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Original Research Article

Comparison of surgical site infection and wound dehiscence rates between primary and delayed primary closure of incision in ileal perforation patients

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ABSTRACT

Background: Ileal perforation is a common surgical emergency associated with significant postoperative complications, particularly surgical site infection (SSI) and wound dehiscence. The method of wound closure, primary closure (PC) versus delayed primary closure (DPC), may influence these outcomes. This study aimed to compare the rates and timing of SSI and wound dehiscence between primary and delayed primary wound closure in patients undergoing surgery for ileal perforation.

Methods: This quasi-experimental study was conducted at the Department of Surgery, Dhaka Medical College Hospital, Dhaka, Bangladesh, from September 2022 to August 2023. The study included 34 patients diagnosed with ileal perforation who underwent laparotomy at the Department of Surgery of Dhaka Medical College Hospital. All patients were equally allocated into two groups: Group A- Patients who underwent primary wound closure (PC), and Group B - Patients who underwent delayed primary wound closure (DPC).

Result: The baseline characteristics (age, gender, and BMI) were similar between the groups ($p>0.05$). SSI occurred in all patients in Group A (100%) compared to only 8 patients (47.1%) in Group B, showing a significant reduction in SSI with DPC ($p<0.001$). Most SSIs in Group A occurred on the 5th POD, while in Group B, the peak was on the 10th POD. Partial wound dehiscence was significantly more common in Group A (64.7%) compared to Group B (23.5%) ($p=0.038$). Although complete dehiscence was higher in Group A (35.3%) than Group B (11.8%), the difference was not statistically significant ($p=0.225$). Notably, 64.7% of patients in the DPC group had no wound dehiscence, while none in the PC group avoided this complication ($p<0.001$).

Conclusions: This study showed that delayed primary closure significantly reduces the incidence of surgical site infection and wound dehiscence in ileal perforation, making it a preferable option in ileal perforation case.

Keywords: Ileal perforation, SSI, Wound dehiscence, Primary closure, Delayed primary closure

INTRODUCTION

Ileal perforation remains a significant cause of pneumoperitoneum globally, with enteric fever being one of the most common underlying etiologies. Other causes include non-specific inflammation, tuberculosis, and trauma.[1,2] Without timely surgical intervention, ileal perforation can lead to high morbidity and mortality.[3] Prompt surgical management following adequate resuscitation is essential. The mainstay of treatment

typically involves either primary perforation closure or exteriorization via an ileostomy.[4,5] Surgical site infections (SSIs) are frequently encountered in cases of ileal perforation. Contamination of the surgical wound by intestinal contents significantly increases the risk of infection.[6-8]

Numerous factors contribute to the development of SSI, including the presence of drain, use of steroid, underlying disease, and positive intraoperative culture.[9]

Additionally, the technique used for wound closure, whether primary or delayed primary, has been identified as a critical factor influencing postoperative wound complications.[6]

SSI can severely affect postoperative outcomes, contributing to increased morbidity and mortality. Emergency surgeries, particularly those involving contaminated fields, are associated with a significantly higher risk of SSI. One of the ongoing debates in such scenarios is the optimal method for skin closure.

In most emergency abdominal surgeries performed via midline laparotomy, surgeons face the dilemma of choosing between primary closure (PC) and delayed primary closure (DPC). PC involves immediate closure of the wound edges, allowing for faster recovery and improved cosmetic results. Conversely, DPC entails leaving the wound open initially and closing it a few days later, especially in contaminated or dirty wounds, to reduce the likelihood of infection.

Due to the lack of consensus on the superior technique, the choice between PC and DPC often comes down to individual surgeon preference. Moreover, randomized controlled trials comparing these techniques frequently suffer from a high risk of bias. Nonetheless, several studies suggest that DPC may reduce the incidence of wound infection and shorten hospital stay.[10-12]

Complications associated with SSI, such as wound dehiscence, stitch sinus, stitch abscess, hypertrophic scar, keloid, and incisional hernia pose considerable challenges for both surgeons and patients.[13]

These complications not only cause patient discomfort but also increase the cost of treatment and prolong hospitalization.[14-16] Despite the widespread use of prophylactic antibiotics in emergency surgeries for peritonitis, outcomes in terms of infection control have remained inconsistent.[17]

In this study, we aimed to compare the rates and timing of SSI and wound dehiscence between primary and delayed primary wound closure in patients undergoing surgery for ileal perforation.

METHODS

This quasi-experimental study was conducted at the Department of Surgery, Dhaka Medical College Hospital, Dhaka, Bangladesh, over the period from September 2022 to August 2023.

The study included 34 patients diagnosed with ileal perforation who underwent laparotomy at the Department of Surgery of Dhaka Medical College Hospital. All patients were allocated into two groups using a purposive sampling method: Group A - patients who underwent primary wound closure (PC), and Group B - patients who underwent delayed primary wound closure (DPC).

Inclusion criteria

Patients with ileal perforation based on clinical, radiological, and intraoperative findings.

Exclusion criteria

Exclusion criteria included patients with diabetes mellitus, long-term steroid use, morbid obesity (BMI >40 kg/m²), pre-existing skin infections, chronic kidney disease, malignancy, gastrointestinal perforation at sites other than the ileum, as well as prisoners and moribund patients.

Data collection procedure

Informed written consent was taken from all participants or their legal guardians (for patients aged <18 years). Per-operatively, 34 ileal perforation cases were selected by a purposive sampling method, and eligible participants were assigned to one of the two groups. All odd-numbered patients were included in Group A: PC group, and all even-numbered patients were included in Group B: DPC group.

Demographic and clinical data were recorded in a pre-structured data sheet. All patients were resuscitated before surgery. Intravenous antibiotics (Ceftriaxone 1 gm or Cefuroxime 750mg and Metronidazole 500 mg) were administered pre-operatively at the time of resuscitation and continued at least 48 hours post-operatively.

Antibiotics were upgraded depending upon the clinical response of the patient, the degree of contamination, concomitant infective condition, or culture report of the subsequently sent wound swab.

Surgical procedure

All patients in the study underwent midline laparotomy. After the identification of source of contamination thorough peritoneal toileting was done with Normal Saline until the effluent was clear.

Definitive treatment was done by repair or resection, or exteriorization of perforation site as an ileostomy. Then abdominal fascia was closed by prolene No 1 suture in continuous fashion. Following fascial closure, skin closure was carried out according to the assigned group criteria.

Group A–primary closure

In this group, the skin was closed immediately after fascial closure using interrupted 2-0 prolene sutures with a cutting needle. No subcutaneous sutures were placed. The closed wound was then covered with an occlusive dressing using dry sterile gauze. On the 3rd postoperative day (POD), the dressing was removed. The wound was subsequently examined on the 4th, 5th, 10th, 15th, and 30th postoperative days.

Group B–delayed primary closure

In this group, the skin was left open after fascial closure. The wound was packed with saline-soaked gauze and covered with a dry dressing. On the 2nd POD, the packing was removed, the wound examined, and a fresh dressing applied under aseptic conditions. Twice daily dressing with saline soaked gauze was done up to 3rd POD.

On the 4th POD, the wound was carefully re-examined. If no sign of infection, such as serous or purulent discharge, necrotic tissue, unhealthy granulation, or surrounding inflammation, was present, the skin was closed with interrupted sutures. If any sign of infection was detected, closure was deferred, and the dressing regimen continued until the wound appeared healthy.

Postoperative wound care and follow-up

In both groups, skin sutures were removed ten days after closure, provided there were no signs of infection. If SSI developed post-closure, one or more sutures were removed, a wound swab was sent for culture, and dressing was continued until the wound either healed by secondary intention or was suitable for resuturing. In cases of complete wound dehiscence, immediate tension closure was performed.

All patients were followed for one month postoperatively at scheduled intervals to monitor wound healing and detect any delayed complications.

Statistical analysis

All data were recorded systematically in a pre-formatted data collection form. Quantitative data was expressed as mean and standard deviation, and qualitative data was expressed as frequency distribution and percentage. The difference between the groups was analyzed by Student's t-test as regards normally distributed data. Categorical variables were compared with the Chi-squared/Fisher's Exact test.

A p value <0.05 was considered significant. Statistical analysis was performed by using SPSS 26 (Statistical Package for Social Sciences) for Windows version 10. This study was ethically approved by the Institutional Review Committee of Dhaka Medical College Hospital.

RESULTS

Table 1 shows that the majority of participants in both groups fall within the 21–40 years age range, with a mean age of 33.59±20.17 years in Group A and 32.18±11.86 years in Group B (p=0.805), indicating no statistically significant difference. Gender distribution is identical in both groups, with 88.2% males and 11.8% females, showing no significant difference (p=1.000).

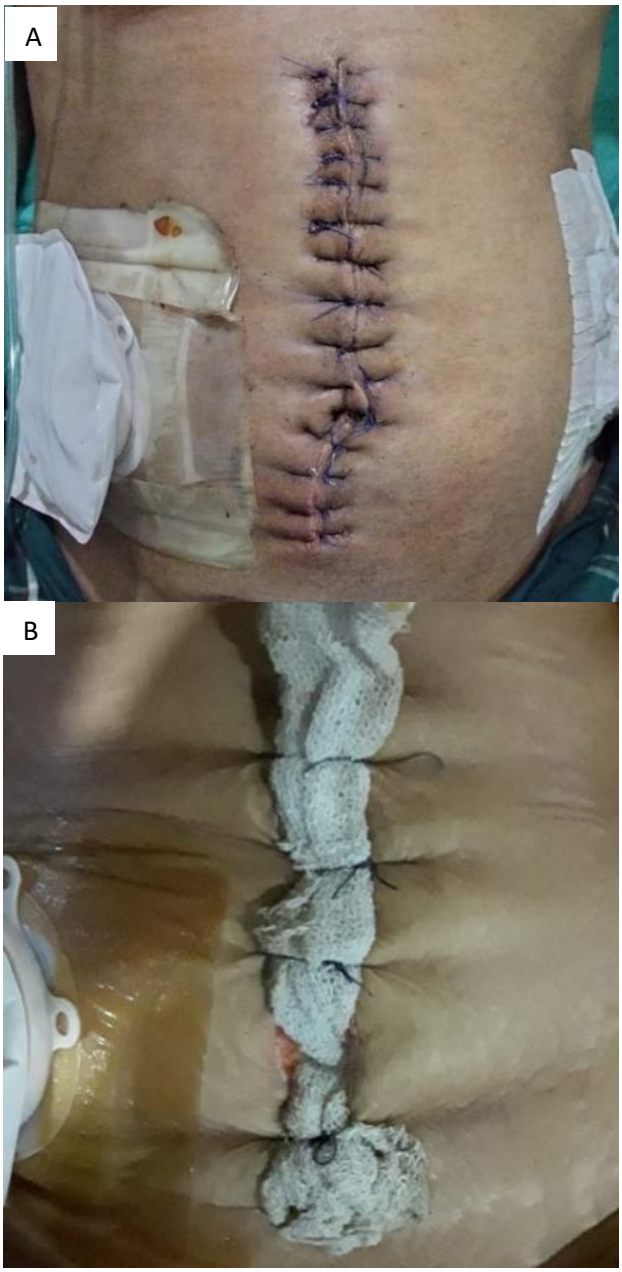

Figure 1: (A) Primary closure of wound and (B) wound packed with saline-soaked gauze in DPC.

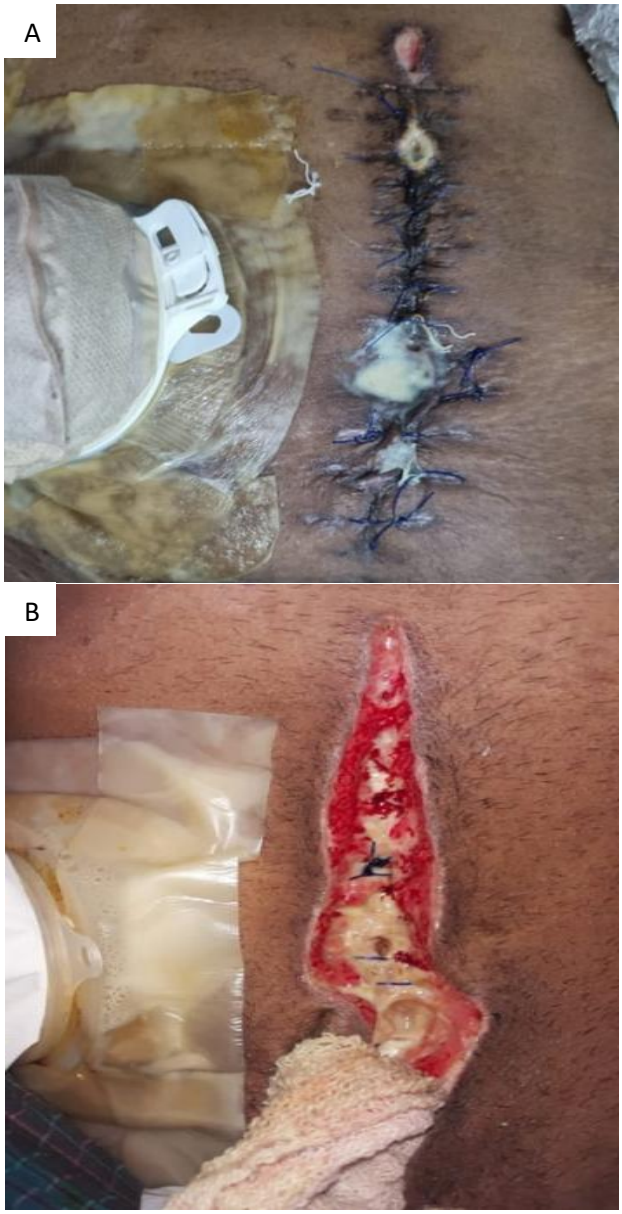

Figure 2: (A) Partial wound dehiscence following PC and (B) infection of an open wound following DPC.

BMI classification reveals a higher proportion of individuals with normal weight in Group B (58.8%) compared to Group A (41.2%), though the mean BMI is nearly identical between the groups (24.23±5.28 in Group A vs. 24.19±3.14 in Group B; p=0.978), suggesting no significant variation in BMI. Table 2 shows that in Group A, 17 patients (100.0%) had SSI. In Group B, SSI was present only in 8 patients (47.1%), and 9 patients (52.9%) were free from SSI. There was a significant difference in postoperative SSI between Group A and Group B (p<0.001). DPC of incision significantly reduced the incidence of SSI in Group B.

Table 3 shows that in Group A, the majority of SSIs were observed on the 5th postoperative day (POD), accounting for 41.2% of cases, followed by occurrences on the 4th POD (17.6%), 10th POD (17.6%), 3rd POD (11.8%), and 15th POD (11.8%). In contrast, Group B had the highest number of SSIs on the 10th POD (50.0%), followed by the 4th POD (37.5%) and the 15th POD (12.5%). No cases of SSI were reported in either group on the 30th POD.

Table 4 shows that between Group A and Group B, there was a significant difference regarding postoperative wound dehiscence. Data showed that out of 17 patients in group A, 11(64.7%) had partial wound dehiscence. On the other hand, only 4(23.5%) patients developed partial wound dehiscence in group B, which was statistically significant (p=0.038).

Complete wound dehiscence is higher in group A (35.3%) compared to group B (11.8%), but not statistically significant (p=0.225). Overall, 11 (64.7%) patients in DPC avoided any type of postoperative wound dehiscence, but no patient in the PC group (0.00%) could avoid wound dehiscence (p<0.001).

Table 5 shows that in Group A, partial dehiscence was most frequently observed on the 7th POD (35.3%), followed by occurrences on the 10th and 15th PODs (11.8% each), and a single case on the 5th POD (5.9%). Complete dehiscence in Group A occurred on the 7th, 10th, and 15th PODs (11.8% each). In Group B, partial dehiscence was recorded on the 10th and 15th PODs (11.8% each), while complete dehiscence occurred on the 7th and 10th PODs (5.9% each). No cases of dehiscence, either partial or complete, were reported on the 30th POD in either group.

Table 1: Comparison of age, gender, and BMI between group A and group B (n=34).

Age group (in years)	Group A (n=17)	Group B (n=17)	P value
<20	6 (35.3%)	3 (17.6%)	0.805
21-40	7 (41.2%)	11 (64.7%)	
41-60	1 (5.9%)	3 (17.6%)	
>60	3 (17.6%)	0 (0.0%)	
Total	17(100.0%)	17(100.0%)	
Mean±SD	33.59±20.17	32.18±11.86	
Gender			1.000
Male	15 (88.2%)	15 (88.2%)	
Female	2 (11.8%)	2 (11.8%)	
Total	17(100.0%)	17(100.0%)	

Continued.

Age group (in years)	Group A (n=17)	Group B (n=17)	P value
BMI (kg/m^2)			
Underweight (<18.5)	4 (23.5%)	1 (5.9%)	
Normal weight (18.5-24.9)	7 (41.2%)	10 (58.8%)	
Overweight (25-29.9)	4 (23.5%)	5 (29.4%)	0.978
Obese (≥30)	2 (11.8%)	1 (5.9%)	
Total	17(100.0%)	17(100.0%)	
Mean±SD	24.23±5.28	24.19±3.14	

Group A: Primary closure, Group B: Delayed primary closure

Table 2: Distribution of patients according to SSI between group A and group B (n=34).

Postoperative SSI	Group A (n=17) No. (%)	Group B (n=17) No. (%)	P value
Yes	17 (100.0)	8 (47.1)	
No	0 (0.0)	9 (52.9)	<0.001
Total	17 (100.0)	17 (100.0)	

Group A: Primary closure, Group B: Delayed primary closure

Table 3: Frequency of SSI according to onset in group A and group B (n=25).

Postoperative SSI according to onset	Group A (n=17) No. (%)	Group B (n=8) No. (%)
At 3rd POD	2 (11.8)	0 (0.0)
At 4th POD	3 (17.6)	3 (37.5)
At 5th POD	7 (41.2)	0 (0.0)
At 10th POD	3 (17.6)	4 (50.0)
At 15th POD	2 (11.8)	1 (12.5)
At 30th POD	0(0.0)	0 (0.0)
Total	17 (100.0)	8 (100.0)

Group A: Primary closure, Group B: Delayed primary closure

Table 4: Frequency of wound dehiscence in group A and group B (n=34).

Postoperative wound dehiscence	Group A (n=17) No. (%)	Group B (n=17) No. (%)	P value
Partial	11 (64.7)	4 (23.5)	0.038
Complete	6 (35.3)	2 (11.8)	0.225
No	0 (0.0)	11 (64.7)	<0.001
Total	17 (100.0)	17 (100.0)	

Group A: Primary closure, Group B: Delayed primary closure

Table 5: Frequency of postoperative wound dehiscence according to POD in group A and group B (n=34).

Postoperative wound dehiscence	Group A (n=17) No. (%)	Group B (n=17) No. (%)
At 5th POD		
Partial	1 (5.9)	0 (0.0)
Complete	0 (0.0)	0 (0.0)
At 7th POD		
Partial	6 (35.3)	0 (0.0)
Complete	2 (11.8)	1 (5.9)
At 10th POD		
Partial	2 (11.8)	2 (11.8)
Complete	2 (11.8)	1 (5.9)
At 15th POD		
Partial	2 (11.8)	2 (11.8)
Complete	2 (11.8)	0 (0.0)
At 30th POD		
Partial	0 (0.0)	0 (0.0)
Complete	0 (0.0)	0 (0.0)

Group A: Primary closure, Group B: Delayed primary closure

DISCUSSION

In the present study, the majority of patients in both Group A (primary closure, PC) and Group B (delayed primary closure, DPC) were between 21 and 40 years of age. The mean age was 33.59±20.17 years in Group A and 32.18±11.86 years in Group B, with no statistically significant difference between the groups (p=0.805). These findings are consistent with previous studies by Duttaroy et al, Chiang et al, and Aziz et al, who reported similar mean ages among their patient populations.[17-19] Ahmad et al. (2014) also found comparable mean ages in the PC (26.67±7.32 years) and DPC (28.15±6.88 years) groups, with no significant difference in age distribution.[20]

Gender distribution in both groups was identical, with 15 males (88.2%) and 2 females (11.8%) in each, indicating a strong male predominance and no statistically significant difference between the groups (p=1.000). These findings are supported by studies from Chhaparwal et al, Duttaroy et al, Chiang et al, Aziz et al, and Bhadragoudra et al, all of whom reported male predominance.[17-19,21,22] However, Ahmad et al reported a higher number of female patients in their study, though the difference in gender distribution was also not statistically significant.[20]

The mean BMI in this study was nearly identical between the two groups: 24.23±5.28 kg/m² in Group A and 24.19±3.14 kg/m² in Group B, with no significant difference ($p = 0.978$). Furthermore, BMI categories were not significantly associated with the development of SSI. These results are in agreement with Baksi et al, who reported mean BMI values of 24±3.5 kg/m² in the DPC group and 24.5±3.0 kg/m² in the PC group, also finding no statistically significant difference.[9]

Regarding surgical site infection, our study found a statistically significant reduction in SSI in the DPC group. All 17 patients (100%) in the PC group developed SSI, whereas only 8 patients (47.1%) in the DPC group experienced it ($p < 0.001$). Moreover, the onset of SSI differed between the groups, occurring most frequently on the 5th postoperative day (POD) in the PC group (41.2%) and on the 10th POD in the DPC group (50%). This delay and reduction in SSI incidence in the DPC group could be due to frequent postoperative dressing changes, which may reduce bacterial load and improve drainage. Similar observations were made by Siribumrungwong et al and Nasib et al.[23,24]

Other studies also support our findings. Mostafa et al. (2020) reported an SSI rate of 44% in PC compared to just 8% in DPC.[25] Duttaroy et al found a much higher SSI rate in PC (45.2%) compared to DPC (2.7%).[17] Sasikumar et al and Singh et al likewise observed higher SSI rates with PC (77.7%) versus DPC (44.4%).[10,26] These consistent findings reinforce the advantage of DPC in reducing the incidence and delaying the onset of postoperative infection.

Wound dehiscence was also notably lower in the DPC group. In Group A, all patients experienced some degree of wound dehiscence, while 11 patients (64.7%) in the DPC group had no dehiscence ($p<0.001$). Partial dehiscence was observed in 64.7% of patients in Group A and 23.5% in Group B (p=0.038), while complete dehiscence was higher in Group A (35.3%) than in Group B (11.8%), though the difference was not statistically significant. The highest frequency of dehiscence occurred on the 7th POD in the PC group and on the 10th POD in the DPC group. Notably, complete dehiscence continued to appear as late as the 15th POD in the PC group, but not in DPC.

These findings align with those of Sasikumar et al, who reported 9.4% wound dehiscence in PC and only 3.8% in DPC.[10] Similarly, Duttaroy et al, Ahmed et al, and Aziz et al found lower dehiscence rates with DPC.[17,19,27] Singh et al observed dehiscence rates of 22% in PC versus 3.7% in DPC, while Chhaparwal et al and Ashraf et al also reported significantly higher wound dehiscence rates in PC groups.[21,26,28]

Overall, the findings of this study strongly support the delayed primary closure in ileal perforation cases, as it significantly reduces the rates of surgical site infection and wound dehiscence without prolonging hospitalization.

This study had several limitations. Firstly, this was a single-center study with a relatively small sample size. Secondly, the study duration was short. Additionally, several important risk factors of SSI, like the degree of peritoneal contamination, the time duration of peritonitis, and wound soiling with ileal content, were not considered during sample selection. These factors might influence the rate of SSI and its subsequent outcome.

CONCLUSION

The study findings show that delayed primary closure (DPC) offers significant advantages over primary closure (PC) in patients undergoing surgery for ileal perforation. DPC was associated with a markedly lower incidence of surgical site infection and wound dehiscence, improving wound healing outcomes. These findings suggest that DPC is a more effective wound management approach in ileal perforation case. So, implementing DPC can enhance postoperative recovery, reduce complications, and improve patient care.

Recommendations

Further study with a prospective and longitudinal study design, including a larger sample size, needs to be done to validate the findings of our study.

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