

## Original Research Article

# A randomised study to evaluate wound outcome following delayed primary vs primary closure of skin in duodenal perforation peritonitis

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### ABSTRACT

**Background:** This study aimed to evaluate wound outcome following delayed primary versus primary closure of skin in duodenal perforation peritonitis.

**Methods:** The present study was a randomised interventional study that included 90 patients on accrual of duodenal perforation peritonitis which were divided into primary closure (PC) and delayed primary closure (DPC) groups comprising 45 patients each. The outcome measures were complications, surgical site infections, hospital stay and final wound status during the follow up of 30 days. Data collected was compared taking P-value <0.05 as significant.

**Results:** The patients were in the age group of 12–60 years, with men in majority in both groups. Mean SSI score in PC and DPC was comparable (2.67 SD 1.58 vs. 2 SD 1.61, P=0.058). SSI was more in PC group than DPC group (11.11% vs. 2.22%, P<0.05). Wound/pus culture was positive in 62.22% in PC and 46.67% in DPC. Major complications like wound dehiscence was noticed mainly in PC group while minor Complications like Stitch abscess, granuloma, sinus was more in DPC group. Mean of duration of stay (days) was comparable between PC and DPC group (14.07 SD 7.64 vs. 13.96 SD 6.94, P=0.805). Final wound outcome after 30 days was healthy scar in majority of patients in PC and DPC group (57.78% vs. 66.67%) with no significant difference between them (p=0.434).

**Conclusions:** In conclusion, DPC showed comparable results with PC with similar SSI and wound healing without significant complications.

**Keywords:** Delayed primary closure, Duodenal perforation, Wound outcome

### INTRODUCTION

Infection in human world and especially in surgical wound has a major role to play in deciding wound outcome. Peritonitis caused because of duodenal perforation is a rare but potentially life-threatening condition.<sup>1</sup> Peptic ulcer disease is the main cause of duodenal perforation, followed by duodenal ischemia, duodenal diverticula, infectious disease, and autoimmune conditions, consisting of Crohn's disease, vasculitis (e.g., abdominal polyarteritis nodosa), and scleroderma with a mortality rate of 8% to 25%.<sup>2-7</sup>

The closure of duodenal perforation remains critical for preventing infection following surgery.<sup>8-10</sup> In the effort of preventing the surgical site infections (SSI), numerous risk factors such as age, body mass index (BMI), comorbidities, surgery type, type of wounds, surgical blood loss, suture material and type of suturing must be taken into account. Type of skin closure is one of the factors which can reduce the SSI thereby reducing the hospital stay and medical costs entailed in the surgery.<sup>11-14</sup>

Primary closure (PC) and delayed primary closure (DPC) are common skin closure methods following surgery.<sup>15-17</sup>

At one end PC involves immediate suturing of the wound and on the other end, DPC works on the principle of delaying the wound closure for 3-5 days for healing and clearing the primary infection of the wound with proper dressing. The use of DPC have shown phenomenal results in terms of reducing the contamination in dirty abdominal incisions but its efficacy in perforated duodenal ulcer has not yet been done in isolation.<sup>18-21</sup>

The present study aimed to compare the incidence of SSI with DPC and PC of skin following laparotomy for perforated duodenal ulcer.

## METHODS

The interventional randomized study was conducted for duration of 18 months from December 2018 till June 2020. Inclusion criteria for the study was documented cases of duodenal perforation on laparotomy >12 year of age and with duration of symptoms <48 hours were included in the study. Patients with duodenal perforation >2 cm in size, American Society of Anesthesiologists (ASA) grade  $\geq$ III, multiple perforations, traumatic duodenal perforation, previous abdominal surgery, and with associated comorbidities such as tuberculosis, diabetes, malnutrition-anemia, hypoproteinemia, Immunodeficiency state/steroid use, chronic obstructive pulmonary disease, coagulopathy, and malignancy were excluded. Institutional ethical clearance was obtained for the study (IEC/VMMC/SJH/2018-190).

After obtaining a written informed consent, 90 patients of duodenal perforation peritonitis fulfilling inclusion criteria were randomized into two groups by sealed envelope method: Group A included 45 patients in which PC of skin incision was done and Group B included 45 patients in whom DPC of skin incision was done.

Data related to demography, symptoms (abdominal pain, constipation, vomiting, and fever) and their duration, and comorbidities were recorded. General physical examination and systemic examination was done. All patients were resuscitated adequately with IV fluids (Ringer lactate, dextrose). Foley's catheterization and Ryle's tube insertion was done to monitor urine output and decompress the abdomen.

Diagnosis of hollow viscous perforation was made on basis of abdominal signs of peritonitis with evidence of free gas under domes of diaphragm.

Hematological and other investigations were done for pre-anesthetic fitness. Informed consent for exploratory laparotomy, as well as inclusion in our study in case of intraoperative confirmation of duodenal perforation was taken from the patient.

All surgeries were performed under general anesthesia. Pre-operatively and peroperative antibiotic dose of 3rd generation cephalosporin (injectable cefoperazone (0.5g) + sulbactam (0.5g) I.V).

Surgical technique of exploration and duodenal perforation repair was similar in all the patients. During surgery pus and abdominal secretions was taken for culture and sensitivity. After confirming the site of perforation, thorough peritoneal lavage was done with warm normal saline until clear effluent was restored. Special attention was paid to irrigate the sub-hepatic pouch, lesser sac, the paracolic gutters and pelvis. Packs were placed around the perforation to contain any further spillage while suturing the perforated site. Edges of the ulcer were freshened using surgical blade (size 11). Graham's omentopexy/Modified graham's omentopexy was done. After Omentopexy, two drains, one in Morrison's pouch (Right sub hepatic) and the other in pelvis were placed and fixed followed with closure of rectus sheath with continuous 1-0 prolene.

PC (Group A), wounds was closed with monofilament nylon interrupted sutures/skin stapler. The stitched wound was examined 24 hours postoperatively, followed by dressing. The stitches were removed on 10th day.

For DPC (Group B), skin was left open for 5 days where it was packed and changed with diluted Betadine (0.5% povidone iodine) soaked gauze on a daily basis. On day 5, it was sutured provided it appeared clean or otherwise DPC was delayed further. The final stitches were removed on the 14<sup>th</sup> day.

The wounds were routinely inspected in both groups from the 1st postoperative day onward daily till the time of discharge and then followed up weekly till 30 days. Clinical outcomes studied were incidence of SSI in both the groups (that is, discharge of pus from the site of infection), wound dehiscence (superficial and full thickness), and duration of hospital stay. Southampton grade 0-5 was used to compare infection in both groups with Grade 0 being regarded as no infection and further grading as per the pus discharge and appearance of the wound. Patient was observed specificity for the following clinical/wound outcomes parameters: surgical site infection, wound culture positivity, stitch abscess, stitch granuloma, stitch sinus, wound dehiscence (superficial and full thickness), duration of hospital stay and final wound outcome.

## Statistical analysis

The data was presented as mean and standard deviation. Independent t test/Mann-Whitney Test and Chi-Square test/Fisher's exact test were used to compare the parameters among the two groups. A p value of <0.05 was considered statistically significant.

## RESULTS

Most of the patients were in the age group of 31-50 years. There was no significant difference between PC and DPC groups in terms of age distribution (37.4 SD 12.57 vs. 37.33 SD 11.26, P=0.887). Number of men and

women were comparable between PC and DPC groups (P=0.315) (Table 1).

Perforation size (P = 0.219) and degree of contamination (P = 0.542) were comparable between PC and DPC.

In majority of cases, perforation size was 0.5x0.5 cm and degree of contamination was >500 to 1000 ml.

**Table 1: Comparison of demographic characteristics between primary and delayed primary closure.**

Demographic characteristics	Primary closure (n=45)	Delayed primary closure (n=45)	Total	P value
<b>Age (years)</b>				
≤20	6	4	10	0.486
21-30	7	9	16	
31-40	14	12	26	
41-50	9	15	24	
51-60	9	5	14	
Mean±Stdev	37.4±12.57	37.33±11.26	37.37±11.87	0.887
Median(IQR)	36(30-45)	40(27-44)	40(30-45)	
Range	18-60	18-59	18-60	
<b>Gender</b>				
Female	42	7	49	0.315
Male	3	38	41	

**Table 2: Comparison of surgical site infection score between primary and delayed primary closure.**

Surgical site infection score	Primary closure (n=45)	Delayed primary closure (n=45)	Total	P value
<b>0</b>	7	13	20	0.301
<b>1</b>	4	5	9	
<b>2</b>	6	8	14	
<b>3</b>	13	8	21	
<b>4</b>	10	10	20	
<b>5</b>	5	1	6	0.058
Mean±Stdev	2.67±1.58	2±1.61	2.33±1.62	
Median (IQR)	3(2-4)	2(0-3)	3(1-4)	
Range	0-5	0-5	0-5	

**Table 3: Comparison of wound/pus culture between primary and delayed primary closure.**

Wound/Pus culture	Primary closure	Delayed primary closure	Total	P value
<b>No growth</b>	17	24	41	0.138
<b>Positive culture</b>	28	21	49	
<b>Wound/Pus culture organisms</b>				
Insignificant growth	6	2	8	0.416
<i>Staphylococcus</i>	1	0	1	
<i>Acinetobacter</i>	2	3	5	
<i>E.coli</i>	7	2	9	
<i>Enterococcus</i>	3	2	5	
<i>Klebsiella</i>	3	6	9	
Mixed growth	6	6	12	

Compared to PC group, DPC group had comparable SSI scores (2.67 SD 1.58 vs. 2 SD 1.61, P=0.058) (Table 2).

Wound/pus culture was positive in 62.22% in PC and 46.67% in DPC (P=0.138). *E. coli* and *Klebsiella* were the main organisms found in positive pus culture in majority of the cases (20% each), with no significant

difference between groups in terms of type of microorganism (Table 3).

Complications occurred in 33 cases in PC group and 37 cases in DPC group. Compared to PC, DPC group had more cases with Stitch abscess (10 vs.4), Stitch granuloma (5 vs. 2), and stitch sinus (3 vs. 1) and less cases with Partial dehiscence (10 vs. 13) and Complete

dehiscence (9 vs. 13), but statistically the difference was not significant ( $P>0.05$ ) (Table 4). Mean SD standard deviation of day of wound dehiscence in DPC was 7.89

SD 1.52 which was significantly higher as compared to PC (4.35 SD 1.57) ( $p$  value  $<0.05$ ).

**Table 4: Comparison of complications between primary and delayed primary closure.**

Complications	Primary closure (n=33)	Delayed primary closure (n=37)	Total	P value
Stitch abscess	4	10	14	0.144
Stitch granuloma	2	5	7	0.434
Stitch sinus	1	3	4	0.616
Partial dehiscence	13	10	23	0.468
Complete dehiscence	13	9	22	0.327

**Table 5: Comparison of outcome between primary and delayed primary closure.**

Outcomes	Primary closure (n=45)	Delayed primary closure (n=45)	Total	P value
<b>Duration of stay (days)</b>				
$\leq 10$	18	20	38	0.806
11-20	18	15	33	
$>20$	9	10	19	
Mean $\pm$ Stdev	14.07 $\pm$ 7.64	13.96 $\pm$ 6.94	14.01 $\pm$ 7.26	0.805
Median (IQR)	13 (7-18)	11 (9-17)	12 (9-17.75)	
Range	6-32	6-29	6-32	
<b>Final wound outcome on 30th day</b>				
Granulation Tissue	12	7	19	0.434
Healthy Scar	26	30	56	
Scar with granulation	7	8	15	

Compared to PC group, DPC group had comparable mean duration of stay (days) (13.96 SD 6.94 vs. 14.07 SD 7.64,  $P=0.805$ ) and comparable final wound outcome on 30th day ( $P=0.434$ ). Final wound outcome was Healthy Scar in 62.22% patients, followed by Granulation Tissue in 21.11%, and Scar with granulation in 16.67% patients (Table 5).

## DISCUSSION

To our knowledge, this is the first Indian study to compare the two skin closure techniques (PC and DPC) in cases with laparotomy following perforated duodenal ulcer. The study results showed that DPC is comparable to PC in preventing the SSI but delayed the wound dehiscence significantly.

The study mainly consisted of patients between 31 years and 50 years of age with almost equal distribution in both the groups. Mean age of the patients was 37.37 SD 11.87 years, which was similar to that reported by other authors.<sup>22,23</sup>

Majority of patients were males in both groups, with no significant difference between them. Male preponderance was also reported in other studies.

SSI score in both the groups was evaluated according to Southampton wound Scoring system. It was found that Mean SSI score in PC and DPC was comparable (2.67 SD 1.58 vs. 2 SD 1.61,  $P=0.058$ ) with culture growth showing less cases with DPC as compared to PC, however the difference failed to reach statistical significance. The findings were relatively in line with some of the previous studies.<sup>24</sup>

One of the main factors responsible for the wound infection development is bacterial contamination of the wound (from the colonic flora) during surgery. In DPC, since regular dressings are done with betadine which keeps the local area clean of the normal flora, the final skin closure may show less SSI.

In present study, wound/pus culture was positive in 62.22% in PC and 46.67% in DPC, with no statistical difference between them.

Similar findings have been reported previously where wound infection rates in PC were more as compared to DPC like 51.43% vs. 25.72%, 68% vs. 40%; 42.5% vs. 17.5%; 27.8% vs. 7.7%, and 77.4% vs. 30.4%.<sup>25,23,26-28</sup> This in itself reinforces the fact that DPC helps in containing the infection through a double check, one, before the skin closure and second after the skin closure.

The culture studies showed that *E. coli* and *Klebsiella* were the commonest organism. The findings are consistent with the previous studies where most common organism isolated from pus culture was *E. coli* in 45.45%, 35% and 11.8% patients, respectively.<sup>22,29,28</sup>

Overall, complications following skin closure in both the groups were comparable with both (partial/superficial and complete/full thickness) wound dehiscence being slightly more in PC group than DPC group and Stitch abscess, stitch granuloma and stitch sinus being more in DPC group ( $p > 0.05$ ). The findings are supported in another study, where in terms of surgical site infection, the severity of infection (superficial, deep or organ space) was not significantly different between the PC and DPC groups;  $P = 0.378$ , but significantly greater wound dehiscence was encountered in PC group ( $P = 0.011$ ).<sup>22</sup> Similarly, two other studies also reported lower incidence of wound dehiscence in DPC.<sup>17,28</sup>

None of the patients had mortality or severe morbidity as they were managed with drainage of abscess, excision of sinus or granuloma and conservative closure of the wound dehiscence.

Concurrent to the fact that SSI were comparable in both the groups, the mean duration of hospital stay was also similar in both the groups (14.07 SD7.64 in PC and 13.96 SD6.94 in DPC,  $P = 0.805$ ). In comparison, one of the study found that hospital stay of PC group patients was significantly higher than DPC group (10.30 SD4.82 days vs. 7.77SD2.029 days) indicating that DPC group has less duration of hospital stay when there was no complication.<sup>22</sup> However it must be added here that the duration of hospital stay in DPC may increase owing to the delayed closure of the wound after 5 days rather than due to wound complication or the occurrence of SSI alone.

Final wound outcome after 30 days was healthy scar in majority of patients in PC and DPC group (57.78% vs. 66.67%,  $P = 0.434$ ). There was no loss to follow up or mortality in the present study. The healing of wound was normal in both the groups without any signs of infection. The slightly more healthy scar in DPC group might be because of the increased oxygenation in open wounds with repeated bactericidal dressings. But since there was no statistical difference, its advantage over PC technique cannot be confirmed. It might be because wound healing is influenced by multiple factors and it is rare that only oxygenation as a single factor impacts.

The study must be interpreted in view of certain limitations. The effect of demographic and patient clinical factors on the wound healing was not analysed. The study sample size was small which might have led to insignificant results. However the study holds strength in being randomised in nature, thus annulling the confounding factors that might influence the wound healing.

## CONCLUSION

In conclusion, DPC showed comparable results with PC with similar SSI and wound healing without significant complications. However, DPC is a tedious, cumbersome and invasive task because of its daily routine of wound dressings and late sutures and PC is an easy one-day task with more acceptance to the patients. The choice of the technique needs future research to arrive at a statistically significant conclusion. Till now, PC can be the choice in laparotomies following perforated duodenal ulcers.

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