

# Open Mesh Repair for Ventral Hernias – Onlay or Preperitoneal: Analysis of a Young Surgeon's Dilemma

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**Abstract:** ***Background:** Ventral hernias are protrusions of an abdominal viscus or a part of the viscus through an opening in the anterior abdominal wall other than the groin. Most of these patients undergo conventional open mesh repair by pre peritoneal or onlay reinforcement using a prosthetic mesh. Even though technically more difficult; preperitoneal mesh placement has been considered superior to onlay mesh. However, onlay mesh placement is considered an easier and faster option, especially in a severely scarred abdominal wall. **Methods:** All patients with ventral hernias who underwent open mesh repair by onlay or preperitoneal prosthetic (polypropylene) mesh over a period of 18 months at a tertiary care teaching hospital were included in the study. Choice of mesh placement was based on the surgeon's decision at the time of surgery. They were observed for early complications like seroma formation and infection, and late complications like chronic pain and recurrence. **Results:** 103 out of 121 patients who underwent open surgery for ventral hernias were available for follow up at the end of two years. 52 patients had undergone onlay mesh repair and 51 had undergone preperitoneal repair. 44 were male and 59 were female, with age ranging from 24 to 83 years. The defects ranged from 2.5 cm to 8 cm in maximal diameter. In contrast to 13 out of 51 patients of onlay repair, only 4 out of 52 patients of preperitoneal repair had at least one of the complications studied (p value = 0.031) However, there was no statistically significant difference in the incidence of long term complications of recurrence and chronic pain between the onlay and preperitoneal mesh groups. **Conclusion:** Though onlay mesh repair has higher overall complication rates compared to preperitoneal repair, the long term outcomes are not significantly different. Whenever possible, preperitoneal mesh repair should be carried out for ventral hernias. However, onlay repair being technically easier, can be considered as a safe and appropriate option in case of technical difficulty in dissecting safe and sufficient preperitoneal space in scarred abdominal walls or when surgical expertise to do the same is not available.*

**Keywords:** Ventral hernia, polypropylene mesh repair, complications, recurrence

## 1. Introduction

Ventral hernias include incisional hernias, para-umbilical hernias, umbilical hernias, epigastric hernias, and Spigelian hernias [1]. Techniques of ventral hernia repair surgery have evolved from simple suture repair of native myofascial tissue to use of prosthetics to reinforce the layers of the anterior abdominal wall. It is well established that the use of permanent prosthetic mesh reduces the overall risk of recurrence [2]. Though there is lack of consensus in nomenclature of mesh placement [3], by convention these locations can be (a) *onlay* - anterior to rectus sheath, (b) *inlay* - within the edges of an abdominal wall defect substituting for absent myofascial tissue, (c) *sublay* - either between the rectus muscle and posterior rectus sheath (retro-rectus) or between the posterior rectus sheath and peritoneum (preperitoneal) (d) *underlay* - posterior to the parietal peritoneum, with a non adhesive intraperitoneal surface. Laparoscopy has added a new technological dimension to this common surgery with definite reduction of wound complications and early return to normal functioning. But there are no proven benefits in the recurrence rates [4] after the laparoscopic procedure, wherein a costlier mesh

with anti adhesive properties on the intraperitoneal surface, is placed as underlay [5,6].

Open surgery with mesh reinforcement remains the usual option for ventral hernia repair, especially at teaching hospitals where residents and young surgeons perform this procedure in large numbers. Though there is consensus that non absorbable lightweight monofilament material with large pore size is the best prosthetic, [7] it is still not clear which is the best location for mesh placement within the layers of the anterior abdominal wall [8]. Onlay mesh placement is a technically easier and faster procedure, especially in the hands of a less experienced surgeon. But dissecting the skin flap off the fascia increases the risk of wound complications like seroma and surgical site infections [9]. Retro rectus positioning of the mesh is considered the gold standard for ventral hernia repair by most authors, though the mesh cannot extend beyond the borders of the rectus sheath [10]. Even though preperitoneal repair requires careful separation of the parietal peritoneum from a stretched out and potentially scarred myofascial layer, mesh placed at this level is protected both from superficial wound complications and adhesion formation with intraperitoneal

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contents, while allowing tissue ingrowth from inside and outside. Systematic meta-analyses also have demonstrated that sublay techniques are better than the other mesh locations, though data is still considered inadequate in quality [11]. However, onlay is a more practically feasible approach in situations where the expertise of the operating surgeon is limited, such as in general surgery training programmes.

We examined the outcome of onlay repairs as compared to preperitoneal sublay repair using polypropylene mesh at a teaching hospital in an observational study.

## 2. Materials and Methods

All patients who underwent elective ventral hernia repair with onlay or preperitoneal mesh repair at a tertiary care postgraduate surgical training centre during a period of 18 months from January 2014 to June 2015 were included, and followed up for two years post operatively. Emergency procedures were excluded. The location of mesh placement was decided by the senior surgeon of the operating team depending on the technical ease in separating the parietal peritoneum to create a safe and sufficient preperitoneal space. Lightweight polypropylene mesh was used in all cases.

Patients were optimized preoperatively on outpatient basis for co-morbidities if any and admitted one day prior to surgery. Decision regarding the type of anaesthesia was based on the anaesthesiologist's assessment and the surgical site. Perioperative antibiotic prophylaxis was given with one dose of third generation cephalosporin intravenously at the time of induction of anaesthesia.

On table skin preparation was done by painting with 5% povidone iodine aqueous solution. Scars were excised in case of incisional hernias. Preperitoneal repair was considered as primary option wherever possible by making an attempt to create preperitoneal space by dissecting the parietal peritoneum off the posterior rectus sheath. Small tears of the peritoneum were repaired using continuous polyglactin suture. Onlay mesh repair was opted for wherever difficulty was encountered in this dissection.

Preperitoneal repair was carried out by placing mesh of adequate size to cover the defect with an overlap of 5 cm beyond the edges of the defect. Mesh was sutured in place to the myofascial layer to avoid dislodgement using 2-0 polypropylene sutures at the four corners and in between, depending on the dimension of the mesh. The myofascial layer was then closed with a running 1-0 polypropylene suture.

Onlay mesh placement was done by dissecting off the skin and subcutaneous tissue just superficial to the anterior rectus sheath to allow 5 cm overlap of the mesh beyond the margins of the defect. The myofascial layer was closed with continuous 1-0 polypropylene suture and mesh of adequate size placed with 5cm overlap from the suture line of the reconstituted myofascial layer and fixed in place with interrupted sutures of 2-0 polypropylene.

Suction drains were placed over the mesh in all cases. Subcutaneous tissue was approximated with polyglactin sutures. Skin closure was done with staples. Parenteral antibiotics were continued till removal of drain. Oral fluids were started in the postoperative evening and normal diet resumed on day 1, except in cases of ileus, where a slower return to oral diet was required. Patients were ambulated the next morning after surgery. Dressings were removed on the second day postoperatively. Sutures were removed on day 9 -12 depending on healing of the operative wound. Seromas were treated with aspiration and continuation of oral antibiotics for five days. Infections were managed by removal of few sutures to afford good drainage, continued antibiotics and dressings.

Patients were discharged as soon as they were ambulant and on normal diet with advice to avoid lifting heavy objects for six months. They were reviewed at one month in the outpatient department. Further follow up at six months, one year and two years was done by a telephonic interview. Outcome was assessed and recorded for early complications (seroma, surgical site infections), chronic discomfort affecting ADL (activities of daily living) and recurrence of hernia upto two years. Statistical analysis was carried out using SPSS in consultation with a statistician. Statistical significance was inferred when p values were < 0.05.

## 3. Results

Open mesh repair was done in 121 patients during the period of the study. Two year follow up could be done for 103 patients (17 were lost to follow up and one died due to unrelated causes). Out of these 51 had undergone onlay mesh placement and 52 had preperitoneal mesh placement.

Pre operative assessment of patients with demographics, co-morbidities and type of hernia is summarized in table 1. More than half the patients were in the age group 40 – 60 years. The youngest patient, 24 year old was a case of epigastric hernia. The oldest patient was an 83 year old male with paraumbilical hernia. The majority of the patients were females (57.3%). However, there were no significant differences in the surgical procedures depending on the demographics of ventral hernias. Incisional hernias made up 41.7% of ventral hernias in the study. Significantly higher number of incisional hernias underwent onlay mesh repair than preperitoneal repair ( $p = 0.025$ ). More than two – thirds (68.7%) of all patients had at least one co – morbidity, There was no significant difference in the type of repair on the basis of presence of co – morbidities. Intra –operative findings are summarized in Table 2. Majority of the patients (79%) had defect sizes between 2 – 4 cm. Ten patients had multiple defects. 77 of the hernias (76.7%) had omentum as content.

Post operative outcomes and complications are summarized in Table 3. Overall, 17 out of 103 patients had complications. 13 of them were in the onlay mesh group, while 4 were in the preperitoneal group ( $p = 0.031$ ). There were 20 complications in these 17 patients, 16 of which were early complications like seroma and SSI. Majority of the early complications occurred in the onlay mesh group (12 out of 16), though the difference was not statistically

significant. Among the four late complications, two patients had chronic pain and recurrence of hernia, both in the onlay group. This too, was not statistically significant.

#### 4. Discussion

In this study, ventral hernia patients were included according to the traditionally followed definitions [1] as well as the international online registry (Eura HS) proposed by the European Hernia Society [12] – “a hernia of the abdominal wall excluding the inguinal area, the pelvic area and the diaphragm”. Polypropylene mesh was used in all cases. Patients who underwent “onlay” repair (placement of mesh anterior to the anterior rectus sheath/ external oblique) were compared with those who underwent “preperitoneal” repair (mesh placement between the parietal peritoneum and the posterior rectus sheath). The definitions of these planes of mesh placement are in accordance with the consensus proposed [3].

The study was conducted at a tertiary care hospital training general surgeons. The procedures were performed by surgical residents in the final year of their training under the guidance of consultants. It is well documented that preperitoneal repair is technically more difficult and consumes more time than onlay repair [13,14]. In every case, the default plan was the “better” procedure of preperitoneal mesh placement. In case of difficulty in achieving a safe and sufficient preperitoneal space for adequate mesh overlap of the defect, the decision to perform onlay repair was made.

Age or sex of the patient did not make any significant difference in predisposing the patient to either of the repair procedures (Table 1) Patients with co-morbidities, especially diabetics have been reported to have higher chances of undergoing onlay repair, possibly due to the differences in healing properties or conscious decision to avoid preperitoneal repair which takes longer time [15]. In our series too, patients with diabetes, hypertension and obesity were more prone to undergo onlay repair, though the differences were statistically insignificant.

Even though only 43 patients (41.7%) had incisional hernias, they contributed to 54.9% of all onlay repairs. This was statistically significant ( $p = 0.025$ ) when compared to spontaneous ventral hernias which contributed to 71.2% of all preperitoneal repairs. This can be well explained by the fact that incisional hernias develop in scars wherein adhesions make the dissection of peritoneum off the posterior rectus sheath more difficult and subject to tearing.

The size of the defect did not have any significant effect in the procedure selected. The maximum size of defect in our series was 9 cm, a case of post traumatic midline laparotomy. Ten patients had multiple defects in the scar, the so called “swiss cheese defect” [16]. Eight out of these ten patients underwent preperitoneal repair, possibly because of multiple sacs providing redundant peritoneum, thus allowing for suture repair of peritoneum and creation of the preperitoneal space for mesh placement. Majority of the hernias contained intra-peritoneal structures (viz. omentum and gut,  $n = 9$ ) Out of the 13 patients who had

preperitoneal fat as content, a large majority ( $n=11$ ) underwent preperitoneal repair, well explained by the ease of dissecting under a defect which does not transmit a sac. However, the  $p$  value (0.052) for the tendency of individual groups (omentum, pre-peritoneal fat, small bowel and large bowel as contents) to undergo onlay or preperitoneal repair was just short of the value of significance.

Overall, 17 patients (16.5%) had complications. Rate of complications was 25.5% (13/51) for onlay mesh group and 7.7 % (4/52) for preperitoneal group ( $p = 0.031$ ). There were 20 complications in these 17 patients, 16 of which were early complications like seroma and SSI. Majority of the early complications occurred in the onlay mesh group (12 out of 16), though the difference was not statistically significant. Two patients had chronic discomfort affecting ADL and recurrence of hernia, both in the onlay group. This too, was not statistically significant.

Seven patients (6.8%) developed seroma, whereas incidences upto 11% have been described in large reviews [17]. Higher incidence of seroma in onlay mesh repair when compared to sublay or preperitoneal repair has been a consistent finding in literature [14, 18, 19, 20]. The dissection of subcutaneous tissue off the anterior rectus sheath and the external oblique aponeurosis during onlay mesh repair is non anatomical and transects capillaries as well as perforating vessels passing from inside the rectus sheath to the skin. Insertion of prosthetic material within this space further adds to the tendency for tissue fluid to collect due to foreign body reaction. Even though this space is usually drained with closed suction devices, seroma formation can be sustained till effective vascularity is established by regeneration of capillaries within the healing tissue [21]. In comparison, the preperitoneal procedure involves placement of mesh within an already existing anatomical plane between the rectus and the peritoneum with the rich lymphatics of the peritoneum and rectus muscles on either side which absorb the tissue fluid. In our study, 6 out of 7 patients who developed seroma were in the onlay mesh group – an incidence of 11.5 % in the onlay group and 1.9 % in the preperitoneal group.

The overall rates for infection in open mesh hernia repairs for ventral hernia have been reported from 6 -12 % [22,23]. In our study, 9/ 103 patients (8.7%) had surgical site infections – six in the onlay group (11.5%) and three in the preperitoneal group (2.9%). Even though the differences were not statistically significant, the trend was in agreement with literature [11, 24]. Infections were managed with drainage, dressings and antibiotics. Though other reviews have reported upto 2% mesh explantation [17], it was not required for any patient in our series.

We had two recurrences (1.9%), associated with chronic dragging discomfort affecting activities of daily living. Both were in the onlay group (3.9%,  $p = 0.495$ ). Higher recurrence rates for onlay mesh repairs has been well documented in various studies, recent meta-analyses and Cochrane reviews [8, 11, 24, 25]. It is but logical that the repair is more secure if the prosthesis is placed in such a way that intra-abdominal pressure tends to closely appose it against the defect as in the case of preperitoneal repair, rather than the pressure tending to force the mesh away from a



weakened suture line as in case of onlay repair. Added to this physical disadvantage is the fact that there is iatrogenic devascularisation in the subcutaneous tissue – myofascial layer interface in case of an onlay repair. Hence structurally and functionally, onlay repair remains inferior in quality to preperitoneal repair.

## 5. Conclusion

The use of prosthetic mesh has widely been accepted as the standard of care in repair of abdominal wall hernias [7, 26, 27], with most studies concluding that there are certain benefits of positioning the mesh posterior to the rectus muscle complex, rather than anteriorly in its interface with subcutaneous tissue. Our study found that even though significantly higher number of overall complications occurred in the onlay group, there was no statistically significant difference in the long term outcome during the period of two year follow up.

With laparoscopic expertise and facilities still not widely established [28] and available, open mesh repair remains the usually available option to most patients. While fresh debates are on to evaluate the long term advantages of the use of prosthetic mesh [29], open onlay mesh repair for ventral hernia remains a reasonably safe option without significant long term differences in outcome when compared with preperitoneal repair in a technically difficult situation or in the hands of a novice surgeon. It should be opted for especially when there are chances of bowel injury due to difficult dissection to create safe and sufficient preperitoneal space, or when there is a high chance of the mesh itself eroding the bowel through a thinned out and scarred peritoneum.

## 6. Conflicts of Interest

Nil

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**Table 1: Demographics and Pre – operative Findings**

	Total (n = 103)	Onlay group (n=51)	Preperitoneal group (n= 52)	P value	Chi-square value
<b>Age group</b>					
3 <sup>rd</sup> decade	6 (5.82%)	3 (5.9%)	3 (5.8%)	0.805(f)	
4 <sup>th</sup> decade	19 (18.44%)	8 (15.7%)	11 (21.2%)		
5 <sup>th</sup> decade	27 (26.21%)	13(25.5%)	14(26.9%)		
6 <sup>th</sup> decade	30 (29.12%)	17(33.0%)	13(25.0%)		
7 <sup>th</sup> decade	16 (15.5%)	7(13.8%)	9(17.3%)		
8 <sup>th</sup> decade	3 (2.91 %)	1(2.0%)	2(3.8%)		
9 <sup>th</sup> decade	2 (1.94%)	2 (1.96%)	0(0 %)		
<b>Sex</b>				0.678	0.678
Male	44 (42.7%)	20 (39.2%)	24 (46.1%)	0.183 0.146 0.999(f) 0.999(f) 0.356 0.573	0.77 2.11   0.852 0.318
Female	59 (57.3%)	31 (60.8%)	28 (53.9%)		
<b>Co morbidities</b>					
Absent	71 (68.9%)	32 (62.8%)	39 (75.0%)		
Present	32 (31.1%)	19 (37.2%)	13 (25.0%)		
Diabetes	10	7	3		
Hypertension	24	15	9		
CAD	3	1	2		
Hypothyroidism	3	1	2		
Anemia	11	4	7		
Obesity	18	10	8		
<b>Type of hernia</b>				0.025	7.417
Incisional	43 (41.7%)	28 (54.9%)	15 (28.8%)		
Spontaneous	60 (57.3%)	23 (45.1%)	37 (71.2%)		
Umbilical/ Paraumbilical	43	15	27		
Epigastric	17	8	9		

Statistical significance calculated by Chi square test in all data except those marked as (f) were the Fischer's exact test was used

**Table 2: Intra – operative Findings**

	Total (n = 103)	Onlay group (n=51)	Preperitoneal group (n= 52)	p value
<b>Defect size</b>				
2 – 4 cm	79 (76.7%)	44 (86.27%)	35 (67.30%)	0.123(f)
4 – 6 cm	10 (9.7%)	4 (7.84%)	6 (11.53%)	
> 6 cm	4 (3.9%)	1(1.96%)	3(5.76%)	
Multiple defects	10 (9.7%)	2 (3.92)	8 (15.38%)	
<b>Hernial contents</b>				0.052(f)
Omentum	77 (74%)	41 (80.4%)	36 (69.2%)	
Preperitoneal fat	13 (12.7%)	2 (3.9%)	11 (21.2%)	
Small bowel	8 (7.8%)	5 (9.8%)	3 (5.8%)	
Large bowel	5 (4.9%)	3 (5.9%)	2 (3.8%)	

**Table 3: Complications**

	Total (n = 103)	Onlay group (n=51)	Preperitoneal group (n= 52)	p value
<b>No of Patients with complications</b>	17(16.5%)	13 (25.5%)	4 (7.7%)	0.031
<b>Early complications</b>				
Seroma	7 (6.8%)	6 (11.5%)	1 (1.9%)	0.112
SSI	9 (8.7%)	6 (11.5%)	3 (2.9%)	0.295
<b>Late complications</b>				
Chronic pain	2 (1.9%)	2 (3.9%)	0	0.495
Recurrence	2 (1.9%)	2 (3.9%)	0	0.495

Statistical significance calculated by Chi square test in all data except those marked as (f) were the Fischer's exact test was used