

COMPARISON OF INTRAOPERATIVE TIME, WOUND INFECTION AND SEROMA FORMATION IN PATIENTS UNDERGOING SUBLAY VERSUS ONLAY MESH HERNIOPLASTY FOR VENTRAL HERNIA

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Abstract

Objective: To compare the outcome of sublay versus onlay mesh hernioplasty for primary ventral hernia in terms of frequency of seroma formation, wound infection and mean operative time. **Methodology:** This randomized controlled trial was conducted at North Surgical Ward, King Edward Medical University/Mayo Hospital, Lahore, over six months. A total of 140 patients aged 18–60 years with primary ventral hernia were randomly assigned to undergo either sublay (n=70) or onlay (n=70) mesh repair. Patients with obesity, strangulated hernia, or comorbidities affecting wound healing were excluded. Postoperative outcomes including seroma formation (assessed by ultrasound), wound infection (graded via Southampton system), and operative time were compared. **Results:** Seroma formation occurred in 2.9% of sublay cases versus 17.1% in onlay (p = 0.005). Wound infections were observed in 7.1% of sublay and 17.1% of onlay patients (p = 0.070). Mean operative time was significantly longer in the sublay group (82.24 ± 7.30 minutes) compared to the onlay group (73.70 ± 7.38 minutes) (p < 0.001). Stratified analysis revealed significantly fewer seromas and infections among sublay patients across most subgroups. **Conclusion:** Sublay mesh hernioplasty is associated with significantly reduced seroma formation and a trend toward fewer wound infections compared to onlay repair, albeit with longer operative time. These findings support the use of sublay technique for safer postoperative outcomes.

INTRODUCTION

Ventral hernia of the abdominal wall is a fascial defect of the anterolateral abdominal wall, leading to intermittent or continuous protrusion of intra-abdominal or preperitoneal contents. It includes umbilical, paraumbilical and epigastric hernias. Ventral hernias can be classified as primary which are nonincisional and secondary which include acquired,

incisional and recurrent hernias.¹ Ventral hernia is a quite commonly encountered surgical problem with an estimated incidence of about 15-20%. It is also evident from clinical data that about 52% of incisional hernias occur 6 months after the surgery, owing to excessive tension and insufficient healing of the previous incision.² Repair of ventral hernia is

among the most frequently performed surgical procedures worldwide.³ The recurrence of hernias, often regarded as the most daunting complication for surgeons, substantially elevates healthcare costs and intensifies the overall economic burden. Various techniques have been used for the repair of ventral hernia, for instance onlay, sublay and sandwich technique.⁴ Current clinical data favours a few aspects of each of these procedures separately.⁵

Raghuveer et al. elaborates that sublay mesh placement is more effective/safe than onlay placement, demonstrating a lower complication rate with the sublay technique. Specifically, the recurrence rate in the sublay group was 4.35% compared to 8.51% in the onlay group, though this difference was not statistically significant ($p>0.05$). Importantly, the mean postoperative hospital stay was significantly shorter for the sublay group at 4.8 ± 1.51 days, compared to 6.68 ± 1.46 days for the onlay group ($p<0.05$). Additionally, while the sublay technique had a longer mean surgery duration of 72.3 ± 9.23 minutes compared to 65.25 ± 10.58 minutes for the onlay group, this difference was statistically significant ($p<0.05$). Crucially, the incidence of postoperative complications such as seroma and wound infection was significantly lower in the sublay group, at 6.52% and 4.35% respectively, compared to 21.30% and 19.20% in the onlay group ($p<0.05$). These findings suggest that the sublay technique not only reduces the risk of complications but also promotes a quicker recovery, highlighting its potential as the preferred method for primary ventral hernia repair.⁶

According to a multicenter Hungarian trial, onlay mesh repair demonstrated superior outcomes in large hernias, but this benefit came at the cost of increased postoperative infection rates compared to sublay repair.⁷ Moreover, in our country onlay method is the most commonly performed procedure because it is comparatively easier for the junior and trainee surgeons.⁸

As there is still a lack of consensus regarding the best choice for mesh placement,⁹ aims of the study to compare sublay (retromuscular) and onlay (anterior rectus sheath) mesh hernioplasty techniques by evaluating seroma formation, intraoperative time, wound infection rates. By determining which method provides better outcomes in these key areas, we can significantly improve patient care. If sublay mesh

hernioplasty proves to be superior, it would lead to fewer postoperative complications, shorter recovery times, and overall better patient satisfaction. Furthermore, these improvements would enhance healthcare efficiency by reducing surgery duration, minimizing hospital stays, and lowering overall costs.

METHODOLOGY

This randomized controlled trial was conducted at the North Surgical Ward, King Edward Medical University/Mayo Hospital, Lahore, over a period of six months following the approval of the synopsis (Oct 2024 to March, 2025). The study aimed to compare the outcomes of sublay versus onlay mesh hernioplasty in patients undergoing surgery for primary ventral hernia, specifically evaluating postoperative seroma formation, wound infection, and mean operative time.

A total of 140 participants were included, with 70 in each arm of the trial. The sample size was calculated using the WHO sample size calculator, factoring in an anticipated seroma rate of 6.52% for sublay and 21.3% for onlay mesh repairs, with a power of 80% and a significance level of 5%. Inclusion criteria included adult patients aged 18–60 years of either gender with a primary ventral hernia (umbilical or paraumbilical) greater than 2 cm, diagnosed via ultrasound and confirmed by a consultant radiologist. Patients were excluded if they had obesity ($BMI >30$), strangulated hernias, co-morbid conditions interfering with wound healing (e.g., diabetes mellitus, HCV, HBV), were undergoing chemotherapy or radiotherapy, or had chronic illnesses like chronic renal failure, tuberculosis, or HIV.

After obtaining ethical approval and written informed consent, eligible patients admitted through the outpatient department were enrolled. Patient demographic and clinical information was recorded on a predesigned proforma. Patients were randomly allocated into two groups using the lottery method. Group S underwent sublay mesh repair, while Group O underwent onlay mesh repair. All surgeries were performed by consultant surgeons. The onlay mesh repair technique involved dissection and reduction of the hernial sac followed by closure of the fascial defect. A prolene mesh (6×11 cm or 15×15 cm based on defect size) was placed on the anterior rectus

sheath and secured with sutures or staples. In contrast, the sublay mesh repair technique involved placement of the mesh beneath the rectus muscles but above the posterior rectus sheath or peritoneum after reduction and closure of the defect.

Operative time, defined as the duration from skin incision to skin closure, was recorded in minutes. A drain was placed in all cases and removed once the output dropped below 25 ml. A baseline ultrasound was conducted after drain removal, followed by another ultrasound on postoperative day 3 to assess for seroma formation. Seroma was defined as a postoperative collection of serous fluid greater than 15 ml, measured on ultrasound and aspirated accordingly. Wound infection was evaluated on postoperative days 3 and 7, based on clinical signs of inflammation and graded using the Southampton grading system. Data were analyzed using SPSS version 26.

RESULTS

Table 1 summarizes the demographic and clinical profiles of the 140 patients enrolled in the study,

providing a detailed overview of their age distribution, gender, hernia type, and defect size. The gender distribution showed that a slightly higher proportion of the participants were female subjects 53.6% (n = 75), while males were 46.4% (n = 65). In terms of age distribution, the sample was nearly evenly split: 50.7% (n = 71) were in the 18–40 year age group, whereas 49.3% (n = 69) were aged between 41–60 years. The average age of the study population was 39.82 ± 12.58 years, indicating a wide age range among participants, indicating a broad age range within the study population. Regarding the type of hernia, umbilical hernias were slightly more prevalent, affecting 52.9% (n = 74) of patients, while 47.1% (n = 66) had paraumbilical hernias. The mean size of the hernial defect among participants was 4.13 cm with a standard deviation of ± 1.14 cm, highlighting a moderate variability in hernia sizes across the study group. These baseline characteristics provided a well-balanced distribution suitable for comparative evaluation of surgical outcomes between the sublay and onlay mesh repair groups.

Table 1: Demographic and Clinical Information of Participants (n=140)

Variable	Group	Count	Percent
Gender	Male	65	46.4%
	Female	75	53.6%
Age Group	18–40 years	71	50.7%
	41–60 years	69	49.3%
Type of Hernia	Umbilical	74	52.9%
	Paraumbilical	66	47.1%
Age (years)	Mean $\pm$ SD	39.82 $\pm$ 12.578	
Hernial Defect Size (cm)	Mean $\pm$ SD	4.134 $\pm$ 1.1416	

Table 2 outlines the comparative analysis of outcome variables between the sublay and onlay mesh hernioplasty groups. Regarding seroma formation, the sublay group had a notably lower incidence with only 2 out of 70 patients (2.9%) developing seroma, compared to 12 patients (17.1%) in the onlay group (p=0.005), indicating that the sublay technique is associated with a significantly lower risk of postoperative seroma. For wound infection, 5 patients (7.1%) in the sublay group experienced postoperative wound infections compared to 12 patients (17.1%) in the onlay group. Although the incidence was higher

in the onlay group (p = 0.070), suggesting a trend but not a conclusive association between technique and wound infection risk. In terms of mean operative time, the sublay group had a significantly longer duration of surgery, with a mean time of 82.24 ± 7.30 minutes, compared to 73.70 ± 7.38 minutes in the onlay group (p < 0.001), indicating that while sublay repair may be more time-consuming, it is potentially associated with better postoperative outcomes in terms of seroma and infection rates.

Table 2: Comparative Analysis of Outcome Variables Between Groups(n=140)

Outcome		Sublay Group (n=70)	Onlay Group (n=70)	Total (n=140)	P value ^a
Seroma Formation	Yes	2 (2.9%)	12 (17.1%)	14 (10.0%)	0.005
	No	68 (97.1%)	58 (82.9%)	126 (90.0%)	
Wound Infection	Yes	5 (7.1%)	12 (17.1%)	17 (12.1%)	.070
	No	65 (92.9%)	58 (82.9%)	123 (87.9%)	
Mean operative time(mins)		82.24 ± 7.30	73.70 ± 7.38		<0.001

^aChi square test

The table 3 examines how seroma formation and wound infection outcomes differ between the sublay and onlay hernioplasty groups across several demographic and clinical subgroups. Gender-wise, male patients in the sublay group had a significantly lower rate of seroma formation (2.6%) compared to male patients in the onlay group (22.2%), with a p-value of 0.012. Among females, 3.1% in the sublay group developed seromas versus 14% in the onlay group (p = 0.111). Age-based stratification also demonstrated significant results. Among patients aged 18-40 years, the seroma rate was 3.1% in the sublay group and 17.9% in the onlay group (p = 0.049). A similar trend was observed in the 41-60 years group, with rates of 2.6% in sublay and 16.1% in onlay (p = 0.048). When stratified by hernia type, umbilical hernias showed a significantly lower seroma incidence in the sublay group (2.6%) compared to the onlay group (22.9%) (p = 0.008). For paraumbilical hernias, although the seroma rate was lower in the sublay group (3.2%) than in onlay (11.4%) (p = 0.209). Among male patients, wound infections were significantly lower in the sublay group (5.3%)

compared to the onlay group (22.2%) (p = 0.040). Among females, infection rates were also lower in the sublay group (9.4%) than in the onlay group (14%), (p = 0.546). For the age group 18-40 years, wound infections were seen in 9.4% of sublay cases and 20.5% of onlay cases, with p = 0.197. Among 41-60 years, infections were 5.3% in sublay and 12.9% in onlay (p = 0.263); neither reached statistical significance but indicated a trend toward lower infection in sublay repairs. Umbilical hernia patients had significantly fewer wound infections in the sublay group (2.6%) compared to the onlay group (17.1%) (p = 0.032). However, for paraumbilical hernias, no significant difference was observed (12.9% in sublay vs. 17.1% in onlay, p = 0.632).

Table 3: Comparative Analysis of Outcome Variables Between Groups according by various effect modifiers(n=140)

Variable		Group	Yes (Count & %)	No (Count & %)	Total	p-value ^a
Seroma Formation	Male	Sublay	1 (2.6%)	37 (97.4%)	38	0.012
	Female	Onlay	6 (22.2%)	21 (77.8%)	27	
	Male	Sublay	1 (3.1%)	31 (96.9%)	32	0.111
	Female	Onlay	6 (14.0%)	37 (86.0%)	43	
	18-40 years	Sublay	1 (3.1%)	31 (96.9%)	32	0.049
		Onlay	7 (17.9%)	32 (82.1%)	39	
	41-60 years	Sublay	1 (2.6%)	37 (97.4%)	38	0.048
		Onlay	5 (16.1%)	26 (83.9%)	31	
	Umbilical	Sublay	1 (2.6%)	38 (97.4%)	39	0.008
		Onlay	8 (22.9%)	27 (77.1%)	35	

Wound Infection	Paraumbilical	Sublay	1 (3.2%)	30 (96.8%)	31	0.209
		Onlay	4 (11.4%)	31 (88.6%)	35	
	Male	Sublay	2 (5.3%)	36 (94.7%)	38	0.040
	Female	Onlay	6 (22.2%)	21 (77.8%)	27	
	Male	Sublay	3 (9.4%)	29 (90.6%)	32	0.546
	Female	Onlay	6 (14.0%)	37 (86.0%)	43	
	18-40 years	Sublay	3 (9.4%)	29 (90.6%)	32	0.197
		Onlay	8 (20.5%)	31 (79.5%)	39	
	41-60 years	Sublay	2 (5.3%)	36 (94.7%)	38	0.263
		Onlay	4 (12.9%)	27 (87.1%)	31	
	Umbilical	Sublay	1 (2.6%)	38 (97.4%)	39	0.032
		Onlay	6 (17.1%)	29 (82.9%)	35	
	Paraumbilical	Sublay	4 (12.9%)	27 (87.1%)	31	0.632
		Onlay	6 (17.1%)	29 (82.9%)	35	

^aChi square test

DISCUSSION:

This randomized controlled trial compared sublay and onlay mesh hernioplasty techniques in patients undergoing primary ventral hernia repair, specifically evaluating postoperative seroma formation, wound infection, and operative time. The findings indicated that sublay mesh repair was associated with a significantly lower rate of seroma formation (2.9% vs. 17.1%, $p = 0.005$) and a trend toward reduced wound infection (7.1% vs. 17.1%, $p = 0.070$), though it required significantly more operative time (82.24 ± 7.30 minutes vs. 73.70 ± 7.38 minutes, $p < 0.001$). Our results are consistent with those of Hassan et al,¹⁰ who reported a significantly lower rate of seroma formation and surgical site infection in the sublay group compared to the onlay group ($p = 0.027$ and $p = 0.035$, respectively) in a retrospective study conducted at a tertiary hospital in Ranchi, India. Similarly, Tahir et al¹¹ found that sublay mesh repair led to significantly fewer wound infections (5% vs. 15%) and seromas (4.61% vs. 20%) compared to onlay, along with a lower recurrence rate (0% vs. 15%) and shorter hospital stays ($p < 0.05$ for all outcomes). In a quasi-experimental study from Pakistan, Liaqat et al¹² observed postoperative seroma formation rates of 18.10% in the onlay group versus 4.65% in the sublay group ($p = 0.023$), reinforcing the current study's finding of reduced seroma incidence with the sublay approach. Another Pakistani study by Muhammad et al¹³ also showed zero recurrence and lower SSI (0%)

in the sublay group compared to onlay, though interestingly reported a higher seroma rate in sublay repairs (18% vs. 10%). This discrepancy may be attributed to differing surgeon expertise, mesh handling techniques, or the retrospective design of their study versus our randomized controlled design.

Contrasting results were observed in the retrospective cohort study by Shakeel et al¹⁴ who reported no significant difference in seroma (2.9% vs. 2.9%), SSI (8.6% vs. 2.9%), or operative time (median: 120 vs. 121 minutes) between sublay and onlay groups. Similarly, Farouk et al¹⁵ found that although wound infection (3.3% vs. 10%) and seroma (26.7% vs. 33.3%) rates were lower in the sublay group, the differences were not statistically significant. These findings suggest that institutional protocols, surgical proficiency, and patient selection criteria may significantly impact outcomes.

A study by Pervin et al¹⁶ conducted in a peripheral hospital setting echoed our findings. They observed more frequent seroma formation, wound infections, and recurrence in the onlay group, although not statistically significant, while the sublay group had earlier drain removal and shorter hospital stays ($p < 0.05$). These trends align well with the present study's observation that sublay repair, despite taking longer, potentially enhances postoperative recovery and reduces complications. Finally, the multicentric Hungarian trial reported by Raghuvver et al⁵ while highlighting some advantages of onlay repair in large hernias, still showed that sublay repairs were

associated with significantly fewer complications, including seroma (6.52% vs. 21.3%) and wound infection (4.35% vs. 19.2%)—findings closely mirroring our results.

Overall, the literature supports our conclusion that sublay mesh repair results in fewer postoperative complications than the onlay technique. However, the longer operative duration associated with the sublay method remains a consideration, particularly in settings with limited operating room resources or among less experienced surgeons. Nevertheless, the improved safety profile and reduced complication rates associated with sublay repair may justify the additional operative time, especially in patients at higher risk for infection or seroma.

Our study's strengths include its randomized controlled design, balanced baseline characteristics, and use of objective criteria such as ultrasound-confirmed seroma and standardized wound infection grading. However, limitations include the single-center setting, relatively short follow-up duration (limited recurrence data), and exclusion of obese and comorbid patients, which may limit generalizability. Further multicenter trials with longer follow-up are recommended to assess recurrence and cost-effectiveness comprehensively.

Conclusion:

Sublay mesh hernioplasty is associated with significantly reduced seroma formation and a trend toward fewer wound infections compared to onlay repair, albeit with longer operative time. These findings support the use of sublay technique for safer postoperative outcomes.

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