

# Early Closure of End Ileostomy Following Visceral Slide Assessment Using Abdominal Ultrasound

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## ABSTRACT

**Purpose:** The purpose of our study is to decide whether to perform or not early closure of end ileostomy based on the release of abdominal adhesion following visceral slide assessment using ultrasound after its creation. **Method:** 59 patients with stoma closure from January 2022 to May 2024 were involved in the study. Of these, 9 patients were excluded from the analysis since stoma became permanent, 50 patients (20 female patients) were included. They were divided into 2 groups. In EC (early closure) group, we decided operation timing using ultrasound and performed closure within 180 days after ileostomy. In LC (late closure) group, we performed closure after 180 days based on doctor's judgment without former procedure. **Result:** There was no significant difference in the number of adhesions separated by operation between the 2 groups. Stoma-related complications and readmission rate in EC group were significantly lower than in LC group. No significant difference was noted in terms of operative time, length of postoperative hospital stay, operative intestine injury, morbidity and mortality between the 2 groups. **Conclusion:** Our findings suggest that stoma closure within six months performed in a certain period based on the ultrasound assessment can achieve a safety level equal to that of stoma closure after six months.

**Keywords:** Visceral Slide Assessment, Anastomosis, Peritonitis.

## Article Information

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## 1. INTRODUCTION

Loop ileostomy is typically constructed to transform downstream anastomosis and may locally be obstructed, while end ileostomy is often constructed after enterectomy which seem to have anastomotic leak.<sup>[1]</sup> In general, the closure is performed 6 months after ileostomy, considering intra-abdominal adhesion, fragility and inflammation. However, patients hope to have closure of ileostomy as soon as possible due to several stoma-related complications and the decrease in QOL. Early closure of loop ileostomy in colorectal surgery is reported in number of literatures. Some studies suggested that early closure is not only safe<sup>[2,3,4,5]</sup> but also can reduce postoperative complications<sup>[6,4]</sup>,

improve quality of life<sup>[2]</sup>, cut down expenses<sup>[7,8]</sup>, and still effectively protect distal anastomosis.<sup>[2,3,9]</sup> But there has been no enough studies about the closure of end ileostomy created for various reasons. The period between ileostomy and closure would allow softening of peristomal adhesion, and resolution of fragility and inflammation, thus leads to reduce surgical difficulties related to the closure of ileostomy.<sup>[8]</sup> For the patients with end ileostomy, it requires longer time to close the stoma compared with those with loop ileostomy.<sup>[1]</sup> This is related to intra-abdominal inflammation, edema of intestine and invasion during the procedure of ileostomy. Also, serious intra-abdominal adhesion generated after end ileostomy could

present a barrier to closure. But stoma-related complications increase with the delay of closure and temporary closure is the optimal choice to reduce complications and improve quality of life.<sup>[10]</sup>

The incidence of stoma-related complications is variable, and some studies estimated it 14%-17%.<sup>[3]</sup> To reduce operative risk and relieve pain, it is essential to decide optimal closure timing.

In the abdomen of the patient with end ileostomy, serious adhesive changes are generated due to intra-abdominal inflammation and surgical procedures. Adhesions are pathological bonds between surfaces within body cavities.<sup>[11]</sup> Peritoneal adhesions (PAs) are a pathological condition in which fibrous tissue bands are formed between the omentum, the small and large bowels, the abdominal wall, female pelvic organs, and other intra-abdominal organs.<sup>[12]</sup> Postoperative adhesions are observed after major abdominal surgery at a rate of 63-97%.<sup>[13]</sup> Peritoneal injury due to surgery, infection or irritation results in fibrinous exudation and fibrin formation before adhesion is created.<sup>[14]</sup> Also wide incision potentially increases the risk of ileus, SBO, thus leading to broad intra-abdominal adhesion.<sup>[15]</sup>

Midline incision is performed to close end ileostomy and intra-abdominal adhesion makes it difficult to enter abdominal cavity, thus increases iatrogenic injuries. Softening of such postoperative adhesion is needed, making it possible to enter abdominal cavity in end ileostomy re-revision, and to reduce operative intestinal injuries and complications. The development of adhesion and inflammation are closely related, vice versa; softening of adhesion is related to resolution of inflammation. Both surgery and infection can disturb the equilibrium between coagulation and fibrinolysis in the abdominal cavity, with a subsequent increase in the formation of peritoneal adhesions.<sup>[16]</sup> Intra-abdominal inflammation is one of key factors in adhesion

development and several cytokines generated by inflammation reaction play an important role in the formation of adhesion.<sup>[17,18,19]</sup>

According to statistical analysis, the incidence rate of peritoneal adhesion is about 13%<sup>[20]</sup> Adhesion formation is the result of both insufficient fibrinolytic capacity and increased fibrin formation in response to an enhanced inflammatory status of the peritoneum.<sup>[21]</sup> So it is obvious that softening of adhesion is only achieved by resolution of intra-abdominal inflammation, the main reason for intra-abdominal adhesion. Softening of intra-abdominal adhesion would allow entering abdominal cavity through surgical scar in closure, also presents resolution of intra-abdominal inflammation, thus it can be an indication of re-revision after ileostomy. We could determine the adhesion extent of peritoneal wall and intestines by visceral sliding assessment using ultrasound. Vertical movement of intra-abdominal contents to abdominal wall during excessive inspiration/expiration of patient was referred to as visceral sliding between intestine and peritoneum.<sup>[22]</sup> Previous abdominal surgery or peritonitis may result in adhesions between the viscera and abdominal wall, and this can lead to reduction or loss of visceral slide.<sup>[23]</sup> Frank F.Tu<sup>[24]</sup> et. al reported that sensitivity=86%, specificity=91%, positive predictive value=55%, negative predictive value=98% as for visceral slide threshold value<1cm to predict adhesion. But Ceana H. Nezhat<sup>[25]</sup> et. al reported that sensitivity=83.3%, specificity =100%, positive predictive value=100%, negative predictive value=98.5%, accuracy=98.6% in this test. In our study, this test was performed using ultrasound 20 days after end ileostomy due to severe peritonitis or ileus and it showed no visceral sliding or less than 1cm around the surgical scar. This is due to adhesion between peritoneal wall and intestine, postoperative paralytic ileus and edema of intestine at this site. Over time, intra-abdominal adhesion softens,

and bowel paralysis and edema are resolved, resulting in improved visceral sliding in ultrasound findings. The aim of this study is to evaluate closure timing of end stoma using ultrasound and identify its safety and efficacy compared with closure after six months.

## 2. MATERIALS AND METHODS

25 patients were included in EC and LC group, respectively. They underwent end ileostomy created due to severe peritonitis, ileus or rectal cancer etc. from 2021 to 2024. In EC group, there were 12 peritonitis, 8 ileus, 3 rectal cancer and 3 others, while there were 14 peritonitis, 7 ileus, 2 rectal cancer and 2 others in LC group. End ileostomy creation and its closure were performed by the same surgeon in all patients. The patients with stoma on the upper ileum were given priority to be included in EC group. Written informed consent was obtained from all patients or their guardians. This study was approved by the Ethics Committee of teaching hospital, Pyongyang University of medical sciences. The following data were collected on patient characteristics: age, sex, ASA grade, body mass index (BMI), the waiting time interval for reversal, comorbidities and stoma-related complications.

### 2.1 ultrasound scan for stoma closure

In EC group, the real-time ultrasound was first performed on the site of surgical scar 20 days after operation. Visceral slide examination was performed using SonoSite ultrasound equipped with a 5.2 MHz celiac transducer and the area with the surgical scar as the center, to the left and right of 2.5 cm, was divided into three regions of upper, medium, and low from top to bottom and we measured bowel movement according to the excessive inspiration/expiration in each region. Medium region refers to umbilical region.

### 2.2 visceral slide score

In real-time ultrasound, we evaluated no visceral sliding as 0, <0.5cm as 1, 0.5~1cm as 2, >1cm as 3. After that, ultrasound was performed

every 30 days and when the scores of three regions were >7, we closed the stoma.

### 2.3 surgical techniques

One day before the ileostomy revision, proximal intestinal tract was washed with 500-1000 cm<sup>3</sup> saline water and enema is performed in distal intestinal tract. All patients in both EC and LC group were given ceftriaxone for prevention prior to surgery and the closure was performed under general anesthesia. Midline incision was used in order to enter abdominal cavity. Of 3 regions, we entered abdominal cavity first through the one with visceral sliding over 1cm. Then we carefully performed incision identifying whether there exists adhesion between peritoneal wall and intestine or not. After abdominal section we evaluated adhesion status in overall abdominal cavity. All adhesion was separated by gentle dissection. A peristomal oval skin incision was performed around the stoma, separating the stoma to anastomose with the proximal intestine. Parastomal intestine with edema was resected before anastomosis. The type of anastomosis was hand-sewn (side-to-side). Closure of the abdominal wall was performed with absorbable sutures (PDS), and the skin was closed with interrupted sutures.

### 2.4 Outcomes

The last surgery was performed in May 2024. Operation time, intestine status at the time of abdominal section (edema, hypertrophy), operative blood loss, the number of comorbidities developed during operation, the number of separated adhesions and length of hospital stay were noted. The separated adhesion was classified according to the grade Canbaz et.al<sup>[26]</sup>suggested in 2005.

Surgical complications occurred within 90 days after closure such as anastomotic leak, wound infection, wound hematoma, ileus, abdominal infection, and mortality were analysed. Complications were classified according to the Clavien-Dindo classification<sup>[27]</sup> and were subdivided into I-II,III-IV group.

**Adhesion grade based on vascularization and density (Canbaz et al,2005)****Grade 0:** no adhesion**Grade 1:** Flimsy adhesions, light and easily released with finger**Grade 2:** Mild adhesions, continuous yet avascular, disrupted by gentle blunt dissection**Grade 3:** Moderate fibrous adhesions, some vascularity, identifiable tissue planes requiring sharp dissection**Grade 4:** Dense scar with obliteration of tissue planes**2.5 STATISTICAL ANALYSIS**

All data were analyzed using SPSS 16.0.

**3. RESULTS**

59 patients with stoma closure from January 2022 to May 2024 were involved in the study. Of these, 9 patients were excluded from the analysis since stoma became permanent, 50 patients (20 female patients) were included. Both ileostomy and closure were performed by the same surgeon in the hospital. All surgical procedure was noted by assistant.

In EC (early closure) group, we decided operation timing using ultrasound and performed closure within 180 days after ileostomy, while in LC(late closure) group, we performed closure after 180 days based on doctor's judgment. Patient characteristics are shown in **Table 1**.

**Table 1: Baseline patient characteristics.**

| Items                                   | EC group    | LC group     | P value |
|-----------------------------------------|-------------|--------------|---------|
| Waiting time interval for reversal, day | 95.28±23.17 | 225.68±37.08 | <0.0001 |
| Age                                     | 56.36±13.16 | 56.04±15.76  | 0.938   |
| Gender, male/female                     | 14/11       | 16/9         | 0.589   |
| ASA                                     |             |              | 0.066   |
| 1                                       | 3(12)       | 5(20)        |         |
| 2                                       | 6(24)       | 8(32)        |         |
| ≥3                                      | 16(64)      | 12(48)       |         |
| Body mass index, kg/m <sup>2</sup>      | 23.75±2.99  | 24.72±4.29   | 0.362   |
| Co-morbidities                          | 16(64)      | 14(56)       | 0.589   |
| Hypertension                            | 6(24)       | 5(20)        | 0.749   |
| Diabetes mellitus                       | 3(12)       | 4(16)        | 0.703   |
| Coronary heart disease                  | 2(8)        | 2(8)         | -       |
| Arrhythmia                              | -           | 1(4)         | -       |
| Renal disease                           | 1(4)        | -            | -       |
| Chronic obstructive pulmonary disease   | 2(8)        | 1(4)         | 0.577   |
| Arthrolithiasis                         | -           | -            | -       |
| Diagnosis                               | 2(8)        | 1(4)         | 0.577   |
| Peritonitis                             | 15(60)      | 13(52)       | 0.594   |
| Ileus                                   | 9(36)       | 10(40)       | 0.785   |
| Other                                   | 1(4)        | 2(8)         | 0.577   |

Values are mean±SD, median(range) or number of patients (%).  $P<0.05$  was considered statistically significant.

In EC group, the interval was  $95.28 \pm 22.7$  d, which was significantly shorter than  $224.08 \pm 38.5$  d in LC group ( $p < 0.0001$ ). In EC group, the number of patients who had closure 0-60 days after ileostomy was 0, 60-90days after; 12, 90-120 days after; 10, 120-150 days after; 2, 150-180 days after; 1. No significant

difference was found in terms of sex, age, BMI, ASA classification, comorbidities in 2 groups. The earliest closure was 62d, and the latest was 153d in EC group, while the earliest was 187d, and the latest was 330d in LC group. Stoma-related complications in 2 groups are shown in **Table 2**.

**Table 2: Stoma-related complications before stoma reversal.**

| Items                                     | EC group     | LC group      | P value      |
|-------------------------------------------|--------------|---------------|--------------|
| <b>Stoma-related complications</b>        | <b>8(32)</b> | <b>17(68)</b> | <b>0.013</b> |
| <b>Ileus</b>                              | -            | <b>1(4)</b>   | -            |
| <b>Obstruction</b>                        | <b>1(4)</b>  | <b>1(4)</b>   | <b>1</b>     |
| <b>Prolapsus</b>                          | -            | <b>1(4)</b>   | -            |
| <b>Stoma herniation</b>                   | <b>2(8)</b>  | <b>2(8)</b>   | <b>1</b>     |
| <b>Stoma retraction</b>                   | <b>1(4)</b>  | <b>2(8)</b>   | <b>0.577</b> |
| <b>Peristomal skin infection</b>          | <b>2(8)</b>  | <b>4(16)</b>  | <b>0.414</b> |
| <b>Dehydration/ Electrolytic disorder</b> | <b>1(4)</b>  | <b>3(12)</b>  | <b>0.327</b> |
| <b>TPN nutrition requirement</b>          | -            | <b>1(4)</b>   | -            |
| <b>Cardiopulmonary disease</b>            | <b>1(4)</b>  | <b>2(8)</b>   | <b>0.577</b> |
| <b>Clavien-Dindo classification</b>       |              |               | <b>0.198</b> |
| <b>I-II</b>                               | <b>7(28)</b> | <b>13(52)</b> |              |
| <b>III-IV</b>                             | <b>1(4)</b>  | <b>4(16)</b>  |              |
| <b>Readmission</b>                        | <b>1(4)</b>  | <b>3(12)</b>  | <b>0.327</b> |

*Values are number of patients(%).  $P < 0.05$  was considered statistically significant.*

Stoma-related complications in EC group were significantly more than in LC group ( $p = 0.013$ ). Especially, the greater number of parastomal prolapse, retraction, skin infection, dehydration, cardiopulmonary

diseases. Readmission rate was higher in LC group than in EC group, but no significant difference was found. Detailed findings in closure are shown in **Table 3**.

**Table 3: Details of end ileostomy closure.**

| Items                                        | EC group                            | LC group                            | P value      |
|----------------------------------------------|-------------------------------------|-------------------------------------|--------------|
| <b>Operative time, min</b>                   | <b><math>98.12 \pm 11.66</math></b> | <b><math>93.68 \pm 10.74</math></b> | <b>0.167</b> |
| <b>Blood loss in operation, ml</b>           | <b><math>79.60 \pm 13.83</math></b> | <b><math>75.80 \pm 9.72</math></b>  | <b>0.266</b> |
| <b>Bowel damages during operation</b>        | <b>2(8)</b>                         | <b>5(20)</b>                        | <b>0.249</b> |
| <b>Mean adhesions lysed during operation</b> | <b><math>3.76 \pm 1.05</math></b>   | <b><math>3.28 \pm 0.89</math></b>   | <b>0.088</b> |
| <b>Bowel statues in laparotomy</b>           |                                     |                                     |              |
| <b>Hypertrophy</b>                           | -                                   | -                                   | -            |
| <b>Edema</b>                                 | <b>1(4)</b>                         | <b>1(4)</b>                         | <b>1</b>     |

*Values are mean $\pm$ SD, median(range) or number of patients (%).  $P < 0.05$  was considered statistically significant.*

The median operation time in EC group was  $98.12 \pm 11.42$  min, which was longer than  $93.68 \pm 10.52$  in LC group, but no significant difference was found. There was no significant

difference in operative blood loss between 2 groups. In LC group, more cases of operative intestine injury occurred compared with EC group, but still no significant difference was

found. During operation, 1 patient had edema of proximal intestine in 2 groups, respectively. The

separated adhesion during operation is shown in **Table 4**.

**Table 4: Adhesion grade (Canbaz et al.,2001).**

| Items          | EC group | LC group | P value |
|----------------|----------|----------|---------|
| Grade 1        | 41       | 36       | 0.969   |
| Grade 2        | 35       | 31       | 0.937   |
| Grade 3        | 12       | 10       | 0.909   |
| Grade 4        | 6        | 5        | 0.937   |
| Total adhesion | 94       | 82       |         |

**P<0.05 was considered statistically significant.**

94 cases of adhesion were separated in EC group, and 82 were separated in LC group. The separated adhesion was classified according to the grade Canbaz <sup>[26]</sup> et. al suggested in 2005.

There was no significant difference in each grade between EC and LC group. Postoperative outcomes are shown in **Table 5**.

**Table 5: Outcomes after ileostomy closure.**

| Items                                                               | EC group  | LC group | P value |
|---------------------------------------------------------------------|-----------|----------|---------|
| Post-operative complications                                        | 8(32)     | 10(40)   | 0.581   |
| Anastomotic leakage                                                 | -         | 1(4)     | -       |
| Wound infection                                                     | 4(20)     | 2(8)     | 0.249   |
| Wound hematoma                                                      | 1(4)      | 2(8)     | 0.577   |
| Ileus                                                               | 1(4)      | 2(8)     | 0.577   |
| Obstruction                                                         | 1(4)      | -        | -       |
| Intra-abdominal infection                                           | 1(4)      | 3(12)    | 0.327   |
| Clavien-Dindo classification                                        |           |          | 0.396   |
| I-II                                                                | 7(28)     | 8(32)    |         |
| III-IV                                                              | 1(4)      | 2(8)     |         |
| Reoperation                                                         | -         | 2(8)     | -       |
| Cause of reoperation                                                |           |          |         |
| Failed attempt of stoma closure                                     | -         | -        | -       |
| Anastomotic leakage                                                 | -         | 1(4)     | -       |
| Ileus                                                               | -         | 1(4)     | -       |
| Postoperative stay, days                                            | 8.92±1.84 | 9.12±2.2 | 0.729   |
| Mortality                                                           | -         | -        | -       |
| <b>Values are mean±SD, median(range) or number of patients (%).</b> |           |          |         |
| <b>P&lt;0.05 was considered statistically significant.</b>          |           |          |         |

Readmission rate due to complication was higher in LC group. There was no significant difference in postoperative complications in 2 groups. Postoperative wound infection occurred

more often in EC group. No reoperation was performed in EC group, while two was performed due to ileus and anastomotic leak in LC group. No patient died in both groups.

## 4. DISCUSSION

The longer the period between ileostomy and closure, the more complications and psychological problems the patient may experience. Early closure of diverting loop ileostomy in colorectal surgery is reported in number of literatures. But there has been no studies about the closure of end ileostomy. End ileostomy results in number of complications until closure due to abdominal inflammation, fragility of intestine, surgical invasion and postoperative adhesion. Also patients would experience some psychological problems and inconvenience due to stoma apparatus. The only way to solve these problems is to close the end ileostomy as soon as possible. However, too early closure could lead to failure due to inflammation, edema, firm adhesion. In the surgery of ileus or severe peritonitis, serious inflammation and edema increase the risk of anastomotic leak, that's why the surgeon chooses end ileostomy. But severe peritoneal damage during operation results in adhesion. Also abdominal infection by foreign bodies(talcum powder, suture, fecal substances) and bacteria cause inflammation reaction, resulting in abdominal adhesion.<sup>[28]</sup>

Postoperative adhesion, paralytic ileus, edema restrict mobility of intestine which lead to decrease in visceral sliding in ultrasound 20 days after operation. Over time, softening of postoperative adhesion and resolution of paralytic ileus and edema occur, which lead to increase in visceral sliding in ultrasound. Furthermore, serious adhesion forms on the surgical scar region since many surgical procedures perform. In our study 18 patient in EC group and 15 patient in LC group had severe adhesion(III, IV) on the surgical scar region and ultrasound showed visceral sliding less than 0.5 cm. Serious adhesion of peritoneal wall and intestine can be the reason for intestine injury in reoperation since it is performed on this region Tu et. al<sup>(29)</sup> evaluated 63 patients and found negative prediction value of 98% when visceral

slide greater>1cm was used to indicate no adhesion.

Postoperative adhesion delays secondary operation time<sup>[30,31]</sup> and increases risk of postoperative intestine injury.<sup>[32]</sup>

In order to minimize postoperative intestine injury and achieve safe closure of end stoma, the area with the surgical scar as the center was divided into three regions from top to bottom. We measured bowel movement according to the excessive inspiration/expiration in each region and evaluated no visceral sliding as 0, <0.5cm as 1, 0.5-1cm as 2, >1cm as 3. When the total score of three regions was greater than 7, we closed the stoma. Here there must be a region with the score greater than 3 which would allow entering abdominal cavity and safe surgery confirming adhesion extent in other regions. If firm adhesion exists, we avoided that region and performed an incision, then carefully separated adhesion. During separation procedure, 2 patients in EC group had intestine injury, but it was not severe. 5 patients in LC group had severe intestine injury during reoperation. This resulted in more abdominal infection in control group after surgery. No difference was found in macroscopic findings of intestine during surgery in 2 groups. But 2 patients underwent reoperation due to postoperative ileus and anastomotic leak.

### Declaration of competing interest

The authors declare that they have no conflict of interest.

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## 5. CONCLUSIONS

Our findings suggest that stoma closure within six months performed in the certain period based on the ultrasound assessment can achieve a safety level equal to that of stoma closure after six months. Further studied are required to establish the optimal time of end stoma closure. However, our study could be the first step to determine the optimal time of end stoma closure.

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