Bangladesh Crit Care J March 2025; 13 (1): 39-45

Original Article

Sublay (Retro muscular) Mesh Reinforcement Technique for Open Incisional Hernia Repair: A Preferable Method to Onlay Regarding Early Outcome

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DOI: https://doi.org/10.3329/bccj.v13i1.81309

Abstract:

Background: *Incisional hernia after laparotomy is a well-known complication and the repair has always been a challenge to the surgeons. Various operative techniques for the repair of incisional hernia are in practice among which the retro muscular mesh placement or the sublay technique popularized by Rives and Stoppa, has been reported to be quite effective, with low recurrence rates (0-23%) and minimal complications. In the study we tried to evaluate and compare the early clinical outcome in terms of patient morbidity and procedure related complication of both sublay and onlay mesh repair technique.*

Objective: *To evaluate and compare the early post-operative outcome of sublay versus onlay mesh repair in the treatment of incisional hernia.*

Methods: *The study was conducted at the Department of Surgery, Sir Salimullah Medical College & Mitford Hospital and Department of Surgery, BIRDEM General Hospital over a period of one year (from December 2019 to November 2020). It was a prospective randomized control trial using 30 cases, Group A sublay (experimental group) and Group B onlay (control group) – 15 patients in each group. The study was approved by the Institutional Ethical Committee. All the patients were followed up postoperatively up to 6 weeks. Data were analysed by SPSS version 23.*

Results: *Regarding post-operative pain, in Group - A patients, pain score was significantly lower than Group - B patients at 24, 48 & 96 hours ($p < 0.001$, < 001 and < 0.05 respectively). In regards of drain removal, Group A patients were benefited by early drain removal than Group B ($p < 0.015$). Mean hospital stay was lower in Group A which was statistically significant.*

Regarding early postoperative outcome, none of the patients in both groups have experienced the common postoperative complications (seroma formation, wound dehiscence, wound infection, mesh reaction & paralytic ileus) in treatment of incisional hernia. This is possibly because of the adequate pre-operative preparation of the patients, preparation of the operative site and meticulous postoperative care. The mean operative time taken in this study was 106.00 ± 29.71 in case of group A and 119.67 ± 44.90 in case group B with P value of 0.418, which is statistically insignificant. The mean age, sex, BMI of the sample population, clinical presentations and per operative findings were comparable.

Conclusion: *In this study sublay mesh repair showed excellent short-term results, with minimal morbidity. So, it is a good alternative to onlay mesh repair that may be applicable to all forms of incisional hernia.*

Key words: *Mesh reaction, onlay mesh repair technique, retro muscular mesh placement, sublay mesh repair technique.*

Introduction:

'Hernia' derived from the Latin word 'Succi Hernialis', which may be defined as protrusion of a viscous or part of a viscous through an abnormal opening in the wall of its containing cavity. Incisional hernia occurs because of failure of facial tissues to heal following laparotomy, mostly encountered with midline vertical and transverse incisions. It starts as a disruption of the musculofascial layers of an wound in early postoperative period.

Incidences of these hernias have been reported 10-50% of laparotomy incisions and 1-5% of laparoscopic port site incisions.[1] Factors predisposing to their development are, patient factors (obesity, general poor healing due to malnutrition, immune-suppression or steroid therapy, chronic cough, cancer), wound factor (poor quality tissue, wound infection) and surgical factors (inappropriate suture material, incorrect suture placement).[1] Successful repair of incisional hernias involve detailed understanding of anatomy regarding anterior abdominal wall and its involved layers.

There are numerous options for mesh placement in incisional hernia repair. Onlay (overlay) repair places the mesh on the

Received : December 10, 2024; Accepted : March 12, 2025

anterior fascia, which typically involves dissection of flaps and primary closure of the fascia below the mesh. Inlay repair places the mesh in the hernia defect and secure the mesh circumferentially to the edges of the fascia. Sublay repair refers to retromuscular or preperitoneal mesh placement. It is also commonly referred to as a Rives-Stoppa or retro-muscular repair. Finally, the underlay repair is when mesh is placed in the intraperitoneal position and secured to the anterior abdominal wall. The underlay is also referred to as an intra peritoneal onlay mesh (IPOM). In the laparoscopic literatures an IPOM refers to an intraperitoneal mesh position which is equivalent to an underlay mesh position.

Onlay mesh repair is mostly practiced method for incisional hernia repair during open technique. But as the mesh lying in subcutaneous space, it is more prone to infection.[1] The number of local studies on this topic is limited, with onlay technique being more commonly employed by most surgeons because of shorter operation time, however it is associated with higher incidence of complications.[2] The sublay technique is popularized by Rives and Stoppa in Europe.[3] This technique has several advantages one of being not transmitting the infection from subcutaneous tissue down to the mesh as it lies quite. Increased intra-abdominal pressure acting anteriorly on the margins tends to oppose the mesh the abdominal wall rather to distracting it. Some studies suggests that the use of the sublay technique as a treatment option for ventral hernias appears to be less complicated than the onlay technique.[3] Laparoscopic hernia repair has also gained popularity over the recent times, but in a developing country like ours the equipment as well as skilled manpower is not available everywhere.[2] However it requires specialized equipment and expensive tissue separating mesh.[1] Laparoscopic IPOM had disadvantages in terms of intraoperative complications, mainly bleeding and bowel injuries. Intraperitoneal meshes can cause severe pain lasting for 24-48 hours after surgery which can mimic peritonitis.[1]

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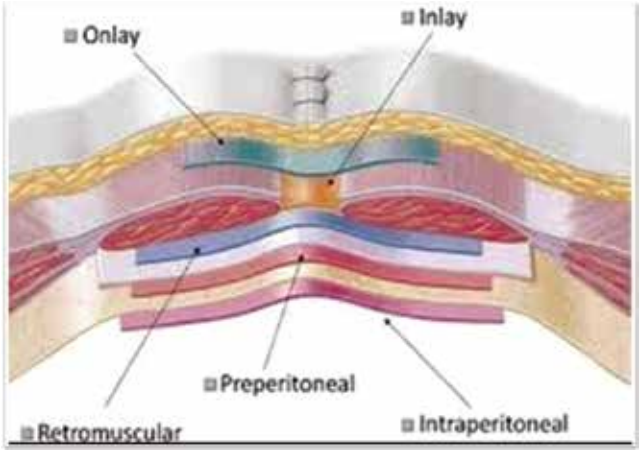

Fig - 1 : Different mesh positions for incisional hernia repair.[2]

Comparing the above different mesh positions the sublay mesh hernia repair seems to be a reasonable option. As all the methods are practicing in our set up (onlay is much more practiced than sublay technique), so to evaluate both and to set up an ideal protocol for treatment, this study was conducted. This was a randomized controlled trial study.

Materials and method:

This study was carried out among 30 patients of incisional hernia, divided into two groups, admitted in different surgery units of Sir Salimullah Medical College & Mitford Hospital and BIRDEM General Hospital for a period of 1 year from December 2019 to November 2020.

Sampling technique was Purposive sampling followed by block randomization. Approval was taken from Institutional review board (IRB), SSMC & MH, Dhaka to carry out this study. Permission was also taken from Head of the Department of surgery and Director General BIRDEM hospital regarding collecting Data. All the patients were selected according to the inclusion criteria. Soft polypropylene mesh was used in all patients (mesh size depended upon the size of the defect). Patients were followed up postoperatively for 6 (six) weeks to assess any complications.

Inclusion criteria:

Patients of both genders having the following criteria were included in the study -

- All type of incisional hernias
- Recurrent incisional hernia
- Port site hernia

Exclusion criteria:

- Incisional hernia - size $\leq$ 2 cm.

  Following groups of patients were excluded from the study as different degrees of their comorbidities may cause complications to the procedure -

- Patients with abdominal malignancy, Cirrhosis of liver.

- Patients presented as emergency like strangulated hernia with signs of obstruction (abdominal distention, vomiting and absolute constipation).
- Pre-existing skin infection at the site of hernia with local signs of inflammation.

Evaluations of the patients:

30 patients were divided into two equal groups (groups A and B) by block randomization. Patients in group A were treated with sublay repair, whereas patients in group B were treated with traditional onlay repair. All patients were subjected to preoperative assessment and postoperative follow-up. Outpatient clinical notes, discharge summary, operative notes, and laboratory data were reviewed.

The patients were evaluated preoperatively with history, clinical examination, baseline investigation and radiological evaluation. History of patients included nature of comorbidity, nature of index surgery, wound events at index surgery and symptomatology. Clinical examination would determine the site, size of defect & contents.

Each patient underwent the following evaluations: Complete blood count, Liver function tests, Fasting and postprandial blood glucose, Kidney function, Radiological evaluation of the abdomen by - Abdominal ultrasound & Computed tomography (in most of the cases to characterise the defect, classify and determine loss of domain), ECG and Echocardiogram (where necessary).

Correction of anaemia, hypoalbuminemia, cessation of smoking (for at least 4 weeks before surgery) and weight reduction before surgery were ensured.

On the day of surgery, preoperatively the patients were prepared with local part preparation, single shot of tetanus toxoid and 3rd generation cephalosporin.

Operative methods:

The operations were performed under general anaesthesia. In all cases the old scar was excised, and the hernia sac and defect were exposed adequately. The sac was opened and the content was reduced after lysis of the adhesions. The excess sac was excised.

In onlay repair, the hernia defect was closed primarily with a continuous nonabsorbable suture. After that, the mesh was cut to a diameter 5 cm greater in all directions than the defect and fixed to the fascia with interrupted 2/0 polypropylene sutures. A suction drain was used and the skin was closed.

In sublay repair, the preperitoneal, retro muscular space was dissected about 5–6 cm beyond the edge of the defect where the mesh was positioned and fixed by 2/0 polypropylene sutures after closer of the defect by delayed absorbable suture. Suction drains were laid on the mesh and brought out through a separate stab. The muscular aponeurotic structures were repaired with prolene no.1, followed by skin closure.

In all patients a soft polypropylene mesh was used. Suction drain was removed when drainage was less than 20 cc with no infection.

Post-operative management:

All patients received inj. Pethidine as an analgesic up to first postoperative day and inj. Ketorolac 30 mg on second and tab. Ketorolac on subsequent postoperative days. Antibiotics were given up to the fourteenth day.

Deep breathing exercises and limbs movements in bed were advised once the patient had recovered from anaesthesia. The patients were encouraged for early gradual ambulation. At the time of discharge, patients were advised to avoid carrying heavy weights and to wear an abdominal belt. Skin sutures were removed usually on the 7th post-operative day and in a few cases after the 10th day (in case of diabetic patients).

Post-operative outcome assessment:

Each patient was assessed before discharge for early postoperative complications such as postoperative fever, pain, subcutaneous seroma, wound infection, ileus, and urinary retention. Thereafter, all patients were followed up at 2 weeks and 6 weeks. The results were tabulated and subjected to statistical analysis.

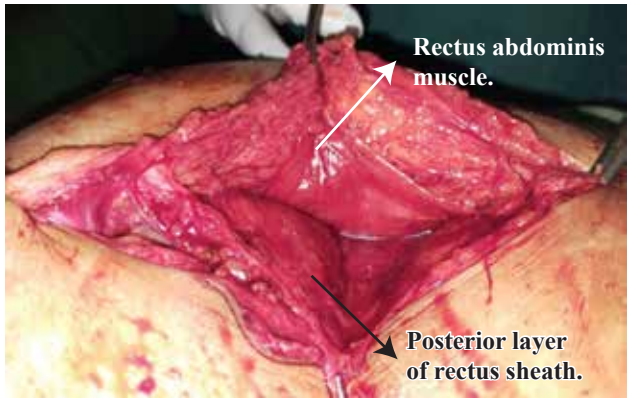

Fig:2 Retro rectus space creation for placement of mesh.

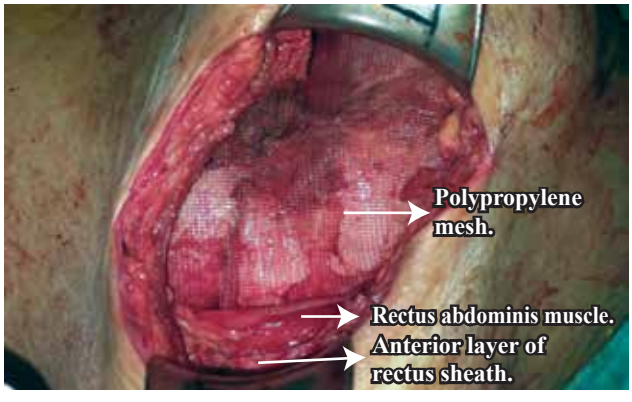

Fig: 3 Placement of mesh in between posterior layer of rectus sheath and rectus abdominis muscle.

Results:

Table I: Distribution of the patients according to demographic variables (N=30)

Demographic variables	Groups		p value
	Group A	Group B	
Age (years)			
o ≤60	10 (66.7)	14 (93.3)	
o >60	5 (33.3)	1 (6.7)	
Mean ± SD	55.20 ± 13.70	46.07 ± 14.33	0.085[c]
Sex			
o Male	7 (46.7)	2 (13.3)	0.109[b]
o Female	8 (53.3)	13 (86.7)	
BMI (kg/m²)			
o Normal	2 (13.3)	5 (33.3)	
o Over weight	10 (66.7)	9 (60.0)	
o Obese	3 (20.0)	1 (6.7)	
Mean ± SD	27.82 ± 2.42	26.23 ± 2.44	0.084

[ca]Chi-square test was done to measure the level of significance.

[b]Fisher's Exact test was done to measure the level of significance.

[c]Unpaired *t* test was done to measure the level of significance.

Figure within parenthesis indicates in percentage.

Regarding age, most of the patients were ≤60 years (66.7% in group A & 93.3% patients in group B). most of the patients were female (total female to male ratio was 2.3:1). most of the patients were overweight (66.7% in group A & in group B 60%). Median duration of hernia in both the groups were 36 months. Increase parity in female has close relevance with developing incisional hernia in females (in group A 75% and in group B 92% females has >2 children). Constipation was the commonest feature after initial surgery (40% in group A & 46% in group B). Patients were moderately heavy workers on an average (53.3% in group -A & 66.7% in group B).

Table II: Distribution of the patients according to examination findings (N=30)

Examination findings	Groups		p value
	Group A	Group B	
Defect of hernia (cm²)			
o Mean ± SD	15.10 ± 12.03	19.92 ± 15.62	
o Median	9	15	0.236[c]
Site of incisional hernia			
o Lower midline incision	8 (53.3)	7 (46.7)	0.999[a]
o Upper midline incision	3 (20.0)	5 (33.3)	0.682[b]
o Oblique	4 (26.7)	3 (20.0)	0.999[b]
Positive Cough impulse	15 (100.0)	15 (100.0)	-

[a]Chi-square test was done to measure the level of significance.

[b]Fisher's Exact test was done to measure the level of significance.

[c]Mann-Whitney U test was done to measure the level of significance.

Figure within parenthesis indicates in percentage.

Mean defect size of hernia in sublay mesh repair group was 15.10 ± 12.03 cm², Whereas the defect size in onlay mesh repair group was 19.92 ± 15.62 cm².

Hernia through lower midline incision was commonest in both the groups (53.3% group A & 46.7% in group B). Mean operating time in group A was 106 ±29.79 min & group B it was 119 ±44.90 min.

Table III: Distribution of the patients according to post-operative pain score (N=30)

Post-operative pain score	Groups		p value
	Group A	Group B	
At 24 hours	5.40 ± 0.74	6.60 ± 0.74	<0.001
At 48 hours	3.20 ± 0.77	4.60 ± 0.99	<0.001
At 72 hours	1.60 ± 0.83	2.13 ± 0.74	0.074
At 96 hours	1.00 ± 0.38	1.40 ± 0.51	0.021

[a]Unpaired *t* test was done to measure the level of significance.

Mean post-operative pain of the patients as per NPRS. In experimental group (Group- A) the mean post-operative pain score rate at 24h, 48h ,72 h and 96h were 5.40 ± 0.74, 3.20 ± 0.77, 1.60 ± 0.83, 1.00 ± 0.38 accordingly. On the other hand, in case of control group (Group –B) these rates are 6.60 ± 0.74, 4.60 ± 0.99, 2.13 ± 0.74, 1.40 ± 0.51 accordingly. In this table the P value in 24hr, 48hr and 96hr are <0.001, <0.001 and 0.021 accordingly, which is statistically significant.

Table IV: Distribution of the patients according to post-operative complications during hospital stay (N=30)

Post-operative complications	Groups		p value
	Group A	Group B	
Seroma formation	-	-	-
Wound dehiscence	-	-	-
Wound infection	-	-	-
Mesh reaction	-	-	-
Paralytic ileus	-	-	-

None of the patients in both groups have experienced the common postoperative complications in treatment of incisional hernia (table IV).

Table V: Distribution of the patients according to duration of drain removal and post-operative hospital stay (N=30)

	Groups		p value
	Group A	Group B	
Duration of drain removal			
o Mean ± SD	4.00 ± 1.69	7.67 ± 4.64	
o Median	4	7	0.015
Post-operative hospital stays (days)			
o Mean ± SD	5.33 ± 2.41	9.60 ± 5.69	
o Median	4	9	0.019

[c]Unpaired *t* test was done to measure the level of significance.

In table V, the mean duration after which the drains removed were 4.00 ± 1.69 days in case of experimental group (group-A) and 7.67 ± 4.64 days in control group (group –B) with a statistically significant P value of 0.015. The mean duration of hospital stays in Group – A was 5.33 ± 2.41 days and in Group –B was 9.60 ± 5.69 days with a P value of 0.019 which is significant statistically.

After 2 weeks 2(13.3%) patients in group –A and 5(33.3%) patients in group- B has complained about pain in their operative site. Whereas after 6 weeks it has been declined to 0(0.0%) in group-A and 1(6.7%) in group- B.

Discussion:

Each incision made on the abdominal wall predisposes the individual to a second operation for repair of incisional hernia. The outcome of hernia surgery based not only on the technique used but on the experience of the operator, meticulous dissection, tension free repair etc. Common practiced techniques for open incisional hernia repair is to use mesh, which is placed either in a sublay (retro muscular) or onlay (mesh placed in subcutaneous plane, over the anterior rectus sheath) position. The refinement of the sublay technique resulted in an overall better outcome making it to be declared the standard of care for incisional hernias.[4]

The mean age of the patients in this study was 55.20 ± 13.70 years in group A and 46.07 ± 14.33 years in group B which is almost similar to other studies.[3,5] Regarding age the study also shows that age of most of the patients were ≤60 years (80%) which is also similar to previous studies.[6]

Most of the patients were female in our study (21patients, i.e. 70%) with a female to male ratio of 2.3:1. In another study it was found 14.6:1, which is consistent with our result.[2] The high female preponderance can be attributed to the majority of index operations being Gynaecological operations with a Pfannenstiel or lower midline incisions and thin rectus sheath, which result in incisional hernia.

The mean BMI in our study was 27.82 ± 2.42 kg/m² in Sublay group and 26.23 ± 2.44 kg/m² in Onlay group. Almost similar result was shown in a study published by Mushtaq U. et al 2019.

The study shows mean duration of the swelling in case of sublay mesh repair is 19.17 ± 17.83 months, whereas in case of onlay mesh repair it is 34.27 ± 46.15 months. In group A 3(20.0%) patients have constipation and 1 (6.7%) patient has urinary symptom as an associated complain. In group B 1(6.7%) patient presented with chronic cough and 5(33.3%) patients presented with constipation as an associated symptom.

In this study, median duration of previous surgery in both the groups were 36 months. Most of our patients were moderately heavy workers (60.0%). Regarding predisposing factors, increase parity has an effect on developing incisional hernia in females as it causes laxity of the lower abdominal muscles. Only 3 (20.0%) patients were found smoker. Constipation was most common problem in postoperative period after initial surgery (43.0%) followed by postoperative wound infection (20.0%).

The mean defect size of hernia in sublay (retro muscular) mesh repair group was 15.10 ± 12.03 cm^2 and in onlay mesh repair group was 19.92 ± 15.62cm^2**.** In our study, lower midline defects were predominated (15 patients, 50.0%) in comparison with other incisions which is found similar with other studies.[7,8] The mean operative time taken in this study was 106.00 ± 29.71 in case of group A and 119.67 ± 44.90 in case of group B with P value of 0.418, which is statistically insignificant. This time requirement may vary as it depends on surgeon's expertise, quality of assistance and dissection plane.[2,3]

In group-A, the mean post-operative pain score rate (as per NPRS) at 24h, 48h ,72h and 96h were 5.40 ± 0.74, 3.20 ± 0.77, 1.60 ± 0.83, 1.00 ± 0.38 accordingly. On the other hand, in case of group–B these rates are 6.60 ± 0.74, 4.60 ± 0.99, 2.13 ± 0.74, 1.40 ± 0.51 accordingly. Here the P value in 24hr, 48hr and 96hr are <0.001, <0.001 and 0.021 accordingly, which is statistically significant.[8,9,10]

Regarding early postoperative outcome, none of the patients in both groups have experienced the common postoperative complications (seroma formation, wound dehiscence, wound infection, mesh reaction & paralytic ileus) in treatment of incisional hernia. Significant differences were found here with other studies.[3,4,7-22.] This is possibly because most of the surgeries were performed by the expert hands of senior surgeons, adequate pre-operative preparation of the patients, preparation of the operative site and meticulous postoperative care.

In this study, the mean duration after which the drains removed were 4.00 ± 1.69 days in case of sublay group and 7.67 ± 4.64 days in onlay group with a statistically significant P value of 0.015. Duration of drain removal is more in onlay technique is due to the fact that it requires more subcutaneous dissection to place the mesh.[4]

The mean duration of hospital stay in sublay group was 5.33 ± 2.41 days and in onlay group was 9.60 ± 5.69 days with a P value of 0.019, which is statistically significant. Our result shows similarity with other recent studies where the mean hospital stay was found less in sublay (retro muscular) group.[10,16,23]

During postoperative follow up, after 2 weeks 2 (13.3%) patients in sublay group and 5(33.3%) patients in onlay group has complained about pain in their operative site. Whereas after 6 weeks it has been declined to 0(0.0%) and 1(6.7%) successively. None of the patients in both groups have experienced the common postoperative complications (seroma formation, wound dehiscence, wound infection & mesh reaction) during follow up after 2 weeks and 6 weeks.

Retro muscular plain is considered to be a better alternative for mesh implantation for many reasons. First, this plane is highly vascular, hence, it prevents infection. Second, the prosthesis in this plane cannot be dislodged or ruptured by intra-abdominal pressure, but instead is held in place by the same force that causes hernia. Third, the prosthesis adheres early to the posterior rectus sheath and renders it inextensible, permitting no further herniation. Finally, the retromuscular space is an already existing anatomical plane, requiring no dissection, and the bare posterior surface of the of the rectus muscles is rich in lymphatics capable to absorb any collecting seroma.[7]

Considering the above discussion regarding our study placement of the mesh in the retromuscular plain seems to be a reasonable alternative.

Conclusion:

Placement of mesh in different positions or layers of abdominal wall yield different results. Our study aimed at determining the sublay (retromuscular) placement of mesh as an acceptable technique with minimal morbidity and maximum benefit in terms of early post-operative outcome in comparison with conventional onlay mesh repair. We found differences between these two methods in our study in perspective of post-operative pain score rate, drain removal time and post-operative hospital stay, depending on which sublay mesh repair can be considered as a good alternative to onlay mesh repair that may be applicable to the treatment of all forms of incisional hernia.

Limitations:

Although optimum care has been taken in every step of this study, still some limitations existed:

- The study was conducted in two selected institutes, so the study population might not represent the whole community.
- Long term follow up of patients is required to profile cases of recurrence of hernia in either group (minimum 2 years). This was not assessed in this study as the follow up period was limited to six weeks after surgery.

Recommendations:

We recommend a multicenter study of large sample size with long term follow up.

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