



Purse-string closure technique reduces the incidence of incisional hernias following the reversal of temporary ileostomy

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Abstract

Purpose The incidence of incisional hernia (IH) at ileostomy closure site has not been sufficiently evaluated. Temporary loop ileostomy is routinely used in patients after low anterior resection for rectal cancer. The goal of this study was to compare the IH rates of standard suture skin closure and purse-string skin closure techniques.

Patients and methods Patients undergoing ileostomy reversal and follow-up CT scan at the University Hospital Frankfurt between January 2009 and December 2015 were retrospectively analyzed regarding IH and associated risk factors. Patients received either direct stitch skin closure (group DC) or purse-string skin closure (group PS).

Results In total, 111 patients underwent ileostomy reversal in the aforementioned period. In 88 patients, a CT scan was performed 12–24 months after ileostomy reversal for cancer follow-up. Median follow-up was 12 months. Median time interval between ileostoma formation and closure was 12 (± 4 SD) weeks. In 19 of 88 patients (21.5%), an IH was detected. The incidence of IH detected by CT scan was significantly lower in the PS group ($n = 7$, 12.9%) compared to the DC group ($n = 12$, 35.2%, $p = 0.017$).

Conclusions This retrospective study shows an advantage of the purse-string skin closure technique in ileostomy reversals. The use of this technique for skin closure following ileostomy reversals is recommended to reduce the IH rates. Randomized controlled trials are needed to confirm these findings.

Keywords Ileostoma closure · Incisional hernia · Purse-string skin closure · Rectal cancer · Wound infection

Introduction

The creation of a temporary loop ileostomy, as part of low anterior rectum resections in patients with rectal cancer, has become the standard treatment and leads to a significant reduction of clinically apparent anastomotic leakage [1]. Both stoma formation and stoma reversal are associated with relevant morbidity [2]. Recognized complications of stoma

reversal include incisional hernia (IH), wound infection, bowel obstruction, and anastomotic leak [2]. In this study, we focused on methods used to decrease the incidence of IH following a reversal of temporary loop ileostomy.

In particular, the risk factors for the development of a hernia at the former stoma site have not yet been analyzed to a sufficient degree. Previous reviews identified incisional hernia rates following stoma reversal in the range of 0 to 48% [3–5].

The effectiveness of the purse-string skin closure (PS) technique seems promising, but the number of studies investigating the effectiveness of PS is also currently limited. Watson et al. (1997) introduced a purse-string skin closure technique for ileostomy reversal and showed a significantly reduced risk of surgical site infection (SSI). This, in turn, resulted in smaller scars, allowing for better cosmesis [6]. PS was reported to be better for controlling superficial incisional surgical site infections [7, 8]. However, there have been no studies with the primary aim of identifying the rate of hernia following stoma closure and or studies which have analyzed the correlation between the reversal surgical technique of temporary

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ileostomy and IH. However, SSI is a well-known risk factor for the occurrence of IHS.

The present study examines the incidence of IH after ileostomy reversal, comparing the surgical technique of skin closure and analyzing the underlying risk factors.

Patients and methods

In this retrospective study, the data of 111 patients, who had undergone ileostomy closure from January 2009 to December 2015 at the University Hospital Frankfurt, were analyzed retrospectively. The data of the patients were identified from the hospital's electronic health records. The study protocol was registered and approved by the Clinical Ethics Committee of the university hospital of Frankfurt (No. 370/14). A total of 14 parameters from the electronic patient file were recorded for each patient: demographic data, date of rectal resection and the creation of a diverting loop ileostomy, date and surgical technique of ileostomy reversal, CT scan date and interval after stoma reversal, BMI, occurrence of SSI, and outcome data.

In our department, ileostomy wounds have been closed using a PS technique since January 2012. No drains are employed. All patients received a single dose of prophylactic antibiotics prior to skin incision including a second-generation cephalosporin and metronidazole. For 88 patients (79.2%), a CT scan for routine cancer follow-up was available for analysis (Table 1).

In patients who were treated with direct stitch skin closure (DC) technique, the stoma was temporarily closed using a

running suture to prevent spillage, followed by an elliptical skin incision around the stoma. After adhesiolysis of the ileostomy, the stoma-bearing part was resected and an end-to-end ileo-ileostomy was performed using a running suture with 4/0 MonoPlus® (B. Braun Melsungen AG, Germany). The wound closure consisted of a running suture of the rectus fascia and subcutaneous tissue. The skin was adapted using either skin staplers, an intracutaneous running suture, or interrupted sutures without the placement of a subcutaneous drain, depending on the surgeon's choice. In patients with purse-string closure (group PS), a circumstomal incision was made 2–4 mm from the stoma–skin border followed by stoma closure. The adhesiolysis, anastomosis, and closure of the rectus fascia were performed accordingly. Subcutaneous tissue was not sutured. The skin was closed using a non-absorbable 0 Premilene® (B. Braun Melsungen AG, Germany) suture in an intracutaneous purse-string technique, leaving a central opening of 5–8 mm (Fig. 1). The suture was removed 3 weeks after surgery in the outpatient clinic.

For our purposes, we considered a hernia to be either (1) the documented presence of a symptomatic hernia at the former stoma site, (2) the reported presence by the patient, (3) the confirmation by clinical examination, (4) the need for surgical repair of a hernia at that location, or (5) a diagnosis using CT scans.

A clinical radiologist evaluated the abdominal wall of the CT scans and presence of any IH on the CT imaging modalities used in the study according to a standard protocol. The radiologist was blinded to clinical findings and the original radiology report, as well as the technique used for skin closure.

Table 1 Patients' flow diagram of a retrospective study on the incidence of incisional hernias following low anterior resection of rectal cancer with a temporary diverting ileostomy and subsequent stoma reversal

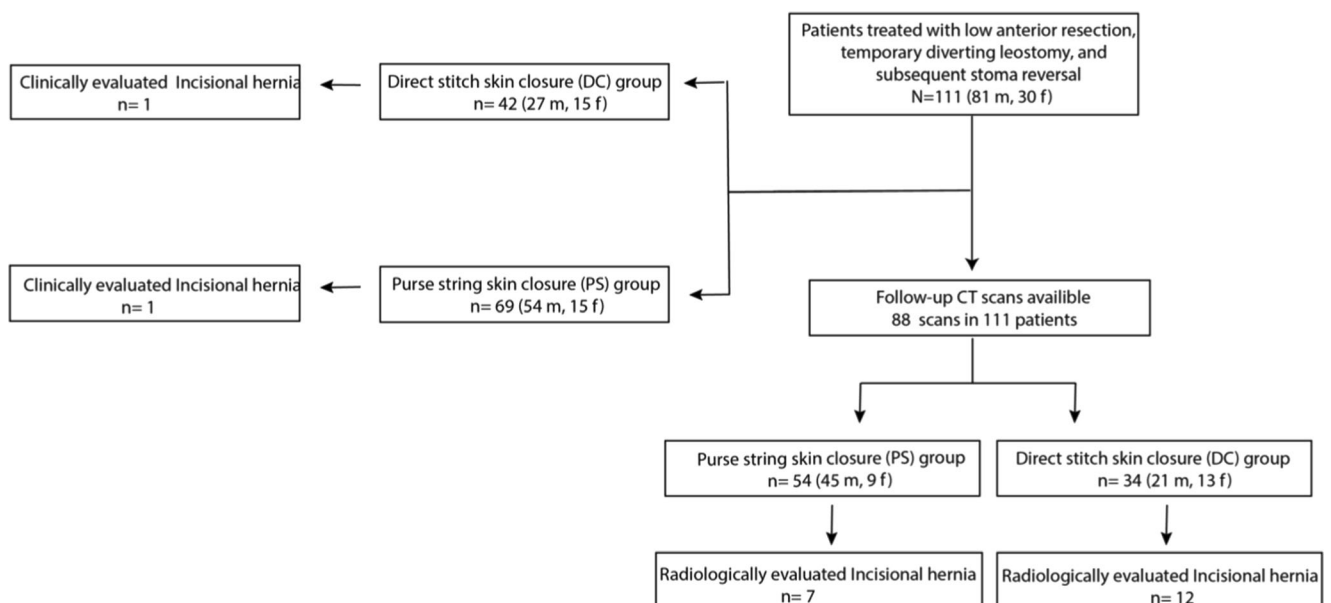




Fig. 1 Purse string skin closure 7 days after closure of the ileostomy

The endpoints of this study were the (1) rate of herniation, (2) the association between the reversal surgical technique of temporary ileostomy and IH, (3) the role of BMI, and (4) wound infection on IH formation.

To be included in this study, patients had to satisfy the following inclusion criteria: (1) diagnosis of rectal carcinoma and (2) ileostomy reversal. Exclusion criterion was patients lost to follow-up.

The Mann–Whitney test, Fisher’s exact test, *t* test, and Spearman’s correlation were used to evaluate the relationships among clinical features. The *p* value < 0.05 was considered statistically significant. Statistics were calculated using BiAS 11.04 software.

Results

Patients’ characteristics

In total, 111 patients (81 males; 30 females) underwent ileostomy reversal between January 2009 and December 2015 at the Department of General and Visceral Surgery at the University Hospital Frankfurt. Forty-two patients (37.9%: 27 males, 15 females) were enrolled in group DC whereas 69 patients (62.1%: 54 males, 15 females) received the PS technique. The median age of the DC group was 65 years (range: 39–83 years) in contrast to 61 years (range: 34–85 years) in the PS group (*p* = 0.03). The median time between formation and ileostomy closure was 12 weeks (range: 4 weeks–27 months) and the median interval from stoma reversal to the last date of clinical follow-up was 24 months (range: 12–50 months).

Clinically evaluated incisional hernia

In two cases (2/111, 1.8%) the hernia was clinically apparent. These two patients required surgical repair of their stoma site hernia. No CT scan was performed in these two patients.

The first patient was a 57-year-old male with a BMI of 30. Adjuvant chemotherapy was performed after the rectal cancer operation prior to ileostomy closure, which was performed using the PS technique 5 months after the stoma creation. Six weeks after the ileostomy reversal, a symptomatic hernia was reported by the patient and confirmed by clinical examination at the closed stoma site.

The second patient was a 68-year-old male with a BMI of 28.4. An adjuvant chemotherapy was performed between the original operation and the ileostoma closure, which was performed using the DS technique 6 months afterwards. Two weeks after the ileostoma reversal, a symptomatic hernia was reported by the patient and confirmed by clinical examination at the closed stoma site.

Radiologically evaluated incisional hernia

To determine the radiological assessment of IH following closure of temporary stoma, CT scans were available for 88/111 (78.3%) patients (Table 2). The median time interval between stoma closure and imaging was 12 months (range: 3–60 months).

The CT scan was performed 9–24 months after the ileostomy closure. The PS technique was performed in *n* = 54 patients (61.3%) and the DC technique was performed in *n* = 34 patients (38.6%). The radiological rate of hernia detection was 21.5% (19/88). The incidence of IH following reversal of temporary ileostomy was significantly less in the PS group (*n* = 7, 12.9%) compared to the DC group (*n* = 12, 35.2%, *p* = 0.017; Figure 2, Table 3).

Risk factors of incisional hernia

After a median follow-up of 24 months (range: 12–50 months), wound infections occurred in 6/88 patients (6.3%). All of these patients were in the DC group. In the PS group, no wound infection was diagnosed (*p* = 0.0042; Table 3).

The average BMI in patients with CT scans was 25.02 kg/m². In 69 patients (78%) without radiological IH, BMI was 25.2 kg/m², and in the patients with radiological IH (*n* = 19), BMI was 26.5 kg/m² (*p* = 0.51). From 19 patients with IH, five patients were women (26.3%) and 14 patients were male (73.6%, *p* = 0.50).

The average age of all 88 patients with CT scans was 64, those without IH (*n* = 69) were 64.7 years old, and those patients with IH (*n* = 19) were 66 years old (*p* = 1). Risk factors for occurrence of IH were SSI but not associated with BMI, age, or gender.

Table 2 Characteristics in patients with CT scans

	Total patients, <i>n</i> = 88	Incisional hernia Yes	Incisional hernia No
Gender (men/women)	66/22	14/5	52/17
Median age [years] (range)	64 (24–87)	66	64.7
Median time: creation to closure [weeks] (range)	12 (range 4 weeks–27 months)	10	12

Discussion

Ileostomy reversal is a routine surgical procedure. However, both stoma formation and stoma reversal are associated with relevant morbidity [2]. It is still associated with complications such as IH, which often needs an additional surgical procedure. In general, the presence of SSI has been shown to be a major risk factor for IH [9]. The technique of skin closure using PS was shown to reduce the incidence of SSI [7]. As far as we know, this study is the first one which investigated the influence of the surgical technique of skin closure on occurrence of IH after ileostomy reversal.

The purse-string closure technique was first introduced by Banerjee to overcome wound infections after ileostomy reversal [6]. The combination of an adaption of the skin with a central opening for the drainage of wound discharge led to a significant reduction of wound infections, which was later verified by our group in a report on 114 consecutive ileo- and colostomy reversals with 0% wound infection rate in the PS group. In that cohort, the conventional wound closure was performed in 81 patients; 33 patients received purse-string skin closure. The groups did not differ regarding age, gender, indication for ileostomy, previous chemotherapy, or operation time [7]. The main difference between these two studies is that in this study, we used different cohorts by analyzing the data from patients with ileostomy reversals with rectum carcinoma and the different endpoints such as CT scan as diagnostic method to determine an IH.

In our study, the PS group had significantly less IH compared to group DC, which could be explained due to significantly higher SSI in the DC group.

The overall incidence of incisional hernias at the ileostomy site in this cohort was 21.5%. This is a similar incidence as previously reported in study specifically designed to assess this outcome [10]. However, these studies most often involved both ileostomy and colostomy wounds. The patients included in our study are a homogenous group of patients with reversed loop ileostomies after low anterior resection for rectal cancer.

This study demonstrates the well-known problem of underestimating the clinically detected hernias at stoma closure sites. The incidence of radiologically IH was 21.5% (19/88). This could suggest that radiologically detected hernias are not clinically relevant. However, this is based upon clinical follow-up, which was only a median of 12 months after stoma closure. Thus, it is possible and likely that initially asymptomatic hernias would increase in size over time and patients would become symptomatic.

It is possible that findings on CT, in a prospective validated cohort, have a greater diagnostic relevance than the data of this retrospective study suggests.

In the two patients with clinically documented IH, a surgical repair of the IH was needed due to symptoms at the former temporary stoma closure side. This only correlates with 1.8% of the total cohort of 111 patients undergoing stoma closure. From this observation, we may conclude that most of the IH revealed on CT scans were not clinically apparent and did not need any further treatment.

Fig. 2 Example of a CT scan, which shows a large hernia through a closed ileostomy site

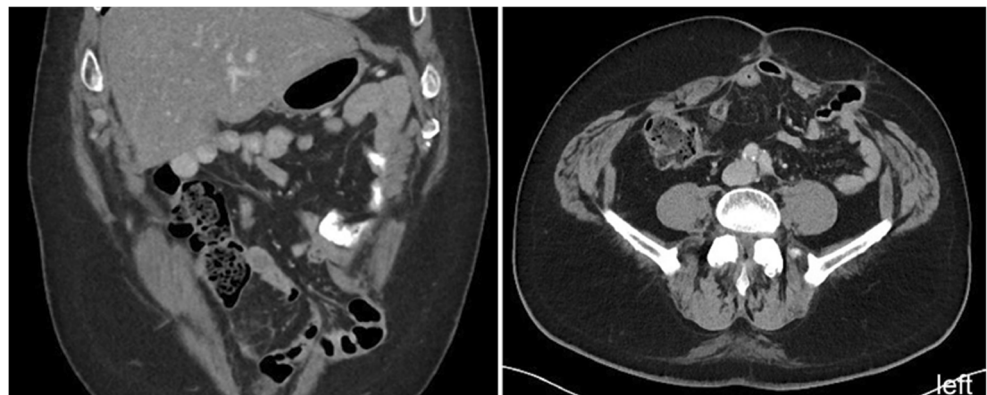


Table 3 Factors associated with postoperative incisional hernia in patients with CT scans

	Total patients, <i>n</i> = 88	Purse string skin closure	Direct stitch skin closure	<i>p</i> value
Incisional hernia				
Yes	19	7 (36.8%)	12 (63.1%)	0.017
No	69	46 (66.6%)	23 (33.3%)	
Wound infection	6	0 (0%)	6 (100%)	0.0042

The problem of hernia detection has been described in previous studies. For example, the European Hernia Society (EHS) recommendations for detection of incisional hernias are to perform a dynamic ultrasound or CT scan [11]. Additionally, Guzman-Valdivia et al. [12], Cingi et al. [13], and Schreinemacher et al. [14] analyzed risk factors predisposing to hernia formation. Schreinemacher found an association with increasing BMI [14], which was not replicated in the other studies, and other factors such as gender, age, or surgical site infection were not confirmed as risk factors. The present study found a significant association between incisional hernia and wound infection, and it did not find any differences in patients with and without hernias at stoma closure sites with regard to BMI, age, or gender. Despite this, these risk factors warrant further consideration.

In this study, we did not determine other complications such as anastomotic dehiscence, re-laparotomy, intestinal obstruction, or length of stay. The relatively short follow-up in this study may mean that more hernias could become apparent over time. The retrospective design of this study could have contributed to lower rates of clinical hernias than would have been identified by prospective studies.

Conclusion

The present study suggests that the purse-string skin closure technique is associated with a lower risk of postoperative wound infection compared to primary skin closure. The reduced rate of SSI may lead to a significantly lower incidence of IHS at the stoma site as diagnosed on CT scans. This finding indicates that the PS technique may be a favorable alternative to primary skin closure.

Additionally, imaging may provide an early surrogate marker of patients whose hernias will later become clinically relevant. Long-term clinical follow-up is needed to validate this theory.

Compliance with ethical standards

Conflict of interest The authors declare that they have no competing interests.

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