

Comparative Study of Onlay and Pre-Peritoneal Mesh Repair in the Management of Ventral Hernias

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Abstract

Background: A ventral hernia in the anterior abdominal wall includes both spontaneous and incisional hernias after an abdominal operation. Mesh repair can be onlay or pre-peritoneal. Controversy exists regarding the use of the type of either meshplasty, due to differences in ease in performing the surgery, time of surgery, complications occurring in the post-operative period and the recurrence.

Aims: (1) To study the anatomical, etiological and clinico-pathological factors leading to ventral hernias. (2) To study the different techniques of repair of ventral hernia with emphasis on pre-peritoneal and onlay mesh repair and their outcomes.

Materials and Methods: 60 patients presenting with the ventral hernias were admitted to Mahatma Gandhi Memorial Hospital, Warangal, from August 2012 to September 2013 and were preoperatively assessed clinically and by ultrasonography to confirm the diagnosis. 30 patients each underwent pre-peritoneal and onlay mesh repair after obtaining consent and satisfying the inclusion and exclusion criteria.

Results: Seroma formation, infection, and chronic pain were seen in 20%, 13.33%, 20% patients, respectively, in onlay mesh repair group and in 10%, 6.66%, and 3.33% patients, respectively, in pre-peritoneal mesh repair group. Recurrence was seen in 10% patients in onlay group. No recurrence was seen in the pre-peritoneal mesh repair group. Associated factors' morbidity was also found to be higher in onlay group.

Conclusion: Seroma formation, infection, and the chronic pain were commonly associated with onlay mesh repair compared to pre-peritoneal mesh repair. Recurrence is higher in cases of ventral hernias operated by onlay mesh repair especially in cases with co-morbidities such as obesity, diabetes, and multiparity. Considering all these observations, we concluded that pre-peritoneal mesh repair is superior to onlay mesh repair.

Key words: Incisional hernia, Mesh repair, Onlay, Pre-peritoneal, Recurrence

INTRODUCTION

Ventral hernia is a protrusion of an abdominal viscus or part of a viscus through the anterior abdominal wall occurring at any site other than the groin. It includes

incisional hernias, paraumbilical hernias, umbilical hernia, epigastric hernias, and spigelian hernias, respectively.¹

The patient seeks medical advice for swelling, discomfort, acute pain, associated gastrointestinal symptoms, or cosmetic symptoms. Diagnosis can be achieved with ease by clinical examination or by ultrasound scanning.

Etiology

The formation of ventral hernias is a multifactorial and complex process. Three types of ventral hernias are recognized: Spontaneous, congenital, and incisional hernias. In 90% of patients, it is an acquired defect

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that is a direct result of increased abdominal pressure.² Causes of this increase in abdominal pressure include multiparous status, obesity, and cirrhosis with ascites.³ Numerous patient-related factors may lead to the formation of ventral hernias and include obesity,⁴ older age, male gender,⁵ sleep apnea,⁴ emphysema and other chronic lung conditions, prostatism,⁶ abdominal distention, steroids,⁶ and jaundice,^{7,8} although some of these causes are controversial. Some evidence suggests that certain biochemical processes, including the metalloproteinases, may lead to both aneurysmal disease and hernia formation. These collagen defects have also been implicated in a higher rate of incisional hernia formation after aortic surgery.⁹ The concept of “metastatic emphysema,” that is, the same processes that break down pulmonary tissue disturb normal fascia, was introduced by Dr. Raymond Read and appears to be well founded.¹⁰

Incisional hernias are unique in that they are the only abdominal wall hernias that are considered to be iatrogenic. It continues to be one of the more common complications of abdominal surgical procedures and is a significant source of morbidity and loss of time from productive employment. Studies have shown that transverse incisions are associated with a reduced incidence of incisional hernia compared to midline vertical laparotomies, although the data are far from conclusive.^{11,12}

Operative Management of Ventral Hernias¹³⁻¹⁷

For many years, the repair of incisional hernia was associated with a high recurrence rate. In more recent years, the introduction of synthetic prosthetic materials has provided the opportunity to perform a tension free repair, thereby reducing the rate of recurrence.

Indications

1. Pain and discomfort
2. Large hernias with small openings
3. A history of recurrent attacks of subacute obstruction, incarceration, irreducibility, and strangulation
4. For cosmetic reasons for a large and unsightly hernia.

General Principles in Repair of Ventral Hernias

1. Spinal and epidural anesthesia gives excellent relaxation with minimal respiratory depression
2. Hemostasis should be as careful and as effective as possible
3. Non absorbable suture material should be used for the repair
4. The choice of incision is governed by the orientation of the defect
5. Healthy fascia must be isolated
6. Closure of the sac is done in one layer, incorporating both fascia and peritoneum after opening the sac,

freeing all adhesions, reducing the viscera and exploring the abdomen

7. Drains should be used wherever needed.

Operative Methods for Repair of Ventral Hernia

The three basic methods are:

1. Primary suture or edge to edge closure
2. Shoelace darns repair
3. Synthetic non-absorbable mesh closure

The method chosen depends on the size of the hernial defect. The size of hernia can be assessed with the patient standing and coughing. The size of the defect and its behavior can be examined with the patient supine. The surgeon's hand with fingers straightened is inserted into the defect, and the patient is requested to raise his head and shoulders forward without the aid of his hands. If necessary, he is asked to raise his straightened legs at the same time.

The repair of narrow hernias is by shoelace technique. This is a quick, easy, and extra peritoneal method that simply returns the unopened hernial sac and its contents to the abdominal cavity and then avoids the tedious and perhaps risky dissection of the adherent loops of bowel on the inner surface of the sac and abdomen. Since the defect is narrow, the lateral cut edges of the rectus sheath come together in the midline and are anchored to the new linea alba. Hernias with a wider defect also can be conveniently repaired by the shoelace darn technique. The third method for these hernias involves the use of sheets of woven or knitted mesh of synthetic non-absorbable materials such as polypropylene, polyester or sheets of expanded polytetrafluoroethylene (PTFE) placed across the defect and stitched to the abdominal wall.

The most common and most favored material today is knitted polypropylene. This method of repair of large post-operative ventral abdominal hernias is a good one and has undoubtedly become popular. It may involve the resection of the hernial sac and the dissection of the adherent loops of bowel with the risk of fistula formation. A large foreign body is used, and the procedure is timeconsuming and requires prolonged anesthesia, whereas shoelace technique is simple, quick, and entirely extra peritoneal.

Prosthetic Mesh Repair

Material of choice

The ideal mesh is one that is cheap and universally available, is easily cut to the required shape, is flexible, slightly elastic, and pleasant to handle. It should be practically indestructible and capable of being rapidly fixed and incorporated by human tissues. It must be inert and elicit little tissue reaction. It must be sterilisable and non-carcinogenic. Polypropylene mesh meets the requirements

of the ideal prosthesis and is today the most common used material for repair of all types of hernia.

The other prosthetic meshes tried are PTFE (Teflon, Gore-Tex), polyester mesh (Dacron), polyglycolic mesh, polyglactic mesh, metal meshes, and gelatin film.

Indications for mesh repair

The indications are:

- Repair of recurrent incisional hernias: Successful repair of recurrent hernias in patients, whose musculature is of poor quality and weak and flabby, fascial coverings are thin and weak, requires prosthetic material.
- In the primary repair of a massive hernia in which tissues are deficient and repair without tension cannot be accomplished readily by conventional techniques of direct suturing. The employment of a bridging prosthesis in a massive incisional hernia will enable the surgeon to avoid excessive tension in wound closure and the hazards of increased intra-abdominal pressure.
- When continued presence of forces tending to disrupt in the future is reasonably predictable. There are certain conditions which present a relatively high risk of recurrence unless prosthetic materials are used. They are chronic cough, increased intra-abdominal pressure from obesity, and massive incisional hernias.
- Losses of essential fascial segments by severe trauma, radical resection of malignant tumors involving the abdominal wall may sometimes require prosthetic materials for effective closure.

Types of Mesh Repair

Various techniques of prosthetic mesh implantation have been explained.

Onlay technique

In this technique, after managing hernial sac and its contents, aponeurosis is approximated using polypropylene suture and the prosthetic mesh is placed over the aponeurosis and fixed with polypropylene suture material.

Inlay mesh repair

After reducing the sac and its contents, the peritoneum is closed using chromic catgut and mesh fixed with polypropylene suture material. Rectus sheath is closed over the mesh. Suction drain kept and wound closed in layers. When placed in the pre-peritoneal position in complex ventral hernia repairs, complication rates are low^{18,19}

Intraperitoneal underlay mesh repair

This technique allows for the largest underlay of mesh on the fascia or abdominal wall, which should reduce recurrence because a larger amount of tissue in growth can occur, reducing possible mesh fascia separation. The open technique involves opening the hernial sac, dissecting

bowel away from the abdominal wall, and placing the mesh intraperitoneally with the non-adhesive surface of mesh facing against the abdominal contents and the tissue in growth side of the mesh against the muscular or fascial side of the abdominal wall. Fixation of the mesh material is currently being debated among surgeons.

Laparoscopic Repair of Ventral Hernia

The laparoscopic approach involves entering the abdomen away from the hernia defect, lysing adhesion to remove structures from the hernial sac, and adjacent abdominal wall. The mesh is inserted through a trocar site and fixed to the abdominal wall with partial thickness tacks or full thickness abdominal muscular or fascial wall suture. The latter is more technically challenging but also more closely duplicates the open approach. The laparoscopic approach has been noted to have a significant seroma rate of approximately 10-15%. The recurrence rates have generally been <5%.²⁰

MATERIALS AND METHODS

60 patients presenting with ventral hernia admitted to Mahatma Gandhi Memorial Hospital, Warangal, from August 2012 to September 2013 were preoperatively assessed clinically and by ultrasonography to confirm the diagnosis. 30 patients each underwent pre-peritoneal and onlay mesh repair after obtaining consent and satisfying the inclusion and exclusion criteria. Statistical significance was confirmed using SPSS 11.1 software.

Inclusion Criteria

All patients presenting with anterior abdominal wall hernias:

- Umbilical hernias
- Epigastric hernias
- Paraumbilical hernias
- Incisional hernias.
- Spigelian hernias

Exclusion Criteria

- Groin hernia
- Divarication of recti
- Patients <12 years of age
- Patients medically not fit for surgery.

Follow-up

All the patients were regularly followed up for 12 months.

RESULTS

Percentage Distribution of Ventral Hernias

In this study of 60 patients of ventral hernia, the most common type of ventral hernia was incisional hernia (40%). Epigastric hernia was the least common type (11.7%) (Table 1).

Age Distribution

The total number of cases studied was 60. The study showed that the maximum number of patients were in the 4th decade of life (58.3%). There were no patients in the age groups 0-10 and 11-20 (Table 2).

Sex Distribution

In a total of 60 cases, 42 patients (70%) were females, and 18 patients (30%) were males (Table 3).

Type of Previous Operation in Incisional Hernia

In our study in cases with incisional hernia (24), 12 cases (50%) underwent tubectomy, 11 lower segment caesarian section (LSCS) (45.8%), and 1 patient underwent hysterectomy (4.2%) (Table 4).

Mode of Presentation

Most of the patients, 51 (85%) presented with swelling, 7 (11.66%) with pain and swelling, and 2 patients with pain, swelling, and vomiting (Table 5).

Table 1: The ventral hernias with respect to number and percentage

Type of hernia	Number	Percentage
Incisional	24	40
Paraumbilical	18	30
Umbilical	11	18.3
Epigastric	7	11.7
Total	60	100

Table 2: Age distribution

Age in years	Number of cases	Percentage
0-10	0	0
11-20	0	0
21-30	9	15
31-40	35	58.3
41-50	13	21.7
51-60	3	5

Table 3: Sex distribution

Sex	Number of patients	Percentage
Male	18	30
Female	42	70

Table 4: Types of previous operations in incisional hernia

Previous operation	Number of patients	Percentage
Tubectomy	12	50
LSCS	11	45.8
Hysterectomy	1	4.2

LSCS: Lower segment cesarian section

Associated Risk Factors or Illness

Of the 60 patients, 15 (25%) were obese, 8 (13.33%) were diabetic, 1 (1.67%) was anemic, and one (1.67%) was hypothyroid. Hence, obesity was the most common associated risk factor (Table 6).

Size of the Defect

The smallest defect measured was 2 cm × 2 cm and the largest defect measured 6 cm × 6 cm in this study.

Antibiotic

All patients were given a dose of third generation cephalosporin at the time of induction of anesthesia, continued with intravenous antibiotics post operatively.

Content of the sac

50 (83.34%) patients had omentum as the content of the sac. 5 (8.33%) had jejunum, 4 (6.66%) had ileum, and 1 (1.67%) had a transverse colon. Hence, omentum was the most common content of the hernial sac (Table 7).

Type of Mesh Repair

30 (50%) patients underwent pre-peritoneal mesh repair, and 30 (50%) patients underwent onlay mesh repair (Table 8).

Table 5: Symptoms/mode of presentation

Symptoms	Number of cases	Percentage
Swelling	51	85
Swelling and pain	7	11.67
Swelling, pain, and vomiting	2	3.33

Table 6: Associated risk factors/illness

Condition	Number of patients	Percentage
Obesity	15	25
Diabetes	8	13.33
Anemia	1	1.67
Hypothyroidism	1	1.67

Table 7: Contents of the sac

Content of the sac	Number of patients	Percentage
Omentum	50	83.34
Jejunum	5	8.33
Ileum	4	6.66
Transverse colon	1	1.67

Table 8: Types of mesh repair

Type of mesh repair	Number of patients	Percentage
Pre-peritoneal mesh repair	30	50
Onlay mesh repair	30	50

Duration of surgery

Mean duration of surgery in Onlay Mesh repair was 45 min and that in pre-peritoneal Mesh repair was 60.15 min. $P < 0.0001$ (Table 9).

Post-operative Complications

Seroma was the most common complication followed by chronic pain and wound infection. Seroma was drained. Chronic pain was managed with analgesics and reassurance. Wound infection was treated with antibiotics and regular dressings (Table 10).

Follow-up and Recurrence

All the patients were regularly followed up for 1 year. Recurrence was observed only in patients with onlay mesh repair. 4 (13.33%) patients out of 30 patients who underwent onlay mesh repair had a recurrence (Table 11).

DISCUSSION

Ventral hernias in the anterior abdominal wall include both spontaneous and most commonly, incisional hernias after an abdominal operation. It is estimated that 2-10% of all abdominal operations result in an incisional hernia.

Small hernias <2½ cm in diameter are often successfully closed with primary tissue repairs. However, larger ones have a recurrence rate of up to 30-40% when a tissue repair alone is performed.¹⁴ Hernia recurrence is distressing to patient and embarrassing to surgeons. Nowadays tension free repair using prosthetic mesh has decreased recurrence to negligible. Despite excellent results increased the risk of infection with the placement of a foreign body and cost factor still exist; however, operating time and hospital length of stay are shortened. Primary tissue repair is associated with higher unacceptable recurrence rate, nowadays; tension free mesh repair is ideal hernia repair technique.¹⁵

Mesh repair can be pre-peritoneal or onlay. Controversy exists among the surgeons regarding the use of a type of either mesh repair, due to differences in ease in performing the surgery, time of surgery, complications occurring in the post-operative period and the recurrence. In our study, attempt has been made to study both types of these mesh repair and their outcome.

Incidence

Incidence among ventral hernias was Incisional hernia - 40%, paraumbilical hernia - 30%, umbilical hernia - 18.3%, epigastric hernia - 11.7%.

Age

Ventral hernias are more common in patients aged between 30 and 40 years (58.3%) in our study. Youngest patient in

our study was 25-year-old. It was found that ventral hernias are rare after 60 years as no patient was more than 60 years in our study.

Sex

Ventral hernias are more common among females. 42 patients were females, and 18 patients were male. In literature, the ratio is 3:1 but in our study, it is 2.33:1. There is no significance difference in the age distribution in males and females, as disease is more common between 30 and 40 years in both. Ellis *et al.*¹³ have obtained a 64.6% of female population in the study of 342 patients. In our study, female population was 70% while Godara *et al.*²¹ series had a female population of 42.5% (Table 12).

Associated Factors in Incisional Hernia

Among incisional hernias gynecological surgeries are the most common associated surgeries. Tubectomy was the most common predisposing surgery, constituting 50% followed by LSCS (45.8%) and hysterectomy (4.2%). Godara *et al.* series²¹ also mentions gynecological surgeries as the most common associated surgery.

Associated Factors with Ventral Hernias

In females most precipitating factor was multiparity. Out of 42 patients, 21 (50%) were multipara. This can be attributed

Table 9: Duration of surgery

Type of mesh repair	Mean duration of surgery (min)
Onlay	45
Pre-peritoneal	60.15

Table 10: Post-operative complications

Complication	Pre-peritoneal	Onlay	Pre-peritoneal (%)	Onlay (%)	P value
Seroma	3	6	10	20	0.3
Wound infection	2	4	6.66	13.33	0.4
Mesh infection	0	0	0	0	-
Chronic pain	1	6	3.33	20	<0.05
Intestinal fistula	0	0	0	0	-

Table 11: Recurrence percentage

Type of operation	Recurrence	Percentage	P value
Pre-peritoneal mesh repair	0	0	-
Onlay mesh repair	4	13.33	<0.04

Table 12: Female percentage

Study group	Percentage females
Ellis <i>et al.</i> ¹³	64.6
Godara <i>et al.</i> ²¹	42.5
Present study	70

to stretching and weakening of anterior abdominal wall musculo-aponeurotic layer. Next common factor was obesity-15 patients (25%). Fat penetrates muscle bundles and layers, weakens aponeurosis and favors appearance of hernia. 8 (13.33%) patients were diabetic, 1 (1.67%) was anemic, and 1 (1.67%) was hypothyroid. In the present series, post-operative morbidity was considerably high in diabetics, contributing 80% of the cases which had post-operative wound infection in the post-operative period. Obesity was another factor that led to increased post-operative morbidity with all 9 cases, of 60 cases in the present series, who developed one or the other post-operative complications being obese. These two important factors are compared with series published by Rios *et al.* and Weber *et al.* in Table 13. Results in the present series are comparable to both these studies.

Clinical Presentation

All patients presented with swelling. About seven patients had pain in the swelling or dragging type of pain abdomen. One patient with incisional hernia and one with umbilical hernia presented with signs of intestinal obstruction and were operated immediately to reduce the hernia and the defect repaired by onlay mesh repair. Toms *et al.*²² concluded that abdominal hernias can present asymptotically to life treating emergencies. About 51 (85%) cases were without complications, 7 (11.67%) were irreducible, and 2 (3.33%) were obstructed. No strangulated case was observed.

Contents of the Sac

The commonest content of the sac observed was omentum 50 (83.33%), followed by jejunum 5 (8.33%), ileum 4 (6.66%), and transverse colon was found in one case (1.67%).

Mean Duration of Surgery

Mean duration of surgery in our series, in cases that underwent onlay mesh repair was 45 min, while in cases with pre-peritoneal Mesh repair took more time and the duration of surgery was 60.15 min in present series ($P < 0.0001$). The difference could be accounted to more time required for dissection for creating pre-peritoneal space. Securing adequate hemostasis is another burden on time. Ease of operation was largely subjective and depends on surgeons' experience, exposure, quality of assistance, and conductive facilities. Godara *et al.*, reported a mean duration of 49.35 min for onlay and a mean duration of 63.15 min for pre-peritoneal mesh repair ($P < 0.0001$), while in Gleysteen²³ series the mean duration for onlay and pre-peritoneal mesh repair were 42 and 70.5 min, respectively. Table 14 shows the comparison of duration of surgery in different series.

Complications

The most common complication observed was seroma in 9 patients (15%). Out of 9 patients, 3 (10%) were in pre-

peritoneal and 6 (20%) in onlay mesh repair group. This complication was managed with seroma drainage. Onlay technique had more of seroma formation, due to the fact that onlay techniques require significant subcutaneous dissection to place the mesh, which can lead to devitalized tissue with seroma formation or infection. The superficial location of the mesh also puts it in danger of becoming infected if there is a superficial wound infection.

Wound infection was found in 6 cases (10%). Out of these, 2 (6.66%) were in a pre-peritoneal group and 4 (13.33%) were in onlay group. These patients were treated with appropriate antibiotics and regular dressing. No patient required removal of mesh because the infection was superficial and responded well to antibiotics.

Chronic pain was a complaint of 7 patients (11.6%) in all. Out of these 6 (20%) were in onlay group while one (3.33%) in pre-peritoneal mesh repair group ($P < 0.05$). The reason for chronic pain in Onlay Mesh repair may be because mesh is placed below subcutaneous plane over the muscle and sutured over it that causes chronic muscle irritation and because of the fact that the closure is in tension.

A significant difference was noticed in chronic pain, between the two techniques, based on the P value calculated on SPSS Software 11.1 while the other complications were comparable between both types of mesh repairs (Table 15).

Hospital Stay

The duration of post-operative hospital stay is an indirect indication of the degree of morbidity in terms of post-operative complications. Average post-operative hospital

Table 13: Associated factors with ventral hernias

Study group	Diabetes	Obesity (%)
Rios <i>et al.</i>	18	9.3
Weber <i>et al.</i>	23	30
Present study	13.33	25

Table 14: Mean duration of surgery

Mean duration in minutes (%)	Godara <i>et al.</i> ²¹ (100)	Gleysteen ²³ (125)	Present study (*50)
Onlay	49.35	42	45
Pre-peritoneal	63.15	70.5	60.15

Table 15: Post-operative complications

Complications* (%)	Godara <i>et al.</i> ²¹	Gleysteen ²³	Present study
Onlay	15	19	20
Pre-peritoneal	22.5	12	10

*Includes seroma, wound infections, and chronic pain

stay period in present series for onlay mesh repair was 7.53 days, as compared to 5.96 days average hospital stay for pre-peritoneal mesh repair ($P < 0.0002$), which were comparable to series published by de Vries Reilingh *et al.*²⁴ and Gleysteen²³ Comparative results are shown in Table 16.

Recurrence

No recurrence of hernia was noticed in pre-peritoneal mesh repair; in present series where as in the onlay group recurrence occurred in 4 (13.33%) cases ($P < 0.04$). Gleysteen²³ found a recurrence rate to be 20% in onlay and 4% in pre-peritoneal mesh repairs (Table 17). A retrospective study in Europe done by de Vries Reilingh *et al.*²⁴ noticed a recurrence rate of 23% in cases that underwent onlay mesh repair, and no recurrence in patients with pre-peritoneal mesh repair.

Pre-peritoneal 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 indistensible 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

1. In the patients presenting with ventral hernia, it is important to recognize the associated risk factors such as diabetes, obesity, parity, previous surgeries to carefully plan the type of repair either pre-peritoneal

or onlay repair to prevent the complications such as seroma formation, wound infection, chronic pain, and the recurrence.

2. Seroma formation, infection, and the chronic pain are found to be more commonly associated with onlay mesh repair compared to pre-peritoneal mesh repair.
3. Recurrence is higher in cases of ventral hernia operated by onlay mesh repair.
4. Recurrence is higher in cases with co-morbidities such as obesity, diabetes, and multiparity.
5. Although time taken for surgery in onlay mesh repair is significantly less compared to pre-peritoneal mesh repair, complications associated with it limits its wider usage. Considering the burden of surgeries especially in third world countries with a limited number of surgeons, it could provide valuable alternative over the pre-peritoneal repair.
6. The ease of the procedure in performing onlay mesh repair over pre-peritoneal repair gives it the points over pre-peritoneal but associated complications limits its use.
7. Finally to conclude, "Pre-peritoneal mesh repair is superior to onlay mesh repair."

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Table 16: Mean hospital stay

Mean hospital stays in days (%)	de Vries Reilingh <i>et al.</i> ²⁴	Gleysteen ²³	Present series
Onlay	8.2	7.9	7.53
Pre-peritoneal	6.1	5.9	5.96

Table 17: Recurrence

Recurrence rate (%)	Gleysteen ²³	de Vries Reilingh <i>et al.</i> ²⁴	Present study
Onlay	20	23	13.33
Pre-peritoneal	4	0	0

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