term hernia repair success rates and reduces complications [13]. Although, one of the benefits of the latter method is that, because the mesh is located deep within the preperitoneal plane, it prevents the spread of infection from subcutaneous tissues [12]. In terms of recurrences, databases and reviews indicate that open mesh repair is superior to suture repair. Whereas there is insufficient evidence to determine which mesh type or position (on- or Sublay) should be used [14]. There is also differences over which technique is better after adhering closely to the principles of incisional hernia repair [15]. The use of prosthetic mesh to treat incisional hernias has increased recently due to the high recurrence rates linked to primary suture repair. By 1999, 65.5% of incisional hernia surgeries included synthetic mesh, up from 34.2% in 1987. Mesh is now the accepted standard of treatment for incisional hernia repair, according to the American Hernia Society [16]. The concept that acute fascial separation early in the postoperative phase causes delayed clinical development of abdominal wall incisional hernias is currently supported by the bulk of studies [17]. In current study, people who had incisional hernia repair in the local setup including Onlay and Sublay were assessed the results of two common mesh deployment methods [15].

This study aimed to compare the outcomes of Onlay and Sublay mesh repair techniques to determine which approach results for better clinical outcomes.

METHODS

Between June and December of 2024, this prospective study was carried out in the general surgery department of Prime Teaching Hospital/Kuwait Teaching Hospital (Peshawar Medical College). A computer-generated random sequence was used to allocate patients to either the Onlay or Sublay groups in a straightforward randomization procedure. This reduced selection bias by ensuring an impartial patient distribution between the two groups. Prime Foundation's ethical committee granted this permission, which has the IRB permission Number Prime/IRB/2024-1094. Before being included in the study, all patients gave their written informed consent. A total of 80 patients were included in this study confirmed diagnosed with ventral abdominal wall hernias. All eligible patients who met the inclusion criteria during the research period were enrolled using a sequential sampling approach. By ensuring that the sample is representative of the normal patient population having ventral hernia surgery, this approach reduces selection bias and increases the repeatability of the study. The sample size calculation was based on existing literature, aiming to detect a 20% difference in postoperative complications between Onlay and Sublay mesh repair techniques. Assuming a 95% confidence interval ($\alpha = 0.05$) and 80% power, a minimum of 20 patients per group, totaling 40 patients, was deemed sufficient.

The sample size was calculated using the formula:

$n=(Z\alpha/2+Z\beta)2\times[p1(1-p1)+p2(1-p2)]/(p1-p2)2$

Where:

$Z_{\alpha/2}$=1.96Z_{\α/2} = 1.96Zα/2=1.96 for a 95% confidence interval,

Z^{β}=0.84Z_{\β}=0.84Zβ=0.84 for 80% statistical power,

p_1p_1p_1(expected complication rate in Onlay repair)=30%,

p_2p_2p_2(expected complication rate in Sublay repair)=10%.

This computation indicated that a minimum of 40 participants each group, or 80 patients overall, were

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needed. In order to ensure that the sample size was sufficient to identify clinically significant changes, the effect size was calculated using prior research on mesh repair results. Given the study's single-center context, the sample size was appropriate. Patients in Group 1 had Onlay mesh repair, which involved placing the prosthetic mesh between the subcutaneous tissues and the anterior rectus sheath. Group 2 included patients with Sublay mesh repair, with the mesh placed in the preperitoneal plane between the rectus muscle and the posterior rectus sheath. Baseline parameters, such as age, gender, comorbidities (including diabetes and hypertension), BMI, smoking status, and hernia size, were evaluated prior to surgery in order to guarantee comparability between the two groups. In terms of these factors, there were no discernible variations between the groups, guaranteeing that results were unaffected by pre-existing discrepancies. In addition to recording comorbidities based on patient history and medical records, the size of the hernia was evaluated preoperatively using clinical examination and ultrasound where required. Patients were included based on clinical assessment, and in cases of diagnostic uncertainty, CT scans were performed to confirm the diagnosis. All patients underwent preoperative anesthetic evaluation to assess their surgical fitness. In all cases, synthetic, lightweight, non-absorbable mesh was used. Perioperative prophylactic antibiotics, including intravenous Tazocin and Metronidazole, were administered to all patients. Patients were monitored postoperatively for wound healing, fluid accumulation in drains, infection, and hospital stay duration. During follow-up visits, clinical examination was used to evaluate postoperative sequelae, including seroma development and wound infection. After surgery, the patients were assessed on 3-7 days, as well as 3 and 6 months later. Localized redness, swelling, purulent discharge, and fever were diagnostic criteria for infection, whereas palpable fluid collections at the surgical site or, if required, ultrasound results were used to identify seroma development. Any indications of recurrence were verified by physical examination and, if necessary, imaging tests such CT or ultrasound scans. On a designated datasheet, pertinent postoperative and clinical data were gathered. Statistical analysis was performed using SPSS software (version 23.0). The chi-square test was used to examine categorical variables, including wound infection, seroma development, and recurrence. The independent t-test was used for regularly distributed data for continuous variables, such as hospital stay and operating time, while the Mann-Whitney U test was utilized for non-normally distributed data. Before choosing the proper statistical test, the Shapiro-Wilk test was used to determine whether continuous variables were normal. Statistical significance was defined as a p-value of less than 0.05.

RESULTS

The current study comprised of a total of 80 patients with ventral abdominal wall hernias. The mean age of the participants was 43.13 ± 11.76 years, with a male predominance of 56.3% (n=45) and females comprising 43.8% (n=35). Among the patients, 64% had midline ventral hernias, while the remaining cases had a subcostal distribution. While assessing complications by gender, females exhibited a higher frequency of seroma formation (27.5% vs. 12.5%), wound infections (32.5% vs. 10%), and recurrence (27.5% vs. 7.5%), with all differences reaching statistical significance ($p < 0.05$). Mesh removal was also more frequent among female patients (17.5% vs. 5%, $p = 0.01$).

Table 1: Age and Gender Distribution of Study Participants with Statistical Significance

Age Group (Years)	Male Frequency (%)	Female Frequency (%)	Total Frequency (%)	p-value
20-30	11 (28.2)	7 (17.1)	18 (22.4)	<0.05
30-40	17 (43.6)	14 (34.1)	31(38.8)	>0.05
40-50	11 (28.2)	20 (48.8)	31 (38.8)	<0.05
Total	39 (100)	41 (100)	80 (100)	-

Spontaneous hernias were more common, accounting for 75% (n=60) of cases, while 25% (n=20) of patients presented with incisional hernias. Age-wise, the highest prevalence of hernias was observed in the 30–40 years (38.8%) and 40–50 years (38.8%) age groups. A significant gender-based difference was noted in the 20–30 years and 40–50 years age brackets ($p < 0.05$), with the latter showing a higher prevalence in females.

Table 2: Comparative Analysis of Postoperative Complications in Sublay and Onlay Surgical Techniques (n=80)

Complication	Sublay Frequency (%)	Onlay Frequency (%)	p-value
Seroma	2 (10)	10 (50)	<0.05
Infection	1 (5)	5 (25)	<0.05
Mesh Removal	0	1 (5)	>0.05
Recurrence	0	6 (30)	<0.05
Flap Necrosis	0	1 (5)	>0.05
Ileus	1 (5)	2 (10)	>0.05

The average operative time was 90 minutes for patients undergoing the Onlay technique, whereas those in the Sublay group had a significantly longer operative time ($p = 0.007$). The hospital stay was notably reduced in the Sublay group, with patients discharged on average three days earlier compared to the Onlay group ($p < 0.05$). The postoperative results revealed a statistically significant difference in complication rates between the two surgical methods. Higher incidence of wound infection (25% vs. 5%, $p < 0.05$), recurrence (30% vs. 0%, $p < 0.05$), and seroma development (50% vs. 10%, $p < 0.05$) were seen in patients in the Onlay group. The Sublay group showed better overall

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outcomes with fewer complications.Notably, mesh removal was required in 5% of Onlay patients, while no cases of mesh removal were reported in the Sublay group.

Table 3: Gender-Wise Distribution and Statistical Analysis of Postoperative Complications

Complication	Male Frequency (%)	Female Frequency (%)	p-Value
Seroma	5 (12.5)	11 (27.5)	<0.05
Infection	4 (10)	13 (32.5)	<0.05
Mesh Removal	2 (5)	7 (17.5)	0.01
Recurrence	3 (7.5)	11 (27.5)	<0.05
Necrosis	1 (2.5)	1 (2.5)	>0.05
Ileus	2 (5)	1 (2.5)	>0.05

DISCUSSION

This study compared the outcomes of Onlay and Sublay mesh repair techniques for the treatment of ventral abdominal wall hernias. The results demonstrate that Sublay mesh repair leads to significantly better postoperative outcomes than on lay mesh repair, this includes fewer cases of seroma formation, low chances of infections, reduced recurrence, and shorter hospital stays. Therefore, these findings support the growing preference for Sublay mesh placement in hernia repair, with existing literature that highlights its advantages. The lower incidence rate of postoperative complications in the Sublay group was one of the study's key findings. The Onlay group (50%) saw significantly more seroma formation than the Sublay group (10%) ($p < 0.05$). According to earlier research, putting the mesh in the preperitoneal plane reduces dead space and lowers the chance of seroma development Sevinc et al. Furthermore, wound infections were more common in the Onlay group (25%) than in the Sublay group (5%), highlighting the preventive function of Sublay implantation against problems associated to infections [18]. Another crucial factor in hernia repair is recurrence. Approximately 30% of patients who had Onlay mesh repair in this study reported recurrence, but none of the patients in the Sublay group did ($p < 0.05$). This finding is consistent with previous research indicating that Sublay mesh placement provides better reinforcement to the abdominal wall, reducing tension at the repair site and lowering recurrence rates (Ahmed and Mehboob). The anatomical positioning of the Sublay mesh likely contributes to its superior durability in hernia repair [19]. Longer for Sublay, $p = 0.007$, this benefit was exceeded benefited by a notably longer hospital stay. However, Patients who underwent Sublay repair were discharged approximately 3 days earlier than those in the Onlay group ($p < 0.05$). This statement supports previous findings that suggest Sublay repair is associated with faster recovery and shorter hospital stays with fewer complications [20]. Postoperative complications in gender-wise differences were also to be taken into consideration. Female patients had a higher frequency of seroma formation 27.5% vs. 12.5%, wound infections 32.5% vs. 10% and recurrence 27.5% vs. 7.5% as compared to male patients. While the exact reasons remain unidentified, its possible explanations include differences in soft tissue composition, hormonal differences the variations of wound healing and responses [15]. However, further research is needed to explore these gender-related differences in more depth. Chitrambalam et al., in (2019) conducted a randomized controlled trial comparing Onlay and Sublay mesh repair in 150 patients. The study found that, with a statistically significant p-value ($p = 0.001$), the Onlay group had a substantially greater rate of seroma development (20%) than the Sublay group (2.67%) [21]. Another important aspect of these findings was the gender-based variation in postoperative problems. Female patients had significantly greater rates of seroma development (27.5% vs. 12.5%), wound infections (32.5% vs. 10%), and recurrence (27.5% vs. 7.5%), all with p-value < 0.05. While the specific causes are unknown, variances in soft tissue composition, hormone variations, and unique wound healing responses may all play a role. There is a need of further follow up to address these gender inequalities and determine whether personalized surgical methods can enhance outcomes in female patients [22]. Whatever the study's benefits, it is important to take into account its limits. The findings' ability to be broadly applied may be limited by the small sample size. Furthermore, this study was observational therefore, longer periods follow up are important to assess the long-term duration of both repairing methods. Future research, particularly larger cohort studies and randomized controlled trials, can provide more evidence and help to refine surgical guidelines for ventral hernia repair. Based on these useful insights the study obtained some crucial results; several limits must be noted. A stratified analysis considering these variables is recommended in subsequent research. Based on these findings, several recommendations were proposed for clinical practice and future research. However, training programs for surgeons should emphasize proper techniques for Sublay placement to ensure consistency in outcomes. To validate these results, future studies should concentrate on bigger, multi-center randomized controlled trials. Furthermore, examining the influence of patient-specific factors, including obesity, diabetes, and history of previous hernia repairs, on surgical outcomes would enable a more personalized and tailored approach to hernia management, ultimately optimizing patient care. Finally, advancements in biomaterials and surgical techniques, including minimally invasive approaches, should be explored to further improve the efficacy and safety of hernia repair procedures.

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CONCLUSIONS

This study demonstrated that Sublay mesh repair offers superior clinical outcomes compared to Onlay mesh repair for ventral abdominal wall hernias. Sublay repair was associated with lower rates of infection, seroma, recurrence, and shorter hospital stays. These findings suggest that Sublay mesh placement is more effective in reducing surgical morbidity and enhancing patient recovery. However, further studies with larger sample sizes and longer follow-up are needed to confirm long-term benefits and assess potential complications such as chronic pain or mesh-related issues.

Authors Contribution

Conceptualization: AAT
Methodology: AAT, MF
Formal analysis: MS, NB, MF, MT
Writing, review and editing: AAT, MS, NB, MI, MF, MT
All authors have read and agreed to the published version of the manuscript

Conflicts of Interest

All the authors declare no conflict of interest.

Source of Funding

The author received no financial support for the research, authorship and/or publication of this article.

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