

Original Article

Onlay Mesh Repair May Reduce the Incidence of Incisional Hernia after Diverting Colostomy Closure

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Key Words

Mesh;
Incisional hernia;
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Purpose. Incisional hernia is a common complication that occurs after diverting colostomy closure. The mesh repairs had been usually used for wound closures in recent years to avoid incisional hernias. So we designed this study to evaluate the effects of mesh repair for the prevention of incisional hernia during colostomy closure.

Methods. The patients underwent diverting stoma closure from January 2015 to August 2021 were divided into two groups: the mesh group, which included patients underwent onlay mesh repair during colostomy closure concurrently, and the simple group, which included patients underwent wound primary closure during colostomy closure. We compared and analyzed the clinical outcomes between these two groups.

Results. Twenty-two patients were excluded from this study. There were 33 patients in the mesh group and 32 patients in the simple group. The clinical data including age, gender distribution, ASA, hospital stay, follow-up interval, ratio of image studies and the complications between two groups was analyzed and no statistically significant difference was noted. The average operation time duration was prolonged in the mesh group (125.1 vs. 98.9 minutes, $p = 0.003$) and more blood loss in the mesh group (41.8 ml vs. 24.2 ml, $p = 0.046$). Two patients had detectable incisional hernia in the mesh group and seven patients in the simple group had detectable incisional hernia ($p = 0.065$).

Conclusions. Onlay mesh wound repair is safe and feasible for patients undergoing colostomy closure. It might decrease the rate of incisional hernias postoperatively.

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Diverting colostomy is a surgical method used to make an artificial outlet for the bowel to allow stool relief from the colon or distal ileum. Diverting colostomy is typically performed in patients who have undergone very low rectal cancer resection or patients with bowel obstruction caused by neoplasm. Diverting colostomy can also be needed in patients with

Fournier's gangrene or other localized perineal infectious diseases. The diverting stoma is usually closed 6-12 months after the underlying disease is controlled by curative surgery or the infection status is resolved. However, incisional hernia is a common complication that occurs after stoma closure, and other operations may be needed for hernia repair.¹ The incidence rate of

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incisional hernia after stoma closure is approximately 0-48% according to a systematic meta-analysis.² Giraldo reported a case-control study where the odds ratio of an incisional hernia after stoma closure was 5.90 with an average follow-up of 35 months.³ Many methods are used to avoid incisional hernias, such as advanced suturing techniques, component separation techniques, use of botulinum toxin type A, and use of a mesh at the time of primary fascia closure.⁴ In recent years, mesh repair has been used for wound closure in a number of study series, and its safety and feasibility have been demonstrated.⁵ Under these conditions, concurrent mesh repair during wound closure may be a suitable method to decrease this kind of postoperative complication.⁶

The first concern regarding mesh use during wound closure is increased risk of infection. Even though bowel preparation is performed, bowel anastomosis is considered a contaminated wound, and a higher surgical site infection rate has been noted previously. However, improved results have been shown in some studies in the last 20 years. Geisler et al. performed hernia repairs in the presence of a stoma or bowel resection; all patients received bowel preparation, and the wound infection rate was only 7%.⁷ Stringers et al. attempted herniorrhaphy with polypropylene mesh during colorectal operations, including right hemicolectomy, colostomy closure, and diverting colostomy.⁸ El-Gazzez et al. reported the use of synthetic mesh in patients undergoing ventral hernia repair during colorectal resection, with a mesh infection rate of 22.5% and a hernia recurrence rate of 40%.⁹ Argudo et al. used prophylactic synthetic mesh onlay repair for elective colorectal surgery in their study; the group with mesh repair had only an 11.8% rate of incisional hernias, and the group without mesh repair had a 73.3% rate of incisional hernias.¹⁰ Several kinds of mesh repairs have been used for incisional hernias, which are classified as onlay, inlay, sublay, and intraperitoneal onlay mesh repair (IPOM) (Fig. 1).¹¹ Onlay mesh repair appears to be easier to perform, so many surgeons choose it, even though sublay mesh repair is usually considered a better method for incisional hernias.^{12,13}

In our institution, mesh repair has become popular management for patients with colostomy closure since

2015, but not for ileostomy closure due to the low risk of incisional hernia.¹⁴ The preliminary results seemed to be promising but the actual value of using mesh to prevent incisional hernia deserved further investigation because few studies focused on mesh repair in colostomy closure. Therefore, we designed this study to evaluate the feasibility and benefits of mesh repair for the prevention of incisional hernia during stoma closure.

Materials and Methods

The medical records of all patients who underwent diverting colostomy closure in the Division of Colorectal Surgery, Department of Surgery, Far East Memorial Hospital from January 2015 to August 2021 were reviewed. The study protocol has been approved by the institution review board (IRB). We retrospectively collected data such as the type of operation, duration of operation, type of mesh chosen, amount of

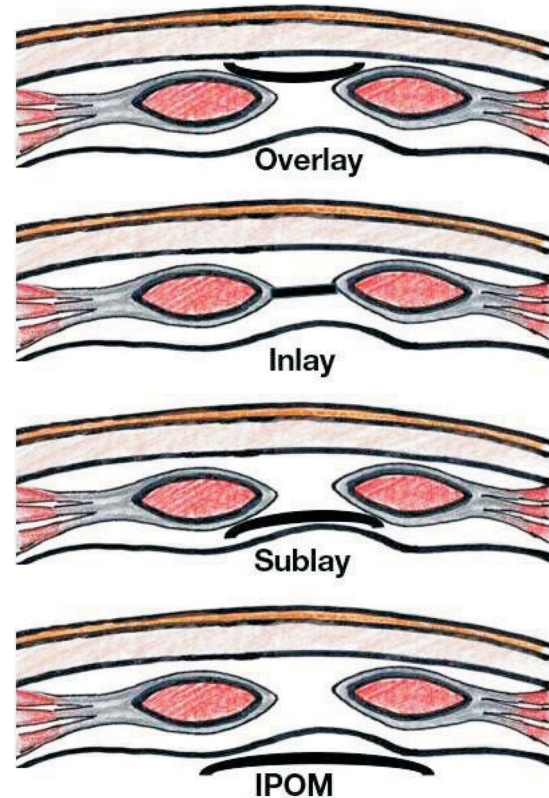


Fig. 1. Several kinds of mesh repairs used for incisional hernias.¹¹

blood loss, length of hospital stay, and postoperative complications. The development of an incisional hernia was detected postoperatively in at least 6-month follow-up period by clinical assessment and documented by either a computed tomography (CT) scan or magnetic resonance imaging (MRI) (Fig. 2). Patients who underwent stoma closure in combination with other operations, such as colectomy or hepatectomy, or patients with prolonged hospitalization for unrelated reasons were excluded. Patients who underwent reversal of Hartmann procedure were also excluded because the surgical approach was different from that of loop stoma closure. The included patients were divided into two groups: the mesh group, operated on by two surgeons who performed onlay mesh repair during colostomy closure concurrently, and the simple group, operated on by the other two surgeons who did not perform onlay mesh repair during colostomy closure. Patients were treated by either with mesh or by simple repairs were upon surgeons' preference.

In the simple group, we used a conventional method to close the fascia layer with interrupted Polysorb sutures, and the skin was closed with interrupted non-absorbable nylon sutures. A drainage tube was placed in the abdominal cavity, and a penrose drain was placed in the subcutaneous layer at the surgeon's discretion.

In the mesh group, we closed the linea alba using interrupted Polysorb or polydioxanone sutures (PDS® Ethicon, NJ, USA) following mesh augmentation, which was placed "onlay" after subcutaneous dissection of at least 3 cm on both sides of the incision. We

used a non-absorbable polypropylene mesh (Optilene® Mesh, B. Braun, Germany) and fixed it with Polysorb sutures to the linea alba and the four corners of the mesh. The completed picture showed as the Fig. 3. Then the skin was closed with non-absorbable nylon sutures. Closed suction subcutaneous drains, such as mini Hemovac drains or Jackson-Pratt drains, were placed in all patients with mesh. The patient selection algorithm was presented at the Fig. 4.

All data were presented as the mean and standard deviation for continuous variables and as numbers

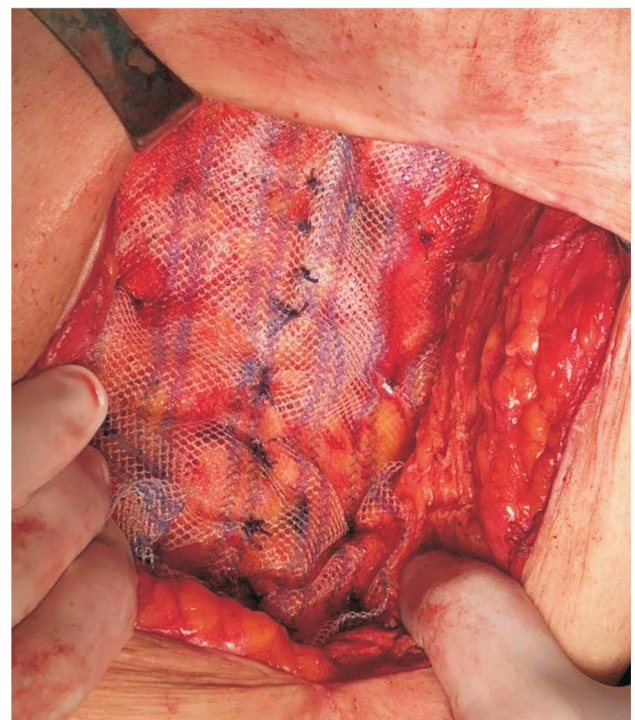


Fig. 3. Onlay mesh repair after the fascia closed by interrupted Polysorb sutures.

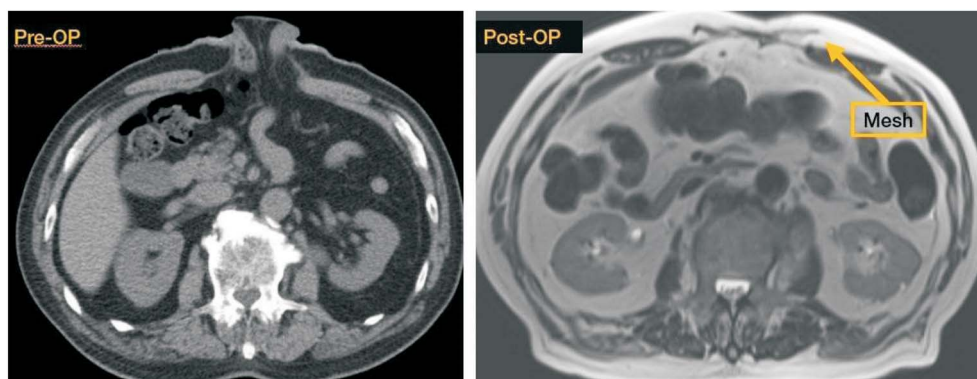


Fig. 2. The development of an incisional hernia was detected in at least 6-month follow-up period by CT scan or MRI.

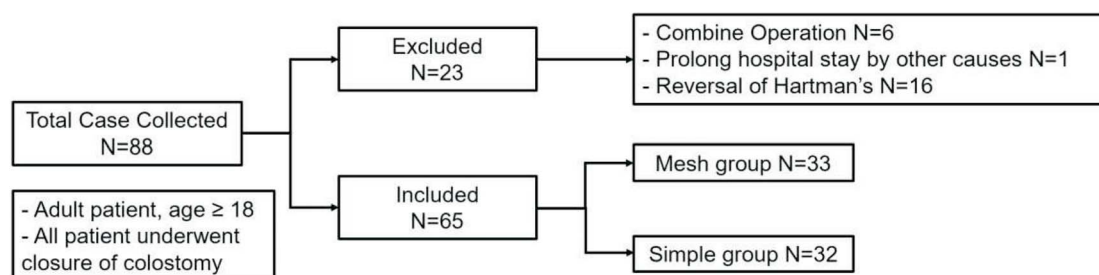


Fig. 4. Patient selection algorithm.

for categorical variables. Comparisons of the continuous data between the two groups were performed with Student's *t* test and the Mann-Whitney *U* test, and comparisons of the categorical data were performed with the Pearson chi-squared test or Fisher's exact test if needed. We used SPSS 22.0 (IBM Corp., NY, USA). $p < 0.05$ was considered statistically significant.

Results

From January 2015 to August 2021, 88 patients underwent stoma closure in our institution were included in our study. Seven of them were excluded for the following reasons: stoma closure combined with other operations such as colectomy or hepatectomy ($N = 4$), prolonged admission due to anal fistula ($N = 1$), and concurrent incisional hernia repair for the previous midline laparotomy ($N = 2$). Sixteen patients who underwent reversal of the Hartmann procedure

were also excluded. The remaining 65 patients were divided into two groups: a mesh group comprised of 33 patients operated on by two surgeons who performed onlay mesh repair during colostomy closure and a simple group comprised of 32 patients operated on by the other two surgeons who did not perform onlay mesh repair during colostomy closure (Fig. 4). The clinical data of the patients, including age, gender distribution, American Society of Anesthesiologist (ASA) score, follow-up interval and the ratio of imaging studies, were shown in Table 1. The average age was 64.7 years in the mesh group and 61.1 years in the simple group ($p = 0.274$). The male-to-female ratio was 23:10 in the mesh group and 26:6 in the simple group ($p = 0.280$). The ASA 2/3 was 22:11 in the mesh group and 21:11 in the simple group ($p = 0.929$). The other outcomes, including length of hospital stay (days), operation duration (minutes), blood loss (ml), detectable incisional hernia, and any complications after operation, a shown in Table 2. The average operation duration was 125.1 minutes in the mesh group and 98.9

Table 1. Baseline characteristics of the patients

Included	Mesh group (n = 33)	Simple group (n = 32)	Total (n = 65)	<i>p</i> -value
Age (mean)	64.7	61.1		0.274
ASA				0.929
ASA II	22	21	43	
ASA III	11	11	22	
Sex				0.28
Male	23	26		
Female	10	6		
Post-op evaluation				
With images study	26 (79%)	16 (50%)	42 (65%)	
Without images study	7 (21%)	16 (50%)	23 (35%)	
Follow up time				
< 2 years	7 (21%)	8 (25%)	15 (23%)	
> 2 years	26 (79%)	24 (75%)	50 (77%)	

minutes in the simple group ($p = 0.003$). The average blood loss was 41.8 ml in the mesh group and 24.2 ml in the simple group ($p = 0.046$). The average hospital stay was 11.4 days in the mesh group and 13.0 days in the simple group ($p = 0.629$). Twelve patients had complications in the mesh group (36.4%, 6 had one complication, 5 had two complications and 1 had three complications). On the other hand, 11 patients had complications in the simple group (34.3%, 5 had one complication, 3 had two complications and 3 had three complications) ($p = 0.665$). Two patients in the mesh group and seven patients in the simple group had a detectable incisional hernia ($p = 0.065$). No mortality or life-threatening events were found in any of the patients.

Discussion

Stoma closure is considered a contaminated surgery. In past years, mesh use in contaminated abdominal surgery has been considered as a contraindication.¹⁵ Recently, several studies have demonstrated that the use of mesh repair in the management of complicated ventral hernia repair was not associated with an increased incidence of surgical site infection (SSI) compared to suture repair, even in potentially contaminated fields.¹⁶ Based on the results of the current study, we believed that mesh repair is also safe for stoma closure because the infectious complication did not increase in the mesh group.

Many studies have reported a high incidence rate of incisional hernia after stoma closure.¹ Bhangu A. published a meta-analysis that included 34 studies and 2729 closed stoma. With a median follow-up time of 36 months, the average rate of hernia occurrence was 7%, and the range was 0-48%.² The other studies showed a higher incidence of incisional hernia of 13-31% as determined symptomatically and up to 30-45% as determined by CT review, and approximately 51% of hernias may need surgical repair.² Varied methods have been applied to avoid incisional hernia, such as component separation techniques (CSTs), botulinum toxin type A (BTA) and mesh repair.⁴ Several studies have shown that using mesh during wound

Table 2. Operation result and complications (the average was calculated with mean)

	Mesh group (n = 33)	Simple group (n = 32)	p-value
Hospital stay (day)	11.4	13.0	0.629
Operation time (min)	125.1	98.9	0.003
Blood loss (ml)	41.8	24.2	0.046
Detectable hernia	2	7	0.065
Complications			0.665
Infection	4	7	
Anastomosis leak	1	2	
Abscess	1	2	
Wound infection	4	3	
Bowel obstruction	4	3	
Post-op bleeding	1	0	

closure may decrease the incidence of incisional hernia. A multicenter, randomized controlled trial showed an amazing result: 790 patients in 37 hospitals were randomized into two groups, mesh closure and standard closure. The hernia rate after two years of follow-up in the mesh group was 12% clinically, and the rate in the control group was 20% ($p = 0.012$); CT revealed that the hernia rate was 9% in the mesh group after one year of follow-up and 21% in the control group ($p < 0.001$). No significant difference in complication rate was found between the two groups, including wound infection, seroma, pain and quality of life.¹⁷ Peltrini R, et al. reviewed 7 studies and collected 1716 cases and classified the types of mesh prevention as onlay, inlay, sublay, and IPOM; the incidence of hernia was not related to the technique used.¹⁸ Peltrini R, et al. also argued that the rate of incisional hernias were not different between using biologic, polypropylene or biosynthetic meshes.¹⁸ Mesh reinforcement after stoma closure has gradually become popular in preventing incisional hernia after operations.

For the hospital stay, in our study, it cost 11.4 days in mesh group and 13.0 days in simple group. Paik B. had evaluated the postoperative outcome of stoma takedown during a mean follow-up of 64.3 months: the postoperative hospital stay was 9.5 days, and the postoperative complication rate was 28.6%.¹⁹ In our study, we calculated the hospital stay since admission, not operation, so it's reasonable that we had two or

three more days than other study. However, we had a higher complication rate compared to other study: 36.4% in mesh group and 34.3% in simple group. The reason was still uncertain, probably the definition of complication was different, and further study or evaluation might be needed.

Although the majorities of studies have confirmed that sublay mesh repair is a better method for treating incisional hernias.^{12,13} However, onlay mesh repair is preferred during stoma closure because it is easier to approach. A higher level of technique might be required for dissection between the fascia and muscle when performing sublay mesh.

The value of onlay mesh repair to reduce the rate of incisional hernias might be highlighted in this study. Our results revealed a trend of decreased incidence of incisional hernia after mesh repair during stoma closure ($p = 0.065$), although the difference was not statistically significant. In contrast, a longer operation time and increased blood loss were noted in the mesh group. It may reflect the nature of a more complex procedure.

As a retrospective study performed in a single institution, there did have some limitations in this study. First, the sample size of patients was small even the study period was 6-year long. Second, there did have some selection bias because the chosen procedures were based upon surgeons' preference. Third, lack in a standard protocol to detect the occurrence of incisional hernias might underestimate the complication rate. Finally, the period of follow up time was not long enough because approximately one quarter of patients were operated within 2 years. Therefore, it deserves further study to investigate if onlay mesh repair is helpful to reduce the rate of postoperative incisional hernias after colostomy closure.

Conclusion

Onlay mesh wound repair is safe and feasible for patients undergoing colostomy closure. It might decrease the rate of incisional hernias postoperatively. It deserves further study to evaluate the actual role of mesh repair in colorectal operations.

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原 著

使用覆蓋式網膜修補可降低結腸造口 閉合後切口疝氣的發生率

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目的 切口疝氣是結腸造口閉合術後常見的併發症。網膜修補於近年來常常被應用於傷口閉合，以減少切口疝氣的發生。因此我們設計了這個實驗，來評估網膜修補對於預防切口疝氣的效果。

方法 從 2015 年 1 月到 2021 年 8 月，於本院接受結腸造口閉合手術的病人被分成兩組：網膜組，病人在關閉造口時同時接受覆蓋式網膜修補；單純組，病人在造口閉合時僅接受一般的傷口關閉。我們比較了兩組之間臨床成績的差異並加以分析。

結果 在排除了 22 個病人後，網膜組分配到 33 個病人而單純組有 32 個。兩組間進行了臨床資料的分析，在年齡、性別、ASA、住院天數、追蹤時間、e 接受影像學檢查的比例和併發症上都沒有統計學上的差異。網膜組的平均手術時間較長 (125.1 比 98.9 分鐘， $p = 0.003$) 而且有著較多的流血量 (41.8 ml 比 24.2 ml, $p = 0.046$)。在網膜組有兩個病人發生切口疝氣，而在單純組則有七個 ($p = 0.065$)。

結論 在造口閉合的病人身上使用覆蓋式網膜修補，是安全而且可行的方式，可以預防降低術後生切口疝氣的機率。

關鍵詞 網膜、切口疝氣、結腸造口閉合、結腸直腸手術。