**Original Research Article**

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

Sajal Gupta, Vimal Bhandari, I. B. Dubey

1Department of General Surgery, Vardhaman Mahavir Medical College and Safdarjung Hospital, New Delhi, India
2Department of Surgery, VMMC & Safdarjung Hospital, New Delhi, India

Received: 01 May 2021
Accepted: 03 June 2021

Correspondence: Dr. Sajal Gupta,
E-mail: sajal.dare@gmail.com

Copyright: © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

**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 SD1.61, 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. 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%. The closure of duodenal perforation remains critical for preventing infection following surgery. 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.

Primary closure (PC) and delayed primary closure (DPC) are common skin closure methods following surgery.
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.18-21

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 ≥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/SJIH/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 14th 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).

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 |
|-----------------------------|------------------------|-------------------------------|-------|---------|
| Age (years)                 |                        |                               |       |         |
| ≤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) | 0.887 |
| Gender                      |                        |                               |       |         |
| 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 |
|-------------------------------|------------------------|-------------------------------|-------|---------|
| 0                             | 7                      | 13                            | 20    |         |
| 1                             | 4                      | 5                             | 9     |         |
| 2                             | 6                      | 8                             | 14    |         |
| 3                             | 13                     | 8                             | 21    |         |
| 4                             | 10                     | 10                            | 20    |         |
| 5                             | 5                      | 1                             | 6     |         |
| Mean±Stdev                    | 2.67±1.58              | 2±1.61                        | 2.33±1.62 | 0.058 |
| 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 |
|---------------------------------|-----------------|-------------------------|-------|---------|
| No growth                       | 17              | 24                      | 41    | 0.138   |
| Positive culture                | 28              | 21                      | 49    |         |
| Wound/Pus culture organisms     |                 |                         |       |         |
| Insignificant growth            | 6               | 2                       | 8     |         |
| *Staphylococcus*                | 1               | 0                       | 1     |         |
| *Acinetobacter*                 | 2               | 3                       | 5     | 0.416   |
| *E.coli*                        | 7               | 2                       | 9     |         |
| *Enterococcus*                  | 3               | 2                       | 5     |         |
| *Klebsiella*                    | 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 <.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 |
|-----------------------------------|------------------------|-------------------------------|-------|---------|
| Duration of stay (days)           |                        |                               |       |         |
| <=10                              | 18                     | 20                            | 38    | 0.806   |
| 11-20                             | 18                     | 15                            | 33    |         |
| >20                               | 9                      | 10                            | 19    |         |
| Mean ± Stdev                      | 14.07±7.64             | 13.96±6.94                    | 14.01±7.26 | 0.805 |
| Median (IQR)                      | 13 (7-18)              | 11 (9-17)                     | 12 (9-17.75) |         |
| Range                             | 6-32                   | 6-29                          | 6-32  |         |
| Final wound outcome on 30th day   |                        |                               |       |         |
| Granulation Tissue                | 12                     | 7                             | 19    |         |
| Healthy Scar                      | 26                     | 30                            | 56    | 0.434   |
| 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 SD11.87 years, which was similar to that reported by other authors.22,23

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 (2.67SD1.58 vs. 2SD1.61, 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.24

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%.25,23,26-28 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.\(^2,29,28\)

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 \((P=0.011)\). Similarly, two other studies also reported lower incidence of wound dehiscence in DPC.\(^2,24\)

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.\(^22\) 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 nullifying 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.

**Funding:** No funding sources

**Conflict of interest:** None declared

**Ethical approval:** The study was approved by the Institutional Ethics Committee \((IEC/VMMC/SJH/2018-190)\)

**REFERENCES**

1. Ansari D, Toren W, Lindberg S, Pyrhiönen HS, Andersson R. Diagnosis and management of duodenal perforations: a narrative review. Scandinavian J Gastroenterol. 2019;54(8):939–44.
2. Haruna L, Aber A, Rashid F, Barreca M. Acute mesenteric ischemia and duodenal ulcer perforation: a unique double pathology. BMC Surg. 2012;12:21.
3. Thorson CM, Par Ruiz PS, Roeder RA, Sleeman D, Casillas VJ. The perforated duodenal diverticulum. Arch Surg. 2012;147:81–8.
4. Ueda N. Gastroduodenal perforation and ulcer associated with rotavirus and norovirus infections in Japanese children: a case report and comprehensive literature review. InOpen forum infectious diseases 2016 \((Vol. 3, No. 1)\). Oxford University Press.
5. Machado NO. Management of duodenal perforation post-endoscopic retrograde cholangiopancreatography. When and whom to operate and what factors determine the outcome? A review article. JOP. 2012;13(1):18–25.
6. Møller MH, Adamsen S, Thomsen RW, Møller AM. Peptic Ulcer Perforation (PULP) trial group. Multicentre trial of a perioperative protocol to reduce mortality in patients with peptic ulcer perforation. Br J Surg. 2011;98:802–10.
7. Lau JY, Sung J, Hill C, Henderson C, Howden CW, Metz DC. Systematic review of the epidemiology of complicated peptic ulcer disease: incidence, recurrence, risk factors and mortality. Digestion. 2011;84:102–113.
8. Leaper DJ. Surgical infection. In: Williams NS, Bulstrode CJK, O’Conell PR \((Eds)\) Bailey and Love’s Short Textbook of Surgery, 25th ed. Hodder Arnold; 2008:32–48.
9. Burt BM, Tavakkolizadeh A, Ferzoco SJ. Incisions, closures, and management of the abdominal wound. In: Zinner MJ \((Ed)\) Maingot’s Abdominal Operations, 11th edition. McGraw Hill Medical Publication; 2007:71–98.

International Surgery Journal | July 2021 | Vol 8 | Issue 7 | Page 2112
10. Kulaylat MN, Dayton MT. Surgical complications. In: Townsend CM, Beauchamp RD, Evers BM, Mattox KL. (Eds) Sabiston Textbook of Surgery, 18th ed. Saunders Publication; 2008:328–334.

11. Kusachi S, Kashimura N, Konishi T, Shimizu J, Kusunoki M, Oka M, et al. Length of stay and cost for surgical site infection after abdominal and cardiac surgery in Japanese hospitals: multi-center surveillance. Surg Infect. 2012;13:257–265.

12. Andersson AE, Bergh I, Karlsson J, Nilsson K. Patients’ experiences of acquiring a deep surgical site infection: an interview study. Am J Infect Control. 2010;38:711–7.

13. Henry MCW, Moss RL. Primary versus delayed wound closure in complicated appendicitis: An international systematic review and meta-analysis. Pediatr Surg Int. 2005;21:625–30.

14. Chiang RA, Chen SL, Tsai YC. Delayed primary closure versus primary closure for wound management in perforated appendicitis: A prospective randomized controlled trial. J Chin Med Assoc. 2012;75:156–9.

15. Cohn SM, Giannotti G, Ong AW, Varela E, Shatz DV, McKenney MG, et al. Prospective randomised trial of two wound management strategies for dirty abdominal wounds. Ann Surg. 2001;233:409–13.

16. Ussiri EV, Mkony CA, Aziz MR. Sutured and open clean contaminated and contaminated laparotomy wounds at Muhimbili National Hospital: a comparison of complications. East Cent Afr J Surg. 2004;9:89–95.

17. Duttaroy DD, Jitendra J, Duttaroy B, Bansal U, Dhameja P, Patel G, et al. Management strategy for dirty abdominal incisions: primary or delayed primary closure? A randomized trial. Surg Infect (Larchmt). 2009;10:129–36.

18. Watanabe A, Kohnoe S, Shimabukor OR, Yamanaka T, Iso Y, Baba H, et al. Risk factors associated with surgical site infection: Risk factors associated with surgical site infection in upper and lower gastrointestinal surgery. Surg Today. 2008;38:404–12.

19. Bahar MM, Jangjoo A, Amouzeshi A, Kavianifar K. Wound Infection Incidence in patients with simple and gangrenous or perforated appendicitis. Arch Iran Med. 2010;13:13–6.

20. Pinkney TD, Bartlett DC, Hawkins W, Mak T, Youssef H, Futaba K, et al. Reduction of surgical site infection using a novel intervention (ROSSINI): study protocol for a randomized controlled trial. Trials. 2011;12:217.

21. Murtaza B, Ali Khan N, Sharif MA, Malik IB, Mahmood A. Modified midline abdominal wound closure technique in complicated/high risk laparotomies. J Coll Physicians Surg Pak. 2010;20:37–41.

22. Ahmed A, Hafiz M, Iqbal Y. A comparison of primary closure versus delayed primary closure in contaminated abdominal surgery on terms of surgical site infection. J Postgrad Med Inst. 2013;7:403–8.

23. Aziz I, Baloch Q, Zaheer F, Iqbal M. Delayed primary wound closure versus primary wound closure - a dilemma in contaminated abdominal surgeries. J Liaquat Uni Med Health Sci. 2015;14:110–4.

24. Bibe A, Bhutta D, Taimur M, Rahman BU, Ishitaq S. A comparison of primary closure vs. delayed primary closure in contaminated abdominal surgery in terms of surgical site infection. IMJ. 2016;8(3):144–7.

25. Nasib G, Shah SI, Bashir EA. Laparotomy for peritonitis: primary or delayed primary closure? J Ayub Med Coll Abbottabad Jamc. 2015;27(3):543–5.

26. Singh PK, Saxena N, Poddar D, Gohil RK, Patel G. Comparative study of wound healing in primary versus delayed primary closure in contaminated abdominal surgery. Hell J Surg. 2016;88(5):314–20.

27. Siribumunrugwong B, Chantip A, Noorit P, Wilasrumee C, Ungpinitpong W, Chatiga P, et al. Comparison of superficial surgical site infection between delayed primary and primary wound closures in ruptured appendicitis. Asian J Surg. 2014;37(3):120–4.

28. Sasikumar MN, Mammen SC. Primary versus delayed wound closure technique in laparotomy wound of perforation peritonitis. Int Surg. 2019;6:3708–14.

29. Agraval V, Joshi MK, Gupta AK, Jain BK. Wound outcome following primary and delayed primary skin closure techniques after laparotomy for non-traumatic ileal perforation: a randomized clinical trial. Indian J Surg. 2017;79(2):124–30.

Cite this article as: Gupta S, Bhandari V, Dubey IB. A randomised study to evaluate wound outcome following delayed primary vs primary closure of skin in duodenal perforation peritonitis. Int Surg J 2021;8:2108-13.