

# Comparison of Wound Infection Rate in Primary and Delayed Primary Wound Closure after Appendicectomy in Gangrenous/ Perforated Appendicitis

YASIR MEHMOOD<sup>1</sup>, PAKEEZA SHAFIQ<sup>2</sup>, NAVEED ASHRAF<sup>3</sup>

<sup>1,3</sup>Assistant Professor of Surgery

<sup>2</sup>Assistant professor of Radiology

Department of Surgery, Faculty of Medicine, Northern Border University, Ar'ar, Saudi Arabia

Correspondence to Dr. Yasir Mehmood, E-mail: dr.yasir@live.co.uk, Cell No: 00966559075226

## ABSTRACT

**Aim:** To compare the rate of wound infection in primary and delayed primary closure after gangrenous/perforated appendicitis

**Methods:** This prospective comparative study was conducted in department of Surgery Ar'ar Central Hospital, Ar'ar Saudi Arabia over a period from Jan 2018 to June 2019. Adult patients undergoing appendicectomy for gangrenous/perforated appendicitis were included. Eighty six patients were divided in two groups of 43 patients each. In Group-A, Primary closure and in Group-B delayed primary closure of wound was done. Main outcome measure was to compare rate of wound infection in both groups. Statistical significance was considered at  $P < 0.05$ .

**Results:** There were total of 86 Patients who were included in the study. Out of these 86 patients, 52 (60%) were males and 34(40%) were females. Wound infection was seen in 7 patients (16.2%) in group A (primary closure), and in 5 patients (11.6%) in group B (delayed primary closure). These differences were statistically non-significant ( $p=0.53$ ).

**Conclusion:** Primary wound closure is safe and can be performed after appendicectomy for gangrenous/perforated appendicitis.

**MeSH words:** Wound infection, Primary closure, delayed primary closure, perforated appendicitis.

---

## INTRODUCTION

Acute appendicitis is the most common cause of an 'acute abdomen' in young adults and appendicectomy is the most frequently performed urgent abdominal operation. It is often the first major procedure performed by a surgeon in training.<sup>1</sup>Wound infection is the most common post-operative complication which results in longer hospital stay, poor cosmesis and overall higher costs of treatment.<sup>2</sup> Rate of wound infection in uncomplicated appendicitis is less than 10%<sup>3</sup> but rises to more than 40% when appendix is perforated or gangrenous.<sup>4,5</sup>

The method of wound closure is an important risk factor which influences postoperative wound infection. After appendicectomy in acute appendicitis, wound is closed primarily at the time of operation in layers including subcutaneous tissue and skin. In case of gangrenous/perforated appendix the opinions are divided regarding the wound closure.

Historically, to decrease the risk of infection at the surgical site, wounds associated with perforated/gangrenous appendicitis have been managed with delayed primary closure. In this case closure is performed after the appearance of a healthy wound, usually at 3-7 days after surgery.<sup>6</sup>It can result in increased pain, long hospital stay with increase hospital costs. Recent studies are in favor that primary wound closure does not increase the risk of wound infection after appendectomy for complicated appendicitis.<sup>7,8</sup> Therefore this study was planned to compare rate of wound infection in primary and delayed primary wound closure after appendicectomy for gangrenous/ perforated appendix.

## METHODOLOGY

This prospective study after approval from institution review board was conducted in department of Surgery Ar'ar Central Hospital, Ar'ar Saudi Arabia over a period from Jan 2018 to June 2019. Patients of either sex between ages of 15 to 50 years were selected in emergency department. Complete history and examination was done. Patients were diagnosed as a case of acute appendicitis. Detail of procedure was discussed with patients and informed consent was obtained. These patients were operated (appendicectomy) in emergency operation theatre. Only the patients with perforated or gangrenous appendix were included in the study. Patients with pregnancy and malignancy were excluded. Patients were divided into two treatment groups, A and B depending on primary and delayed primary wound closure. Non probability convenience sampling was used and patients were included in 2 groups on alternate basis.

In group A, after appendicectomy the peritoneum was closed with vicryl 2/0. After closure of peritoneum the wound was washed with 500ml of normal saline. The muscles were closed with vicryl 2/0 interrupted sutures and the external oblique apponeurosis was closed with vicryl 1 continuous sutures. Subcutaneous fat was approximated with vicryl 2/0 where needed and skin was closed primarily with prolene 2/0 interrupted sutures.

In group B, wound was washed and closed in layer as in primary closure but skin was left open. Wound was packed with pyodine soaked gauze. Wound was inspected daily in ward in both groups and patients were discharged on 3<sup>rd</sup> post- operative day. All patients were given antibiotics (cefotaxime and metronidazole) according to

body weight for 7 days (3 intravenous doses and then oral antibiotics). All the patients were followed in OPD on 5<sup>th</sup>, 7<sup>th</sup>, 14<sup>th</sup>, 30<sup>th</sup> postoperative day. Patients in groups B were subjected to skin closure (delayed primary closure) with prolene 2/0 under local anesthesia on day 5 or 7 depending upon the condition of wound. Stitches were removed on 7<sup>th</sup> post-operative day in group A, and 7 days after application of stitches in group B. Wound was considered infected if there is discharge of pus from the incision site. Wound infection was noticed by consultant surgeon and data was recorded on a Performa.

All statistical analysis was carried out using STATA/SE version 11.2 for Windows (STATA Corporation, College Station, Texas). The collected data were described as mean ± Standard Deviation (SD) and range for numerical data and number and percentage for categorical data. The distribution of numerical data was tested using the Shapiro-Wilk test for normal data. Comparisons between the different study groups were carried out using the Chi-square test (x<sup>2</sup>) and Fisher Exact Test (FET) to compare proportions as appropriate. The Mann-Whitney test was used to compare numerical data. Statistical significance was considered at P<0.05.

**RESULTS**

There were total of 86 Patients who were included in the study. Out of these 86 patients, 52 (60%) were males and 34(40%) were females. The male patients were 29(67%) in Group A, and 23(53%) in Group B, whereas the female patients were 14(33%) and 20(47%) in the two groups respectively. Mean ages of patients in the two groups are shown in Table.1. There were no significant differences between groups A and B regarding their gender and age distribution.

Wound infection was seen in 12 patients out of total 86 patients (13.9 %). Wound infection was seen in 7 patients (16.2 %) in group A (primary closure), and in 5 patients (11.6 %) in group B (delayed primary closure). These differences were statistically non-significant (p=0.53). (Table 2)

In group A, 5 male and 2 female patients were having wound infection whereas in group B, 3 males and 2 females were having wound infection. There were no significant differences in gender and age between patients with wound infection and those without for both groups A and B. (Table.3&4)

Table 1: Age and Gender distribution

		Group A(no.=43)	Group B(no.=43)	Test	P
Gender N (%)	Female	14 (32.56)	20 (46.51)	x <sup>2</sup> =1.75	0.19
	Male	29 (67.44)	23 (53.49)		
Age (years) Mean ±SD; (range)		25.81±7.17; (18-44)	25.12±8.03; (16-48)	MW=0.77	0.44

x<sup>2</sup>: Chi-square test; MW: Mann-Whitney test

Table 2: Comparison of wound infection rate between Group A and Group B

		Group A(no.=43)	Group B(no.=43)	Chi-square test	p
Wound infection N (%)	No	36 (83.72)	38 (88.37)	0.39	0.53
	Yes	7 (16.28)	5 (11.63)		

Table: 3 Relationship between Age, Gender and wound infection in Group A

		No wound infection (no.=36)	Wound infection (no.=7)	Test	P
Gender N (%)	Female	12 (33.33)	2 (28.57)	FET	1.00
	Male	24 (66.67)	5 (71.43)		
Age (years) Mean ±SD; (range)		25.33±6.43; (18-42)	28.28±10.5; (18-44)	MW=0.31	0.75

FET: Fisher Exact Test; MW: Mann-Whitney test

Table: 3 Relationship between Age, Gender and wound infection in Group B

		No wound infection (no.=38)	Wound infection (no.=5)	Test	P
Gender N (%)	Female	18 (47.37)	2 (40.0)	FET	1.00
	Male	20 (52.63)	3 (60.0)		
Age (years) Mean ±SD; (range)		24.76±7.73; (16-48)	27.8±10.69; (16-44)	MW=0.53	0.59

FET: Fisher Exact Test; MW: Mann-Whitney test

**DISCUSSION**

Acute appendicitis is the most common cause of an ‘acute abdomen’ in young adults. The appendectomy rate in a Korean study was 14 per 10,000 populations per year. 21% of these were gangrenous and ruptured appendicitis.<sup>9</sup>Wound infection is the most common post-operative complication which is increased in case of gangrenous and perforated appendicitis.<sup>10</sup>

There is an ongoing debate that wound in case of complicated appendicitis should be managed by primary closure or delayed primary closure. Delayed Primary Closure of contaminated and dirty wounds was first

described by Hepburn in 1919 during World War 1 and this technique became the standard of care for decades.<sup>11</sup> Grosfeld and Solit<sup>12</sup> in 1968 reviewed perforated appendiceal wounds and found a wound infection rate of 2.3% for delayed closure compared to 14.6% with Primary closure. However these findings were before the use of antibiotics. Bacterial contamination of the wound during surgery is the major factor responsible for the development of a subsequent wound infection. Perioperative antibiotic administration allows primary closure of all appendectomy wounds, despite the fact that contaminated wounds have a higher rate of wound infection.

A study was carried out on 400 patients in which wound infection rate was compared in gangrenous or perforated (50%) and simple appendicitis (50%).<sup>13</sup> Primary wound closure was performed in both groups. Wound infection was observed in 15 patients (3.7%), including 6 cases of simple and 9 cases of gangrenous or perforated appendicitis which was not statistically significant. They concluded that wound infection rate between the simple and gangrenous or perforated appendicitis groups is not significant.

Our study was conducted to prove that there is no significant difference in the rate of wound infection between PC and DPC, in complicated appendicitis. In our study majority of the patients were male (61%). Wound infection was seen in total of 12 patients. Wound infection in group A with primary closure was 16.2% and in group B with delayed primary closure was 11.6% which is not statistically significant ( $p=0.53$ ). In addition there were no significant differences in gender and age between patients with wound infection and those without for both groups A and B.

A recent randomized controlled trial was conducted in which 300 and 298 patients were randomized to PC and DPC groups.<sup>14</sup> The rate of wound infection was lower in the primary closure (7.3%) than delayed primary closure (10%). Postoperative pain, length of stay, recovery times, and quality of life were not significantly different in two groups. However, costs for primary closure were cheaper than DPC. Khan KI, et al conducted a study in which rate of SWI was 10% (5 patients) in primary closure and 8% (4 patients) in delayed primary closure.<sup>15</sup>

Meka M, et al recently conducted a study in which sample size is similar to our study. They concluded that risk of wound infection is less in primary as compared to delayed primary closure of wound in perforated appendicitis.<sup>16</sup> Still there are many recent studies in favor of delayed primary closure of wound in perforated appendicitis. These studies show less risk of wound infection rate in case of delayed primary closure as compared to primary closure of wound.<sup>17, 18</sup>

Another important factor is the cost of treatment which is effected by the method of wound closure in complicated appendicitis. A number of foreign studies which documented the cost of management of complicated appendicitis have also been in the favour of PC.<sup>19,20,21</sup> Keeping in mind the incidence of acute appendicitis and rate of appendicectomies, the cost effectiveness of primary wound closure reduces the burden on health resources.

## CONCLUSION

In our study, rate of wound infection is 16.2% after primary closure and 11.6 % after delayed primary closure for perforated/gangrenous appendicitis. These differences are statistically non-significant. We concluded that primary closure of wound after appendicectomy is safe and can be performed instead of traditional delayed primary closure in gangrenous/perforated appendicitis.

### Recommendations:

Primary closure of wound after appendicectomy for gangrenous/perforated appendicitis is safe and can be performed without increasing risk of wound infection.

**Disclaimer:** None

**Conflict of interest:** None

**Financial disclosure:** Deanship of Scientific Research, Northern Border University, Ar'ar, KSA.

**Acknowledgements:** The authors wish to acknowledge the Deanship of Scientific Research, Northern Border University, Ar'ar, Saudi Arabia for the approval and the support of this research study by the grant number (**MED-2017-1-8-F-7210**).

**Grant Support & Financial Disclosures:** Funded by Deanship of Scientific Research, Northern Border University, Ar'ar KSA.

## REFERENCES

- Connell PR. The vermiform appendix. In: Williams NS, Bulstrode CJK, Connell PR. Bailey and Love's Short practice of surgery. 26<sup>th</sup> ed London: Arnold; 2012.1199-1214.
- Urban JA. Cost analysis of surgical site infections. Surg Infect (Larchmt) 2006; 7 suppl 1:S19-S22.
- McGreevy JM, Finlayson SR, Alvarado R, Laycock WS, Birkmeyer CM, Birkmeyer JD. Laparoscopy may be lowering the threshold to operate on patients with suspected appendicitis. Surg Endosc. 2002; 16:1046 – 1049.
- Siribumrungwong B, Noorit P, Wilasrusmee C, et al. A systematic review and meta-analysis of randomised controlled trials of delayed primary wound closure in contaminated abdominal wounds. World J Emerg Surg 2014; 9:49. doi: 10.1186/1749-7922-9-49
- Lemieur TP, Rodriguez JL, Jacobs DM, Bennett ME, West MA. Wound management in perforated appendicitis. Am Surg. 1999; 65: 439 – 443.
- Duttaroy DD, Jitendra J, Duttaroy B, et al. Management strategy for dirty abdominal incisions: primary or delayed primary closure? A randomized trial. Surg Infect (Larchmt) 2009; 10:129–136. doi: 10.1089/sur.2007.030.
- Paiboon S, Wasana K, Tanaporn T. Vigorous wound irrigation followed by subcuticular skin closure in children with perforated appendicitis. J Med Assoc Thai 2010; 93:318-23.
- Rucinski J, Fabian T, Panagopoulos G, Schein M, Wise L. Gangrenous and perforated appendicitis: a meta-analytic study of 2532 patients indicates that the incision should be closed primarily. Surgery 2000 Feb;127(2):136-41. DOI: 10.1067/msy.2000.101151
- Lee JH, Park YS, Choi JS. The epidemiology of appendicitis and appendectomy in South Korea: national registry data. J Epidemiol 2010; 20:97–105. DOI: 10.2188/jea.je20090011
- Jroundi I, Khoudri I, Azzouzi A, Zeggwagh AA, Benbrahim NF, Hassouni F, Oualine M, Abouqal R. Prevalence of hospital-acquired infection in a Moroccan university hospital. Am J Infect Control. 2007;35:412–416. doi: 10.1016/j.ajic.2006.06.010.
- Hepburn HH. Delayed primary suture of wounds. Br Med J. 1919;1(3033): 181–3.
- Grosfeld JL, Solit RW. Prevention of wound infection in perforated appendicitis: experience with delayed primary wound closure. Ann Surg 1968;168:891–5. DOI: 10.1097/00000658-196811000-00016
- Bahar MM, Jangjoo A, Amouzesi A, Kavianifar K. Wound Infection Incidence in Patients with Simple and Gangrenous or Perforated Appendicitis Arch Iran Med 2010; 13 (1):13–6.
- Siribumrungwong B, Chantip A, Noorit P, Wilasrusmee C, Ungpinitpong W, Chotiya P, et al. Comparison of Superficial Surgical Site Infection Between Delayed Primary Versus Primary Wound Closure in Complicated Appendicitis. Ann Surg. 2018 Apr; 267(4): 631–7. doi: 10.1097/SLA.0000000000002464
- Khan KI, Mahmood S, Akmal M, Waqas A. Comparison of rate of surgical wound infection, length of hospital stay and patient convenience in complicated appendicitis between

- primary closure and delayed primary closure. JPMA 2012; 62(6): 596-8.
16. Meka M, Anasuri B. Comparison of superficial site infection between delayed primary and primary wound closures in ruptured appendicitis. *Int Surg J.* 2018 Apr;5(4):1354-7.
  17. DOI: <http://dx.doi.org/10.18203/2349-2902.isj20181109>
  18. Singh PK, Saxena N, Podder D, Gohil RK, Patel G. Comparative study of wound healing in primary versus delayed primary closure in contaminated abdominal surgery. *Hellenic Journal of Surgery* 2016 88:5, 314-320. doi:10.1007/s13126
  19. Ahmad M, Ali K, Latif H, Naz S, Said K. Comparison of primary wound closure with delayed primary closure in perforated appendicitis. *J Ayub Med Coll Abbottabad* 2014;26(2): 153-7.
  20. Henry MC, Moss RL. Primary versus delayed wound closure in complicated appendicitis: an international systematic review and meta-analysis. *Pediatr Surg Int* 2005; 21: 625-30. DOI: 10.1007/s00383-005-1476-8
  21. Brasel KJ, Borgstrom DC, Weigelt JA. Cost-utility analysis of contaminated appendectomy wounds. *J Am Coll Surg* 1997; 184: 23-30.
  22. Rucinski J, Fabian T, Panagopoulos G, et al. Gangrenous and perforated appendicitis: a meta-analytic study of 2532 patients indicates that the incision should be closed primarily. *Surgery* 2000; 127: 136-41. DOI: 10.1067/msy.2000.101151