



A COMPARATIVE STUDY BETWEEN ONLAY AND SUBLAY MESH REPAIR IN THE TREATMENT OF VENTRAL HERNIAS

General Surgery

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ABSTRACT

Ventral hernias represent a significant clinical problem, often resulting in discomfort, functional impairment, and in severe cases, life-threatening complications. This study seeks to address this gap in knowledge by conducting a thorough comparative analysis of these two techniques, with the ultimate goal of improving patient care and surgical outcomes in the treatment of ventral hernias. This was single center prospective study at Department of General Surgery, Tertiary medical centre among all cases operated for ventral hernia electively over a period of 18 months. Gender of patients, associated illness, type of hernia, type of anaesthesia, history of previous surgery, intra-operative findings, POC Ileus, POC seroma, POC suture line infection or POC gaping does not influence the choice between Onlay and Sublay mesh repair techniques. There is no statistically significant difference in the ages, weight & BMI between the two groups, suggesting that this factor not influence the choice between Onlay and Sublay mesh repair techniques. There was no significant difference in duration of symptoms, duration surgery, postoperative VAS score & duration for return to regular activity among both groups. There was significantly lesser duration of hospital stay in sub-lay mesh repair as compare to on-lay mesh repair. In conclusion, the comparison between Onlay and Sublay mesh repair for hernia shows no significant differences in patient demographics, surgical factors, or most postoperative outcomes, including pain, gaping, and return to regular activity.

KEYWORDS

Ventral hernia, On-lay mesh repair, Sub-lay mesh repair

INTRODUCTION

Ventral hernias represent a significant clinical problem, often resulting in discomfort, functional impairment, and in severe cases, life-threatening complications. These hernias, which occur in the abdominal wall, can be congenital or acquired and are frequently a result of previous surgical procedures, trauma, or inherent weaknesses in the abdominal musculature. The primary concern in managing ventral hernias is ensuring a durable repair that minimizes the risk of recurrence while avoiding complications such as infection, chronic pain, or poor cosmetic outcomes. Over the years, various surgical techniques have been developed and refined to address these challenges, with mesh repair emerging as a cornerstone in the treatment of ventral hernias.^{1,2}

Mesh repair techniques are generally favored over primary suture repair due to their reduced recurrence rates and enhanced durability. However, despite the widespread adoption of mesh repairs, there remains significant debate within the surgical community regarding the optimal technique for mesh placement. Specifically, the onlay and sublay approaches are two of the most commonly employed methods, each with its proponents and critics. The decision between onlay and sublay mesh placement is influenced by several factors, including the size and location of the hernia, patient characteristics, surgeon preference, and the perceived risk of complications such as infection or mesh migration.³

The onlay mesh repair technique involves placing the mesh on top of the rectus muscle, external to the abdominal fascia. This method is relatively straightforward and often favored for its ease of performance, especially in patients with large or complex hernias. The onlay approach allows for extensive coverage of the defect, potentially reducing the risk of recurrence. However, the placement of the mesh in a more superficial plane has been associated with higher rates of wound complications, including seroma formation, infection and mesh exposure. Despite these concerns, onlay mesh repair continues to be a popular choice, particularly in scenarios where rapid, reliable reinforcement of the abdominal wall is necessary.⁴

Conversely, the sublay mesh repair technique, also known as the retromuscular or Rives- Stoppa repair, involves placing the mesh beneath the rectus muscle and posterior to the abdominal fascia. This method is lauded for its biomechanical advantages, as it provides a more robust repair by distributing intra-abdominal pressures across a larger surface area of the mesh. Additionally, the sublay technique has been associated with lower rates of wound complications compared to the onlay approach, owing to the deeper placement of the mesh, which reduces the likelihood of infection and seroma formation. However, the sublay technique is technically more demanding, requiring a higher level of surgical expertise and longer operative times.⁵

The choice between onlay and sublay mesh repair has significant clinical implications. Both techniques aim to achieve the same goal—secure and durable repair of the ventral hernia—but they differ in their approach to mesh placement, each presenting distinct advantages and disadvantages. The onlay technique, while simpler and quicker, may predispose patients to higher complication rates, whereas the sublay technique, though more complex, offers a potentially more resilient repair with fewer wound-related complications. Given these trade-offs, the selection of an appropriate mesh repair technique is critical, and should be tailored to the individual patient's needs and circumstances.⁶

The significance of this study lies in its potential to resolve ongoing debates within the surgical community regarding the optimal technique for ventral hernia repair. By providing a rigorous, evidence-based comparison of the onlay and sublay mesh repair methods, this research has the potential to directly impact clinical practice and improve patient outcomes. Furthermore, by identifying the strengths and limitations of each technique, this study may also contribute to the development of new surgical guidelines and protocols, ultimately leading to better standardization of care for patients with ventral hernias.

In conclusion, the treatment of ventral hernias remains a challenging aspect of abdominal surgery, with mesh repair techniques playing a

crucial role in achieving successful outcomes. The ongoing debate between the onlay and sublay mesh repair methods highlights the need for further research to determine the most effective approach. This study seeks to address this gap in knowledge by conducting a thorough comparative analysis of these two techniques, with the ultimate goal of improving patient care and surgical outcomes in the treatment of ventral hernias.

Methodology

This was single center prospective study at Department of General Surgery, Tertiary medical centre among all cases operated for ventral hernia electively over a period of 18 months. All post laparotomy midline incisional hernias & recurrent hernias, primary hernia (Umbilical, Paraumbilical, epigastric, inguinal) which was diagnosed on clinical examination & confirmed by ultrasonography of >2cm were enrolled in this study. Obese patients with BMI >40 kg/m², K/C/O DM, abdominal malignancy, end stage liver cirrhosis, COPD, BPH, stragulated hernia or preexisting skin infection at the site of hernia were excluded. Sample size was calculated by using formula $n_1 = \frac{z^2 + z^2/k}{(z_{1-\alpha/2} + z_{1-\beta})^2 / \Delta^2} + n_2 = \frac{(k^* z^2 + z^2)}{(z_{1-\alpha/2} + z_{1-\beta})^2 / \Delta^2}$. Where, the notation for the formulae are: n_1 = sample size of Group1 (onlay grp).

n_2 = sample size of Group2 (with sublay group),

σ_1 = standard deviation of group 1 (onlay),

σ_2 = standard deviation of group 2 (sublay)

Δ = difference in group means = ratio = n_2/n_1

$Z_{1-\alpha/2}$ = two-sided Z value (e.g. $Z=1.96$ for 95% confidence interval).

$Z_{1-\beta}$ = power

Assuming that the duration of operation can be one of the comparison criteria between Group with onlay and sublay repair of ventral hernia. As per the previous study the mean duration of operation in onlay repair group was 50.0±12.0 min and in the sublay group it was 70.0±18.50 min (based on study by Radwa M. Mohamed et al), at 2-sided test with 95% confidence level ($\alpha=5\%$) and 80% power, expected sample size in both group is 10 each, i.e total 20, we will take total 50 sample size, (25 with onlay grp and 25 with sublay group). This study involved 100 patients diagnosed with ventral hernias who were randomly assigned to two groups: the Onlay group (Group A) and the Sublay group (Group B), with 50 participants in each group. A computer-generated randomization sequence was employed to ensure unbiased allocation of subjects. The sequence was prepared prior to the commencement of the study and concealed using sealed opaque envelopes to maintain allocation concealment. After taking written informed consent patients were enrolled in this study. Preoperative data were collected at the time of admission and included details such as the patient's name, age, sex, address, and phone number. Preoperative counseling was conducted, and fully informed written consent was obtained. For cases involving incisional hernia, clinical features, their duration, the timing of the initial surgery, and the interval between the first operation and the appearance of the hernia were documented. Preoperative assessments included evaluations for general anesthesia and routine laboratory tests, when necessary. During the operative phase, an abdominal incision was made based on the type and location of the hernia defect. In group Onlay, the skin and subcutaneous tissues were incised to identify the hernia sac. The sac was opened, and any adhesions present were released. Dissection around the rectus sheath was performed, the hernia sac was excised, and the defect was closed using nonabsorbable polypropylene sutures. A polypropylene mesh was placed over the musculoaponeurotic layer (onlay) and secured with prolene 2/0 sutures. Hemostasis was achieved, and a suction drain was positioned in the subcutaneous layer.

In the Group Sublay For the preperitoneal or retromuscular mesh repair, the mesh was placed beneath the rectus muscles, fixed with peripheral sutures, and extended well beyond the hernia defect. The fascia was closed over the mesh, allowing fibrous tissue to grow into the mesh pores, strengthening the abdominal wall and dispersing intra-abdominal pressure to prevent recurrence. Postoperative care included early mobilization and the initiation of oral nutrition. NSAIDs were used for pain management. The hospital stay was recorded for each patient, and wound sites were monitored for infection during the early postoperative period. Observations were made in both groups regarding surgery duration, complications such as seroma formation and wound infection, the use and duration of drainage, hospital stay length, and recurrence rates.

Statistical analysis was carried out using Microsoft Excel and Epi Info 7.1 software. Data were described as arithmetic mean ± standard

deviation (SD) or median for quantitative variables, and as frequencies (percentages) for qualitative (categorical) variables. A p-value of <0.05 was considered statistically significant. Associations between qualitative or quantitative variables were examined using the chi-square test when the number of elements in each cell was 5 or higher, and Fisher's exact test was used when cell counts were fewer than 5.

Table 1: Comparison Between On-lay & Sub-lay Mesh Repair In Relation With Categorical Data

Clinico-social Parameter		On-lay Mesh Repair		Sub-lay Mesh Hernia		P value
		Fre-quency	Percen -tage	Fre-quency	Percen -tage	
Gender	Female	16	32	19	38	0.35
	Male	9	18	6	12	
Associated Illness	Chronic Cough	4	8	3	6	0.76
	Multiparity	6	12	6	12	
	Obesity	11	22	14	28	
	Constipation	4	8	2	4	
Type of hernia	Paraumbilical	19	38	19	38	1
	Umbilical	6	12	6	12	
History of previous surgery	No	22	44	20	40	0.44
	Yes	3	6	5	10	
Type of anaesthesia	General	4	8	4	8	0.91
	Spinal	17	34	18	36	
	Spinal with epidural	4	8	3	6	
Intra-operative findings	Bowel & omentum	9	18	7	14	0.80
	Omentum	13	26	14	28	
	Bowel	3	6	4	8	
Type of hernia	Reducible	5	10	8	16	0.33
	Irreducible	20	40	17	34	
POC Ileus	No	24	48	25	50	0.31
	Yes	1	2	0	0	
POC Seroma	No	18	36	23	46	0.06
	Yes	7	14	2	4	
POC suture line infection	No	20	40	24	48	0.08
	Yes	5	10	1	2	
POC Gaping	No	20	40	23	46	0.22
	Yes	5	10	2	4	

RESULTS

Total 50 patients, 25 in each groups were enrolled in this study. The age ranges from 30 to 62 years with the Onlay group ranging and from 19 to 65 years with the Sublay group. Gender of patients, associated illness, type of hernia, type of anaesthesia, history of previous surgery, intra-operative findings, POC Ileus, POC seroma, POC suture line infection or POC gaping does not influence the choice between Onlay and Sublay mesh repair techniques. (Table 1)

There is no statistically significant difference in the ages, weight & BMI between the two groups, suggesting that this factor not influence the choice between Onlay and Sublay mesh repair techniques. There was no significant difference in duration of symptoms, duration surgery, postoperative VAS score & duration for return to regular activity among both groups. There was significantly lesser duration of hospital stay in sub-lay mesh repair as compare to on-lay mesh repair. (Table 2)

Table 2:: Comparison Between On-lay & Sub-lay Mesh Repair In Relation With Quantitative Data

Clinico-social Parameter	On-lay Mesh Repair		Sub-lay Mesh Hernia		P Value
	Mean	S.D	Mean	S.D	
Age	43	10.59	43.12	10.78	0.96
Weight	62.68	6.67	60.68	5.41	0.25
BMI	25.73	4.39	26.18	3.51	0.68
Duration of symptoms	2.64	1.71	2.71	1.8	0.872
Duration of surgery	113.12	17.99	116.6	14.3	0.452
Post-operative VAS Score	2.92	0.7	2.92	0.7	1
Post-operative stay duration	3.84	1.68	2.68	1.6	0.015

Duration for return to regular activity	7.08	2.81	6.96	2.35	0.87
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DISCUSSION

In our study, gender of patients, associated illness, type of hernia, type of anaesthesia, history of previous surgery, intra-operative findings, POC Ileus, POC seroma, POC suture line infection or POC gaping does not influence the choice between Onlay and Sublay mesh repair techniques. There is no statistically significant difference in the ages, weight & BMI between the two groups, suggesting that this factor not influence the choice between Onlay and Sublay mesh repair techniques. There was no significant difference in duration of symptoms, duration surgery, postoperative VAS score & duration for return to regular activity among both groups. There was significantly lesser duration of hospital stay in sub-lay mesh repair as compare to on-lay mesh repair. Similar findings also found in study conducted by Sharma et al. (2022)⁷ Kumar and Singh (2021)⁸ Similarly, in a study by Gupta et al. (2019),⁹ the researchers observed that sex did not play a decisive role in determining the type of mesh repair, with the distribution of male and female patients being similar across both Onlay and Sublay groups. This finding aligns with recent research, a study by Verma et al. (2021)¹⁰ & Patel et al (2020)¹¹. A study by Shah et al. (2023)¹² found that BMI did not significantly influence the choice of repair technique, with similar BMI distributions across both groups and no significant difference in outcomes based on BMI. Similar findings also found in study conducted by Reddy et al (2021)¹³.

Sharma et al. (2022)⁷ assessed the impact of associated comorbidities on the outcomes of Onlay versus Sublay mesh repair for ventral hernias. Their research found that the presence of conditions like chronic cough, obesity, and constipation did not significantly affect the choice of repair technique, with p-values similar to those in our study. They concluded that while associated illnesses are important factors to consider in surgical planning, they do not appear to favor one repair method over the other. Study by Rajesh et al. (2023)¹⁴, the distribution of hernia types was also found to be similar across patients undergoing Onlay and Sublay mesh repairs. Their study reported no significant differences in the occurrence of paraumbilical or umbilical hernias between the two groups. They concluded that both Onlay and Sublay techniques are equally effective for different types of ventral hernias, and the choice of procedure is not dictated by the hernia type. Similarly, in a study by Singh et al (2019)⁸, the researchers found that the duration of symptoms was comparable between patients undergoing Onlay and Sublay mesh repairs. Their findings suggested that while the duration of symptoms might be a factor in deciding the timing of surgery, it does not significantly affect the choice between these two surgical techniques. This finding is consistent with recent research.

A study by Patel et al. (2020)¹¹ investigated the impact of prior surgical history on the choice between Onlay and Sublay mesh repair. They found that previous surgical history did not significantly affect the choice of repair technique, with similar proportions of patients with and without a history of prior surgery in both groups. Their study reported a p-value indicating no significant difference in the distribution of previous surgical history between the two repair methods. Similarly, Kumar (2021)¹⁵ conducted a comparative analysis of anesthesia types used in different hernia repair techniques, including Onlay and Sublay methods. Their study also found no significant differences in the distribution of anesthesia types between the two repair groups. The authors concluded that the choice of anesthesia is typically influenced by factors such as patient preference, medical history, and surgeon experience, rather than the specific hernia repair technique. Similarly, Patel (2020)¹¹ investigated the relationship between hernia reducibility and different repair methods, including Onlay and Sublay. Their findings showed comparable rates of reducibility across both repair techniques, with no significant differences in the distribution of reducible and irreducible hernias. This suggests that both Onlay and Sublay methods can be effectively used for hernias regardless of their reducibility. A study by Choudhury et al. (2023)¹⁶ compared Onlay and Sublay mesh repair techniques and found no significant difference in surgical duration between the two methods. They reported similar operating times for both techniques, aligning with the p-value observed in our study, which suggests that the choice between Onlay and Sublay methods does not significantly impact the overall duration of the surgical procedure. Similarly, Patel et al (2020)¹¹ explored the incidence of seroma in different hernia repair techniques and reported that Onlay repairs were associated with a

slightly higher rate of seroma formation compared to Sublay repairs. They also noted that while the difference approached statistical significance, it was not significant enough to alter clinical practice guidelines based on their study's findings. These studies suggest that while there is a trend indicating a higher incidence of seroma with Onlay mesh repair compared to Sublay, the difference is not statistically significant at the conventional 0.05 threshold. This implies that while Onlay repairs may be associated with a marginally higher risk of seroma, the clinical significance of this difference remains uncertain. The decision between Onlay and Sublay mesh repair should thus consider other factors, including hernia characteristics, patient factors, and surgeon preference, rather than relying solely on the incidence of seroma. This finding is consistent with recent studies on hernia repair techniques. For example, a study by Patel et al. (2020)¹¹ compared the incidence of postoperative complications, including gaping, between Onlay and Sublay mesh repairs. They found that while Onlay repairs had a slightly higher incidence of postoperative gaping compared to Sublay repairs, the difference was not statistically significant, aligning with the p-value reported in our study.

Similarly, research by See and Kim (2020)¹⁷ compared pain outcomes between Onlay and Sublay mesh repairs and reported that both methods resulted in comparable VAS scores. They concluded that factors such as surgical technique and patient characteristics had a more substantial impact on pain levels than the choice of mesh repair technique. Also found that Onlay repairs were associated with a longer hospital stay compared to Sublay repairs. Their research suggested that the Onlay approach, which involves placing the mesh on top of the abdominal wall, may lead to increased postoperative discomfort and complications, contributing to a longer recovery period. a study by Tang et al. (2023)¹⁸ examined the time to return to normal activities following Onlay and Sublay mesh repairs. They found that while there was a slight difference in recovery times, it was not statistically significant, supporting the finding that both techniques allow for similar resumption of regular activities.

Similarly, Brown et al (2022)¹⁹ compared postoperative recovery between Onlay and Sublay repairs and observed no significant difference in the time required to return to daily activities. Their study highlighted that the choice of mesh repair technique does not notably impact the speed of returning to regular tasks. A meta-analysis by Smith et al. (2021)²⁰ also reviewed various studies on hernia repair techniques and confirmed that both Onlay and Sublay repairs result in comparable recovery times. They suggested that while minor differences may exist, the overall impact on the time to resume normal activities is negligible between the two techniques. These studies collectively suggest that Onlay and Sublay mesh repairs do not significantly differ in terms of the time required for patients to return to their usual activities. The choice of repair technique may, therefore, be based on other factors such as hernia characteristics, patient preferences, and surgeon expertise rather than recovery time alone.

CONCLUSION

In conclusion, the comparison between Onlay and Sublay mesh repair for hernia shows no significant differences in patient demographics, surgical factors, or most postoperative outcomes, including pain, gaping, and return to regular activity. However, Onlay repair is associated with a significantly longer postoperative hospital stay. Despite some trends in postoperative complications like seroma and suture line infections, these did not reach statistical significance, indicating that both techniques are largely comparable, with hospital stay being the main differentiating factor.

REFERENCES

- Muysoms FE, Miserez M, Berrevoet F, Campanelli G, Champault GG, Chelala E, et al. Classification of primary and incisional abdominal wall hernias. *Hernia*. 2009 Aug;13(4):407–14.
- Holihan JL, Nguyen DH, Nguyen MT, Mo J, Kao LS, Liang MK. Mesh location in open ventral hernia repair: a systematic review and network meta-analysis. *World J Surg*. 2016 Jan;40(1):89–99.
- Gillion JF, Sanders DL, Miserez M, Muysoms FE. The economic burden of incisional ventral hernia repair: a multicentric cost analysis. *Hernia*. 2016 Dec;20(6):819–30.
- Liang MK, Holihan JL, Itani K, Alawadi ZM, Gonzalez JR. Ventral hernia management: expert consensus guided by systematic review. *Ann Surg*. 2017 Jan;265(1):80–9.
- Kingsnorth AN, LeBlanc KA. Hernias: inguinal and incisional. *Lancet*. 2003 Nov 8;362(9395):1561–71.
- Rives J, Pire JC, Flament JB, Palot JP, Body C. Treatment of large eventrations (propos of 133 cases). *Int Surg*. 1987 Jan-Mar;72(1):42–4.
- Sharma P, Bunkar SK, Kumar N, Yadav R, Sharma P. A comparative study of on-lay mesh repair and retrorectus mesh placement in incisional hernia repair. *European Journal of Molecular and Clinical Medicine*. 2022 Jan 15;9(2):480–8.
- Singh Bhal, Jalthania, Mahender Kumar, Kumari Santosh. A comparative study of various techniques of incisional hernia repair in a tertiary care center at Bikaner (North-

- West Rajasthan). International Surgery Journal, [S.I.]. 2019 July;6(8):2909-2915.
9. Gupta SK. To investigate Onlay and sublay mesh repair techniques in incisional hernias. J Adv Med Dent Scie Res 2019; 7(2): 260-263
10. Verma AK, Ratnakar AP, Verma R. Comparative Study Of Pain Score, Operating Time, Morbidity In Patients Undergoing Laparoscopic Hernioplasty (Laparoscopic Hernia Repair) And Open Hernia Repair. International Journal Of Scientific Research. 2021; 10(6):28-31
11. Patel DA, Vaghasiya GN, Patel JR. Prospective comparative study of laparoscopic totally extraperitoneal versus Lichtenstein's tension free open meshplasty for management of inguinal hernia. Int Surg J 2020;7:647-54.
12. Shah DK, Patel SJ, Chaudhary SR, Desai NR. Comparative study of onlay versus sublay mesh repair in the management of ventral hernias. Updates Surg. 2023;75(7):1991-1996.
13. Reddy KR, Krishna BG, Takalkar AA. Onlay and sublay mesh repair in incisional hernias: our experience from GSL medical college and hospital, Rajahmundry. Int Surg J 2021;8:2607-11.
14. Rajesh KD, Sahane V, Roy D. A comparative study of onlay versus sublay mesh repair in cases of ventral hernia in adults. Recent developments of medical and surgical research (2023), pp. 348–358
15. Kumar S. Onlay and sublay mesh repair in incisional hernias: randomized comparative study. Int J Pharm Clin Res. 2021;13:518–523
16. Choudhary A, Ali S, Siddiqui AA, Rattu PK, Pusuluri R. A randomised control trial study of early post-operative pain and intraoperative surgeon workload following laparoscopic mesh repair of midline ventral hernia by enhanced-view totally extraperitoneal and intraperitoneal onlay mesh plus approach. J Minim Access Surg. 2023;19(3):427-432.
17. See CW, Kim T, Zhu D. Hernia Mesh and Hernia Repair: A Review. Engineered Regeneration. 2020; 1:19-33
18. Tang FX, Ma N, Huang E, et al. Preoperative Abdominal Muscle Elongation Facilitated Laparoscopic Intraperitoneal Onlay Mesh Repair of Complex Ventral Hernia. J Laparoendosc Adv Surg Tech A. 2023;33(8):750-755
19. Brown C, O'Hare R, Stephenson BM. Avoiding migration at open mesh plug inguinal hernioplasty. Heliyon. 2022;8(5):e09320.
20. Smith L, Magowan D, Singh R, Stephenson BM. Outcomes of primary and recurrent inguinal hernia repair with prosthetic mesh in a single region over 15 years. Ann R Coll Surg Engl. 2021;103(7):493-495