

## Superficial Surgical Site Infection after Primary Closure Versus Delayed Primary Closure of Wound in Perforated Appendicitis

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### ABSTRACT

**Objective:** To assess the superficial surgical site infection after primary closure versus delayed primary closure of wound in perforated appendicitis.

**Study Design and Setting:** This was an observational study conducted at Darul Sehat Hospital & Civil Hospital Karachi during March 2019 to August 2019

**Methodology:** All patients of either gender between 18-50 years of age undergoing open Appendectomy through standard gridiron incision in emergency having consented for participation in the study prior to surgery and with per-operative finding of perforated appendix in emergency were included. Patients on steroids or immunosuppressive agents, smoker staking 5 or more cigarettes per day, patients with history of Diabetes Mellitus, chronic liver disease and chronic renal failure were excluded from the study. Patients with perforated appendix were randomly allocated into two Groups. Group A received delayed primary closure at 3<sup>rd</sup> post-operative day while in Group B primary closure was done immediately after appendectomy. All patients were examined for signs and symptoms of superficial surgical site infection at the 5<sup>th</sup> post-operative day before discharge from the hospital. SPSS version 13 was used for data analysis. Chi square test was applied to compare the outcome (superficial surgical site infection) in both groups. P-value <0.05 was considered as significant.

**Results:** A total sixty patients were allocated in each group. Wound infection was very high among patients with immediate closure (40%) as compared to group which received delayed primary closure (15%) (p=0.020).

**Conclusion:** The superficial surgical site infection was significantly higher after primary closure versus delayed primary closure of wound in perforated appendicitis.

**Keywords:** Perforated Appendicitis, Surgical Wound Infection, Wound Closure Techniques,

### INTRODUCTION:

Appendicitis is one of the most common causes of acute abdominal pain; with an incidence of 110 / 100,000.<sup>1</sup> Wound infection at the surgical site is the most common complication after surgery.<sup>2,3</sup> The superficial surgical site is the actual incision site and is also called the surgical wound. They are often used interchangeably. Surgical wound infections can have serious consequences for patients and care facilities:

surgical site infections (SSI) increase postoperative hospital stays, patient mortality, and the need for reoperations. The latest estimates indicated 15.7% of hospital-acquired infections were due to SSI and reported as third most prevalent form of healthcare-related infections.<sup>4</sup> Obesity is considered a risk factor for surgical site infection (SSI). A trend of increasing BMI from normal obesity may increase the risk for SSI risk morbidly has been observed in almost all types of surgery.<sup>5</sup>

The wound infection rate is 4.7% for uncomplicated appendicitis but increases up to 34.1% in perforated appendicitis.<sup>6</sup> In perforated appendicitis; there is a contamination of the incision margins with colonic bacteria and results in surgical site infection during immediate post-operative day. To minimize this contamination and reducing the chances of infection, delayed primary closure of wound is advocated by some surgeons in perforated appendicitis. In this technique wound is left open, dressed daily for 3-5 days with anti-bacterial solution (Povidone-iodine) and then closed primarily.

Superficial surgical site infection (SSI) is common after appendectomy, especially in complicated appendicitis (i.e. gangrene and rupture); the incidence is 9% to 53%. It increases pain, length of stay and costs. The risk factors related to SSI are divided into patient-related factors, surgery-related factors and microbial-related factors.<sup>7</sup> A study by Siribumrungwong et al confirmed the results of previous systematic reviews and meta-analysis, which also indicate

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that lower superficial SSI closure (PC) in primary wounds is better than delayed primary wound closure (DPC) ) Group, 23% (12%, 33%) and 26% (10%, 42%).<sup>8,9</sup>

There is still controversy among surgeons about the appropriate method of wound closure in perforated appendicitis. Most surgeons favor primary closure as it is more satisfying for the patients, reduces length of hospital stay and treatment cost as no additional procedure has to be performed and infection rate comparable to delayed closure.<sup>8,9</sup> Several studies and randomized controlled trials (RCTs) have tried to answer this question in the past, with mixed results.<sup>10,11</sup> Meka et al. concluded that the risk of SSI in ruptured appendicitis showed no difference between PC and DPC techniques. In low-risk SSI patients, PC does not increase the risk of SSI.<sup>12</sup>

As one would expect, this difficulty is less common in today's era of laparoscopic appendectomy. However, open appendectomy is still standard practice in many parts of the world. In fact, even in the UK and Europe, one-third of appendectomy is still performed in an open way.<sup>13</sup> Wound infections is an extremely cumbersome morbidity for the patients. It not only increases hospital stay but also leads to poor scar and social burden on patients and their family.<sup>14</sup> As perforated appendicitis is an already known cause for post-operative wound infection in the selected cases (an intervention at the time of surgery) that reduces post-operative wound infection and results into better patient management and satisfaction. To assess the superficial surgical site infection after primary closure versus delayed primary closure of wound in perforated appendicitis. This study aimed to investigate the effect of delayed primary closure on wound infection by comparing it to primary closure so that hospital stay and operative cost can be reduced and early discharge achieved.

#### **METHODOLOGY:**

This was the comparative observational study conducted at Darul Sehat Hospital & Civil Hospital Karachi during March 2019 to August 2019. All patients of either gender between 18-50 years of age undergoing open Appendectomy through standard gridiron incision in emergency having consented for participation in the study prior to surgery and with per-operative finding of perforated appendix in emergency were included. Patients on steroids or immunosuppressive agents, smokers taking 5 or more cigarettes per day, patients with history of Diabetes Mellitus, chronic liver disease and chronic renal failure were excluded from the study. The sample size was calculated using website open epi.com. Considering average infection rates of 2.9% and 38.9% in the study and control group respectively and taking 95% confidence interval and 95% power of the test, the sample size was 24 patients in each group. Total 60 patients in both groups were assessed for wound closure. Non-probability - consecutive sampling was used and patients were randomly allocated in

Group A (Study group) and Group B (Control group) using random allocation software version 1.0.0. Group A was comprises of patients with delayed wound closure and Group B was comprises of primary wound closure. Initial resuscitation was done with intravenous fluids and analgesics. At induction, all patients were given 1gm of third generation cephalosporin and 500mg of Metronidazole for prophylaxis against infection. After that all patients underwent open Appendectomy via grid iron incision. In the group A, the skin and subcutaneous tissue was closed at 3<sup>rd</sup> post-operative day. However, in the group B, the wound was simply closed at the time of surgery. Similar post-operative antibiotics i.e. Cephalosporins and Metronidazole were given for 5 days in both groups.

All patients were examined for signs and symptoms of superficial surgical site infection at the 5<sup>th</sup> post-operative day before discharge from the hospital. Grading for examination of wound for infection on 5<sup>th</sup> post-operative day was assessed as Grade 0 Normal healing, Grade 1 Normal healing with bruising, Grade 2 Erythema plus fever >38.0, Grade 3 Clear or hemoserous discharge, Grade 4 Purulent discharge, Wound infection was labeled to grade 2 and above. The study was executed after approval of Ethical Review Committee of Liaquat College of Medicine & Dentistry, Karachi. Confidentiality was protected by using password-protected files, encryption when sending information over the Internet, and even old-fashioned locked doors and drawers. Confidentiality of all record was maintained as per hospital policy. SPSS version 13 was used for data entry and analysis. Chi square test was applied post stratification to compare the outcome (superficial surgical site infection) in both groups. P-value > 0.05 was considered as statistically significant.

#### **RESULTS:**

Mean age of the patients was 23.31 ±10.06 years. Mean BMI of the patients was 19.11 ±2.99Kg/m<sup>2</sup>. Duration of surgery of >30 minutes was higher in both groups with 29 (96.7%) in each group (Table – I). Among grading, grade 0 was found to be higher 11 (36.7%) in group A whereas grade 3 was found to be higher 9 (30%) in group B. Significant association was observed in between wound infection and group.

In group B; 24 patients (40%) suffered from wound infection as compared to group A in which 9(15%) patients got infected (Table – II). Wound infection was significantly higher among patients with group B as compared to group A (p-value 0.020). Post stratification analysis didn't show any significant difference in infection rate among the groups on the basis of gender, age, operative time and BMI.

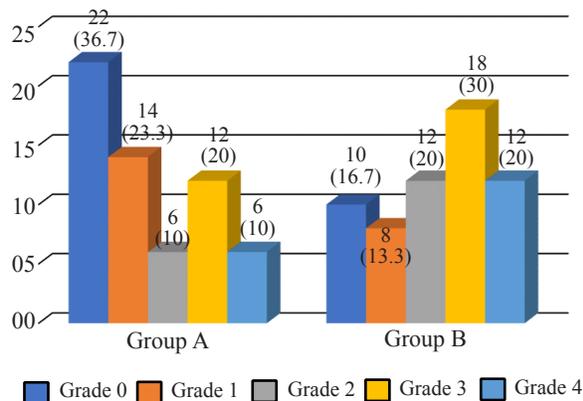
#### **DISCUSSION:**

In perforated appendicitis there is a contamination of the incision margins with colonic bacteria which leads to surgical site infection in the immediate post-operative day. There is

Table – I: Patient characteristics of the two groups

	Group A (n=60)	Group B (n=60)
Age of the patients (years)	23.5 ± 11.3	22.8 ± 13.4
Male : Female	35:25	37:23
BMI of the patients (Kg/m <sup>2</sup> )	20.6 ± 4.1	19.8 ± 5.2
Operative time (minutes)	43.5 ± 12.3	41.8 ± 13.7

Figure I: Comparison of grading with respect to group



**Southampton wound grading system:** Grade 0 Normal healing, Grade 1 Normal healing with bruising, Grade 2 Erythema plus fever > 380, Grade 3 Clear or hemerosous discharge, Grade 4 Purulent discharge. Grade 2 and above was considered as wound infection.

Table – II: Comparison of wound infection between groups

Group	Wound Infection		Total	P-value*
	Yes	No		
A	9 (15%)	51 (85%)	60 (100%)	0.020
B	24 (40%)	36 (60%)	60 (100%)	
Total	33 (27.5%)	87 (72.5%)	120 (100%)	

\* = Chi square test

still controversy among surgeons about the appropriate method of wound closure in perforated appendicitis. A lot of surgeons favor primary closure as it is difficult to brief patient that his/her wound would be left open after surgery and obviously it adds an additional procedure to all the patients and ultimately to the healthcare costs.<sup>15-18</sup> However, studies suggest that delayed primary closure is associated with a significantly lower wound infection rate thus reducing the length of hospital stay, operative cost and more patient satisfaction.<sup>6, 19,20,21</sup>

In our study, wound infection was significantly higher among patients with group B (40%) as compared to group A (15%) although the infection rate came out to be higher in both groups when compared to international literature. Chiang and colleagues have shown that in cases of perforated appendicitis wound infection rate in delayed primary closure group is 2.9% as compared to 38.9% in primary closure group.<sup>20</sup> A recent systematic review conducted by Hureibi

et al. in 2019, they retrieved 471 studies; eight met the eligibility criteria and were included in the analysis. These trials included 1,263 patients, of whom 623 patients underwent delayed closure and 640 primary closures. Surgical Site Infections (SSI) rates were not significantly different between the DC and PC groups (16.25% & 12.68% respectively. OR=0.60, 95% CI: 0.23-1.54.<sup>10</sup> Wound infection is an extremely cumbersome morbidity for the patients. It not only increases hospital stay but also leads to poor scar and social burden on patients and their family. As perforated appendicitis is an already known cause for post-operative wound infection,<sup>22</sup> in these selected cases an intervention at the time of surgery that reduces post-operative wound infection translates into better patient management and satisfaction.

The SSI rate was lower in the PC than the DPC group, with rates of 5% versus 9% respectively. Patients who received PC would be at an approximately 77.8% lower risk of SSI than patients who received DPC, but this was not significantly different.<sup>11</sup> Latif et al reported that delayed primary closure for different pathologies in appendectomy is a safe approach associated with prolonged admission and adverse scar outcome while the primary closure is the most practiced approach which is associated with better patients satisfaction but morbidity rate being low can be grave and at times mortality is encountered.<sup>23</sup> SSI developed in 40.2 % of patients after closure of incisions. Primary closure group had a higher incidence of SSI and longer hospital stay.<sup>24</sup> Delayed primary closure employs a safe means of avoiding this morbidity and its associated cost issues and patient disappointment.

**CONCLUSION:**

The superficial surgical site infection was significantly higher after primary closure versus delayed primary closure of wound in perforated appendicitis.

**REFERENCES:**

1. Wilasrusmee C, Siribumrungwong B, Phuwapraisirisan S, Poprom N, Woratanarat P, Lertsithichai P, et al. Developing and validating of Ramathibodi Appendicitis Score (RAMA-AS) for diagnosis of appendicitis in suspected appendicitis patients. *World J Emerg Surg.* 2017 Nov 9;12:49. doi: 10.1186/s13017-017-0160-3.
2. Ronan O,Connell P. The vermiform appendix. In: William NS, Bulstrode CJ, Ronan O’Connell P, editors. *Bailey and Love’s short practice of surgery.* 25th ed. London: Edward Arnold; 2008 p.1204-18.
3. Khan NK, Fayyad T, Cecil TD, Moran JB. Laparoscopic versus Open Appendectomy: the risk of post-operative infectious complications. *J SocLaparoscSurg*2007; 11:363-7.
4. Thelwall S, Harrington P, Sheridan E, Lamagni T. Impact of obesity on the risk of wound infection following surgery: results from a nationwide prospective multicentre cohort study in England. *ClinMicrobiol Infect.* doi:10.1016/j.cmi. 2015.07. 003

5. Meijs AP, Koek MBG, Vos MC, Geerlings SE, Vogely HC, de Greeff SC. The effect of body mass index on the risk of surgical site infection. *Infect Control HospEpidemiol.* 2019;40(9):991–996. doi:10.1017/ice.2019.165
6. Grosfeld JL, Solit RW. Prevention of wound infection in perforated appendicitis: experience with delayed primary wound closure. *Ann Surg Nov* 1968;168(5):891-95
7. Noorit P, Siribumrungwong B, Thakkinstian A. Clinical prediction score for superficial surgical site infection after appendectomy in adults with complicated appendicitis. *World J Emerg Surg.* 2018;13:23. doi:10.1186/s13017-018-0186-1
8. Siribumrungwong B, Noorit P, Wilasrusmee C, AmmarinThakkinstian. A systematic review and meta-analysis of randomised controlled trials of delayed primary wound closure in contaminated abdominal wounds. *World J EmergSurg*2014; 9:49.
9. 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: A Randomized Controlled Trial. *Ann Surg.* 2018 Apr; 267(4):631-637. doi: 10.1097/SLA.0000000000002464.
10. Hureibia K, Abrahama P, Sunidar O, Alaraimi B, Elzaidi E. To close or not to close? A systematic review and meta-analysis of wound closure in appendicectomy. *International Journal of Surgery Open* 2019; 16: 9-13.
11. 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):153e7.
12. Meka M, Anasuri B. Comparison of superficial site infection between delayed primary and primary wound closures in ruptured appendicitis *IntSurg J.* 2018 Apr;5(4):1354-1357
13. Collaborative NSR. Multicentre observational study of performance variation in provision and outcome of emergency appendicectomy. *Br J Surg*2013;100(9):1240
14. Ahmad M, Ali K, Latif H, Naz S, Said K. Comparison of rate of surgical wound infection, length of hospital stay and patient convenience in complicated appendicitis between primary closure and delayed primary closure. *Age* 2012;35(14.55). 31.38-11.07.
15. Pettigrew RA. Delayed primary wound closure in gangrenous and perforated appendicitis. *Br J Surg.* 1981;68(9):635-38.
16. 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. *J Pak Med Assoc.* 2012;62:596.
17. Siribumrungwong B, Srikuea K, Thakkinstian A, Comparison of superficial surgical site infection between delayed primary and primary wound closures in ruptured appendicitis. *Asian J Surg.* 2014 Jul;37(3):120-4.
18. Chatwiriyacharoen W, Surgical wound infection post surgery in perforated appendicitis in children. *J Med Assoc Thai.* 2002;85(5):572-76.
19. Lemieur TP, Rodriguez JL, Jabobs DM, Bennett ME, West MA. Wound management in perforated appendicitis. *Am Surg*1999;65(5):439.
20. Chiang R-A, Chen S-L, Tsai Y-C. Delayed primary closure versus primary closure for wound management in perforated appendicitis: a prospective randomized controlled trial. *J Chin Med Assoc*2012;75(4):156e9.
21. Shawn JP, Timothy LP. Acute appendicitis. In: Schein M, Wise L. editors. *Controversies in surgery, Volume (4)* NewYork, Springer-Verlag Berlin Heidelberg; 2001.p.141-53
22. Jaffe BM, Berger DH, BrunicardiFC(eds). The appendix. In: *Schwartz's principles of surgery.* 9th ed. Texas: McGraw Hill; 2010 p.1073-89.
23. Latif A, Jamil A, Ansar A, Sarwar S, Sarwar M. Techniques of Wound Closure in Appendicular Surgery: A Prospective Comparative Study at AllamaIqbal Memorial Teaching Hospital. *PJMHS* 2017;11(2):677-80
24. Lateef IO, Jelilat IO, OlaniyiAM, Adedayo KO, Olateju AO, Adebukola OG et al.Prospective Study of Two Management Strategies for Dirty Abdominal Incisions following Laparotomy for Ruptured Appendicitis.*JMSCR*2018;6(2):1263-69

