International Journal of Research in Medical Sciences
*Thakkar NR et al. Int J Res Med Sci. 2025 Nov;13(11):4723-4729*
www.msjonline.org
pISSN 2320-6071 | eISSN 2320-6012
DOI: https://dx.doi.org/10.18203/2320-6012.ijrms20253591

**Original Research Article**

# A comparative study between onlay and sublay mesh repair in the treatment of ventral hernias

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**Received:** 24 July 2025
**Revised:** 03 September 2025
**Accepted:** 16 October 2025

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## ABSTRACT

**Background:** Ventral hernias, characterized by a defect in the anterior abdominal wall fascia, are commonly managed surgically using mesh reinforcement. Among the widely adopted techniques, onlay and sublay mesh placements differ in anatomical location and complication profiles. Despite being routine procedures, consensus on the superior approach remains elusive. Objectives were to compare the clinical outcomes of onlay versus sublay mesh repair in patients undergoing elective ventral hernia surgery.
**Methods:** This was a prospective interventional comparative study conducted at a tertiary care hospital from September 2019 to July 2021. A total of 90 patients were randomly allocated to undergo either onlay (n=45) or sublay (n=45) mesh repair. Parameters compared included duration of surgery, postoperative pain (VAS scores), incidence of early complications (surgical site infection, seroma, hematoma), duration of drain placement, hospital stay, and late complications (mesh infection, bowel obstruction, recurrence). Data were statistically analyzed for significance.
**Results:** The mean duration of surgery was significantly longer in the sublay group, while the onlay group had a higher incidence of early postoperative complications including seroma and wound infections. The sublay group demonstrated significantly shorter postoperative hospital stay and fewer late complications.
**Conclusions:** Although sublay mesh repair requires a longer operative time, it is associated with fewer complications, reduced postoperative morbidity, and quicker recovery. These findings support the adoption of sublay mesh placement as the preferred method in ventral hernia repair.

**Keywords:** Ventral hernia, Onlay mesh repair, Sublay mesh repair, Hernioplasty, Seroma, Postoperative complications

## INTRODUCTION

A ventral hernia is described as the protrusion through the fascia of the anterior abdominal wall. In cases of ventral hernia, the two primary surgical methods frequently employed are the onlay and sublay mesh repair techniques. Numerous research studies have indicated an elevated risk of wound-related complications associated with mesh placement, including instances of surgical site infections, seromas, and flap necrosis.[1] These complications are influenced by the specific location where the mesh is positioned. For instance, when the mesh is exposed to intra-abdominal contents, it potentially heightens the chances of complications such as adhesions, bowel obstruction, and the formation of fistulas. Despite mesh-assisted ventral hernia repair being a common procedure, there remains a lack of consensus regarding the optimal mesh placement site. Consequently, this study endeavors to compare the outcomes of onlay and sublay mesh repair techniques in the treatment of ventral hernias.

## METHODS

A prospective interventional comparative study was carried out in 90 patients with ventral hernia (on the basis of inclusion and exclusion criteria) operated in the

department of general surgery in government medical college and hospital, Aurangabad, Maharashtra for 1.5 years, from September 2019 to July 2021, after ethical committee approval. The diagnosis of ventral hernia was established clinically, based on presenting history and physical examination and supported by investigations in selected cases and the data was collected as per the case record form. Patients were randomly allocated to either of the two groups (onlay mesh repair and sublay mesh group) using the method of randomization: simple randomization, using computerised algorithm at www.randomization.org. and eventually underwent elective onlay and sublay mesh repair. The parameters in the objectives (duration of surgery, early post-operative complications, post-operative pain, number of days drain was in situ, post-operative hospital stay and late post-operative complications) were assessed. Patients were followed up for period of 6 months for late post-operative complications.

***Inclusion criteria***

Patients undergoing elective ventral hernia surgeries, patients between 18 and 70 years of age, patients willing to take part in the study and patients belonging to either gender were included.

***Exclusion criteria***

Patients undergoing emergency surgeries, patients residing at remote places, unable to present for follow-up after discharge, patients undergoing laparoscopic surgeries/concomitant component separation techniques, patients not willing to take part in the study and recurrent hernias were excluded.

***Data analysis***

All the data collected from the patients was compiled in a Microsoft office excel sheet and analysis of the data was done using SPSS software [trial version 20] and open epi software.

For qualitative data Chi square test was applied and for quantitative data t test was applied to calculate the p value.

$P<0.05$ was considered significant at 95% confidence interval.

***Study procedure***

*Pre-operatively*

A detailed history of each patient was obtained starting with history of presenting complaint. A thorough general physical examination was done. All the patients enrolled in the study underwent elective surgery under general /spinal anaesthesia. Preoperative preparations, informed and written consent were obtained. Shaving of parts on the morning of surgery was done. Patient was kept nil by mouth after 10 pm on previous night of surgery.

***Intra-operatively***

Injection amoxiclav 1.2 gm IV was given during induction of anaesthesia. Cleaning and painting was done by 5% povidine iodine solution. Draping was done using sterile linen drapes. Abdominal incision was taken according to the site and type of hernial defect. Skin and subcutaneous layers were incised. Hernial sac was identified, and dissection was done using fine scissors and cautery. The sac was opened and all adhesions wherever present were released. Large sacs were excised and were approximated using absorbable sutures. Then appropriate size polypropylene mesh was placed above the posterior rectus sheath (sublay mesh repair) or above the anterior rectus sheath layer (onlay mesh repair) and was fixed with prolene 2-0 sutures. Once haemostasis achieved, closure was done in layers after putting a suction drain of size 14 in the subcutaneous plane. Duration of surgery was noted.

***Postoperatively***

Patients were kept NBM for 6-8 hours depending on anaesthesia. Injection amoxiclav 1.2 gm IV 8 hourly was given for 2 days. Tab. amoxiclav 625 mg three times a day was started on 3$^{rd}$ postoperative day for next 3 days. Pain was assessed for all patients on post-op day 1, 3, 5, 7 by the standard numeric pain intensity scale [visual analogue pain scale (VAS)], where patients were told to grade their pain on a scale from 0-10, where 0 signified no pain and 10 signified worst or unbearable pain. If the patients were discharged early, the pain of initial days was only considered. Tab. diclofenac 50 mg was given according to pain. Wounds were checked on 3rd postoperative day in all patients and dressing was done. Wounds were checked regularly for surgical site infection like wound cellulitis, wound discharge, flap necrosis, fascial disruption, stitch abscess and were managed accordingly. Patients were routinely examined for any other early post-operative complications like seroma, paralytic ileus, pulmonary complications. Radiological investigations were done wherever necessary to diagnose seroma/paralytic ileus/pulmonary complication. After diagnosing the complication these patients were managed as per the need of the complication. Drain was removed once the drain output was less than 10 ml and the post-operative day when the drain was removed was noted. Patients were discharged as per response to the procedure, after removing their drains and making sure that they didn't have any early complication or were treated if any.

***Follow up***

All the patients included in the study were followed up after 2, 4 and 24 weeks. Detailed clinical and radiological examination was done to look for any recurrences or other late post-op complications like infected/exposed mesh and late small bowel obstruction and patients were readmitted

if they were found to have any of above late post-op complication.

## RESULTS

The comparative study between onlay and sublay mesh repair in the treatment of ventral hernias" was a prospective interventional comparative study, conducted in the department of general surgery at a tertiary care teaching hospital: When the demographic data of the patients was studied it was observed that highest number of patients belonged to the age group of 41-60 years followed by 18-40 years and then >60 years. Also, females had more preponderance to ventral hernias then males and the data was found to be statically significant ($p<0.05$).

In the present study 44 (48.8%) patients presented with umbilical hernia, 38 (42.2%) patients presented with incisional hernia while 8 (8.88%) patients presented with epigastric hernia (Table 2).

The study population was divided into two groups on the basis of the type of repair they underwent; the onlay mesh repair group and the sublay mesh repair group (45 patients in each group). Further assessment of the study population was done post-surgery, intra-op parameters and outcomes of the surgery were also studied. After statistical analysis following points were found (Table 3).

A statistically significant difference was obtained when the results of the two methods were compared with the above variable ($p<0.0001$) (Table 3).

The patient with the exposed mesh was readmitted and the complication was managed by removal of the mesh surgically (Table 4).

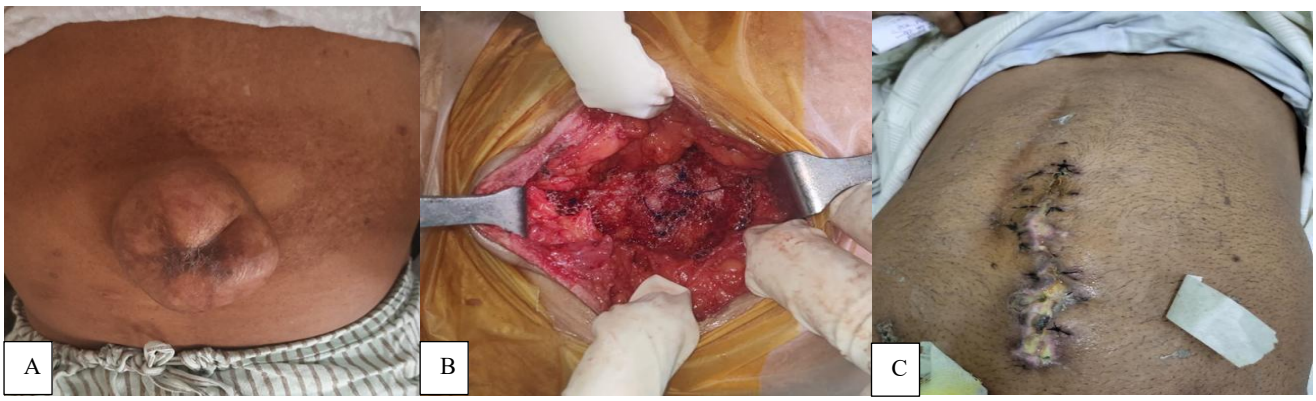


**Figure 1 (A-C): A-Umbilical hernia, B-Onlay mesh placement and C-Flap necrosis at POD 10.**
Case 1 64-year-old male with umbilical hernia underwent onlay mesh repair, suffered from early post-op complication of surgical-site infection.

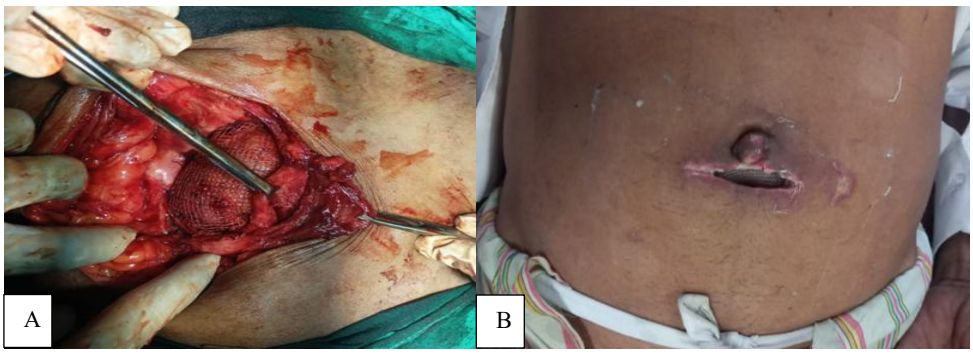


**Figure 2 (A and B): A-Sublay mesh placement, B- Post operative events` Exposed mesh-Late complication.**
Case 2: 49 year old female with lateral (left iliac) incisional hernia managed by sublay mesh repair recovered with healthy scar.

**Table 1: Age and sex distribution.**

| Age (in years) | Umbilical | Incisional | Epigastric | Lumbar | Total |
|---|---|---|---|---|---|
| **18-40** | 14 | 13 | 01 | 00 | 28 |
| **41-60** | 23 | 17 | 03 | 00 | 43 |
| **> 60** | 07 | 08 | 04 | 00 | 19 |
| **Male** | 20 | 08 | 04 | 00 | 32 |
| **Female** | 24 | 30 | 04 | 00 | 58 |

**Table 2: Distribution of type of hernia and its repair.**

| Variables | Umbilical | Incisional | Epigastric | Total |
|---|---|---|---|---|
| **Onlay repair** | 26 | 16 | 03 | 45 |
| **Sublay repair** | 18 | 22 | 05 | 45 |
| **Total** | 44 | 38 | 08 | 90 |

**Table 3: Mean duration of surgery in the two types of repairs (all values in minutes).**

| Type of repair | N | Mean duration of surgery | SD | Minimum | Maximum | P value |
|---|---|---|---|---|---|---|
| **Onlay repair** | 45 | 96.89 | 10.01 | 80 | 120 | <0.0001 |
| **Sublay repair** | 45 | 115.55 | 17.6 | 85 | 150 | |
| **Total** | 90 | 106.22 | 16.96 | 80 | 150 | |

A statistically significant difference was obtained when the results of the two methods were compared with the above variable ($p<0.0001$)

**Type 4: Type of early and late complications in two types of repairs.**

| Complications | Type of repair | No. of patients suffering from complications | Total no. of patients | Percent (%) | P value |
|---|---|---|---|---|---|
| **Early complications** | | | | | |
| SSI (wound cellulitis, wound discharge, flap necrosis, fascial disruption, stitch abscess) | Onlay | 07 | 45 | 15.55 | 0.08996 |
| | Sublay | 03 | 45 | 6.67 | |
| | Total | 10 | 90 | 11.11 | |
| Seroma | Onlay | 02 | 45 | 4.44 | 0.3045 |
| | Sublay | 02 | 45 | 4.44 | |
| | Total | 04 | 90 | 4.44 | |
| Pulmonary complications | Onlay | 01 | 45 | 2.22 | 0.1584 |
| | Sublay | 00 | 45 | 0 | |
| | Total | 01 | 90 | 1.11 | |
| Thromboembolic complications | Onlay | 00 | 45 | 0 | |
| | Sublay | 00 | 45 | 0 | |
| | Total | 00 | 90 | 0 | |
| Paralytic ileus | Onlay | 00 | 45 | 0 | 0.1584 |
| | Sublay | 01 | 45 | 2.22 | |
| | Total | 01 | 90 | 1.11 | |
| None | Onlay | 35 | 45 | 77.78 | |
| | Sublay | 40 | 45 | 88.89 | |
| | Total | 75 | 90 | 83.33 | |
| **Late complications (at 6 months follow up)** | | | | | |
| Recurrence | Onlay | 0 | 45 | 0 | |
| | Sublay | 0 | 45 | 0 | |
| | Total | 0 | 90 | 0 | |
| Bowel obstruction | Onlay | 0 | 45 | 0 | |
| | Sublay | 0 | 45 | 0 | |
| | Total | 0 | 90 | 0 | |
| Infected/exposed mesh | Onlay | 1 | 45 | 2.2 | |
| | Sublay | 0 | 45 | 0 | |
| | Total | 0 | 90 | 0 | |

**Table 5: Post-operative pain (Mean VAS score) in the two types of repair.**

| Post-op day | Type of repair | No. of patients | Pain (Mean VAS score) | Standard deviation | Minimum | Maximum | P value |
|---|---|---|---|---|---|---|---|
| **POD1** | Onlay | 45 | 5.47 | 0.93 | 4 | 7 | 0.01636 |
| | Sublay | 45 | 5.02 | 0.81 | 4 | 7 | |
| | Total | 90 | 5.25 | 0.9 | 4 | 7 | |
| **POD2** | Onlay | 45 | 3.86 | 1.03 | 2 | 6 | 0.05522 |
| | Sublay | 45 | 3.46 | 0.92 | 2 | 6 | |
| | Total | 90 | 3.66 | 0.99 | 2 | 6 | |

Continued.

| Post-op day | Type of repair | No. of patients | Pain (Mean VAS score) | Standard deviation | Minimum | Maximum | P value |
|---|---|---|---|---|---|---|---|
| **POD5** | Onlay | 45 | 2.7 | 0.97 | 1 | 5 | 0.2130 |
| | Sublay | 45 | 2.45 | 0.92 | 1 | 5 | |
| | Total | 90 | 2.58 | 0.95 | 1 | 5 | |
| **POD7** | Onlay | 45 | 2.12 | 0.78 | 1 | 4 | 0.1342 |
| | Sublay | 45 | 1.86 | 0.85 | 1 | 5 | |
| | Total | 90 | 2 | 0.81 | 1 | 5 | |

## DISCUSSION

The patients were divided into 3 age groups 18-40 years, 41-60 years and >60 years which included 28, 43 and 19 patients respectively. Maximum number of patients belonged to the age group 41-60 years. Various studies conducted in the past by Ali-Hussein et al, Dhaigude et al and Kharde et al showed similar results.[3,4,8]

In present study, out of 90 patients 58(64.44%) were females and 32 (35.56%) were males. The female preponderance was statistically significant (p=0.047). There were more than 60 % females in the study of Ahsan et al 82% females in the study of Afridi et al and 52% females in study of Saber et al.[5-7] The high female preponderance can be attributed to the majority of index operations being gynecological operations with a lower midline incision, which result in incisional hernia.[8]

Out of the 45 patients who underwent onlay meshplasty, 26 cases were diagnosed as umblical hernia, 16 cases as incisional hernia and 3 cases as epigastric hernia and among the 45 patients who underwent sublay meshplasty 18 were diagnosed as paraumbilical hernia, 22 cases as incisional hernia, 5 cases as epigastric hernia.

Similarly in the study conducted by Chitrambalam et al most patients presented with umbilical hernia followed by incisional and epigastric hernia.[9]

While studying the duration of surgery in present study in both the groups, in onlay mesh repair group, the minimum duration was 80 minutes and maximum was 120 minutes with the mean duration of surgery being 96 minutes; while in sublay mesh repair group, minimum was 85 minutes and maximum was 150 minutes with mean duration of surgery being 115 minutes (Table 4) which is statistically significant (p<0.0001).

The difference could be accounted to more time required for dissection to create retromuscular space. Securing adequate hemostasis is another burden on time. Furat Shani et al reported a mean duration of 64 min for onlay and a mean duration of 88 min for sublay mesh repair, while in Aly Saber series the mean duration for onlay and sublay mesh repair were 67.5 and 100 min, respectively.[7,10]

Ibrahim et al reported the mean total time in the onlay group to be 75-90 (83.41±10.24) min and 80-100 (89.52±7.25) min in the sublay group.[11]

Operative time is an important factor in any surgical procedure. It is indirect evaluation of morbidity inflicted to the patient, as a long operative time in any surgery has its own set of complications, including anaesthesia related or surgery related issues. Most studies comparing onlay and sublay prosthetic repair of ventral hernia repair have shown significant results with respect to operative time for either of techniques. Venclauscas et al, Demetrashvili et al and Godara et al all have shown, in their respective studies, that the mean operative time for sublay mesh repair is greater than that in case of onlay mesh repair.[12-14]

Wound infections occurred in 8%patients in sublay group and in 17% patients in onlay group in study of Hafiz Ashan et al.[5] Wound infections occurred in 6% patients in sublay group and on 16% patients in onlay group in study of Afridi et al and Saber et al found wound infections in 7% patients in sublay group and in 15% patients in onlay group.[6,7] Another study by Saber et al wound infections occurred in 4% patients in sublay group and in 8% patients in onlay group.[15] Bessa et al found wound infection rates in 0% patients in sublay group and in 2.5% patients in onlay group but with insignificant p value.[16] Milad and his colleagues reported that the retromuscular plane is highly vascular and helps preventing infection, and if any infection occurs in subcutaneous plane, it will not affect the mesh, as the mesh is retromuscular in a deeper plane.[17]

Two out of 45 patients (4.44%) developed seroma in both types of repairs. These figures were not statistically significant as evaluated (p=1.000). Hafiz Ashan et al [5] also did not find any significant difference in seroma formation in sublay versus onlay group (2% in sublay and 6% in onlay group). Saber et al [15] also found similar rates of seroma formation between the groups as like of our study.

According to several scientific publications, seroma is a more frequent complication of onlay technique than in retromuscular method.[8] More frequent development of seroma in cases of onlay mesh repair may be attributed to two reasons increased dissection of subcutaneous tissue during surgery and tight contact of foreign body (mesh) to the subcutaneous tissue.

The patients in the onlay group experience higher degree of pain postoperatively when compared with the patients in the sublay group.

Similar results were obtained in the study conducted by Chitrambalam et al where the mean pain score for onlay

meshplasty on postop day 2, 5 and 7 were 7.91±0.10, 5.01±0.10 and 2.97±0.11 respectively and the mean pain score for sublay meshplasty on postop day 2, 5 and 7 were 6.83±0.06, 3.05±0.04 and 1.05±0.03.[9]

In onlay meshplasty, the mesh is placed subcutaneously and fixed just over the anterior rectus sheath where nerve fibres are abundant which stimulates pain. Due to this subcutaneous placement of the mesh, onlay repairs are more prone for wound infection which again leads to increased pain.

In present study when late post-operative complications were observed during the follow-up period, it was seen that only 1 patient in the onlay group, with umbilical hernia, suffered from infected mesh for which removal of mesh was required whereas in sublay group none of the patients suffered from any late post-operative complications.

Similar results were observed by Ali Hussein et al where patients requiring removal of mesh was 1(1.66%) in onlay group because the infection was deep and not responding well to antibiotics while there was no mesh removed in sublay group.[2]

In the study conducted by Dhaigude et al total of 4 patients were reported with mesh infection out of which 3 (6%) were in onlay group and 1 (2%) was in sublay group.[3]

Sublay mesh repair is considered superior because the mesh with significant overlap placed under the muscular abdominal wall works according to Pascal's principles of hydrostatics. The intra-abdominal cavity functions as a cylinder, and, therefore, the pressure is distributed uniformly to all aspects of the system. Consequently, the same forces that are attempting to push the mesh through hernia defects are also holding the mesh in place against the intact abdominal wall. In this manner, the prosthetic mesh is held firmly in place by intra-abdominal pressure. The mechanical strength of the prosthetic mesh prevents protrusion of the peritoneal cavity through the hernia because the hernial sac is in distensible against the mesh. Over time, the prosthetic mesh is incorporated into the fascia and unites the abdominal wall, now without an area of weakness.

## CONCLUSION

The data obtained by the analysis of the data obtained by operating 90 ventral hernia patients by onlay and sublay mesh repair it can be concluded that sublay mesh repair has an upper hand over onlay mesh repair as it has a shorter duration of hospital stay, shorter post-operative suction drainage and lower rate of post-operative complications (early as well as late) than onlay mesh repair thereby reducing patient morbidity. The duration of surgery, however is less in case of onlay mesh repair.

Considering the above factors, we would recommend that sublay mesh hernioplasty is a better alternative to onlay mesh hernioplasty for all forms of ventral hernia repair and should be used for all patients undergoing ventral hernia repair in tertiary care hospital irrespective of the type of hernia or the size of the defect.

*Funding: No funding sources*
*Conflict of interest: None declared*
*Ethical approval: The study was approved by the Institutional Ethics Committee*

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**Cite this article as:** Thakkar NR, Harbade SR. A comparative study between onlay and sublay mesh repair in the treatment of ventral hernias. Int J Res Med Sci 2025;13:4723-9.