

## Assessment of Incomplete Wound Closure in Complicated Appendicitis

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**Abstract: Background:** Acute appendicitis is one of the most common surgical presentations worldwide. Acute appendicitis is complicated with several sequels, of which the perforated appendicitis presents a major health concern. Perforated appendicitis is profoundly affected with method of wound closure which determines the incidence of wound infection. **Methods:** This is a prospective randomized study that included 360 patients presented with acute appendicitis. Intraoperative recording of the gross pathology of the appendix with assessment of the relation of wound infection and method of wound closure were performed. Moreover, record of the patients' postoperative hospital stay period was assessed. **Results:** Postoperative assessment of appendectomy revealed that 18.8% was appendicitis negative, 63% was uncomplicated appendicitis and 18.2% was perforated appendicitis. We considered primary closure of wounds in 36.4% of patients, delayed wound primary closure in 18.2% of patients and partial closure of wounds in 45.4% of patients. Incidence of infected surgical wounds was 37.5%, 16.7% and 13.3% in primary, delayed primary and partial wound closure respectively. Delayed primary closure had the longest hospital stay (8 days) compared to primary wound closure (7 days) and partial wound closure (4 days). **Conclusions:** The study on hand provided an evidence on how superior the partial wound closure compared to primary wound closure and delayed primary wound closure in patients with appendicitis.

**Keywords:** appendicitis, wound closure, wound infection.

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### INTRODUCTION

Acute appendicitis represents one of the most prevalent causes of abdominal emergency worldwide [1]. The diagnosis of acute appendicitis is mainly clinical, and the surgical intervention is a must [2]. Appendectomy is the usual choice but with different approaches as open or laparoscopic. Acute appendicitis can be complicated by wound infection, perforation or abdominal obstruction leading to serious septic peritonitis with poor prognosis [3].

One of the major concerns post-appendectomy is surgical wound infection. Therefore, significant concerns were shown towards the method of wound closure in appendectomy [4, 5]. Several options of closure of wounds were proposed, primary closure of wounds, delayed primary closure and partial wound closure are all under continuous debate whether to choose one of them. Assessment of the pros and cons of every method is essential in determining the ideal method in appendectomy patients [6, 7]. The current

study aimed to assess the sequels of partial wound closure in cases of perforated appendicitis.

### METHODS

This prospective study was conducted at Al-Sader Teaching Hospital, Misan, Iraq in a period extending for approximately 3 years (May 2016 to April 2018). We randomly included 360 patients [190 (≅ 53%) males vs. 170 (≅ 47%) females] with age ranged from 5 to 82 years. Diagnosis of acute appendicitis was performed through clinical assessment (history record and abdominal examination), laboratory work-up (complete blood picture and full urine report) with or without abdominal ultrasound assessment. After attaining patients' informed consent, the patients were operated with classic technique of open appendectomy (performing gridiron incision after preoperative preparation with preoperative antibiotics intra-venous third generation cephalosporin combined with intra-venous metronidazole one hour preoperative). The antibiotic parenteral treatment was continued for 72

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hours in uncomplicated patients and until complete resolved wound healing in patients presented with perforated appendicitis.

Intraoperative assessment of gross pathological state of the appendix was performed. Gross pathology was divided into either negative appendicitis (normal morphology) or positive appendicitis (with inflammation of appendix). Inflamed appendix was then subdivided into uncomplicated and perforated appendicitis. Patients with intra-abdominal pathologies rather than appendicitis were excluded from this study. Patients with perforated appendicitis were managed by either primary closure, delayed primary closure or partial wound closure. Partial wound closure involved left of 1/3-1/2 of the lower part of the wound unsutured.

Signs of surgical wound infection was followed up (including redness, swelling, pain and development of purulent discharge and systemic manifestations that include fever, malaise, and body aches). Confirmation of wound infection was performed using bacterial cultures. Patients' data were recruited, tabulated and analyzed using SPSS software (version 25. 2017, IBM, USA). We considered statistical test to be significant if p value was equal to or less than 0.05.

## RESULTS

Analysis of data of included patients revealed that 71.4% of patients presented with acute appendicitis aged between 15-45 years as presented in (Table 1).

**Table-1: Demographic data of included patients presented with appendicitis**

Age (years)	No. of patients		Total number	%
	Male	Female		
< 15	32	25	57	15.7
16-30	64	73	137	37.9
31-45	65	55	120	33.7
46-60	23	13	36	10
> 60	7	3	10	2.7

Positive presentation of appendicitis was evident in 292 (81.2%) patients, on the other hand 68 patients (18.8%) were free of inflamed appendix. Of the 292 patients presented with inflamed appendix, 66 patients (22.5%) presented with perforated appendix.

Patients presented with perforated appendix had their wound sutured with primary wound closure in twenty-four patients, delayed wound primary closure in twelve patients and partial closure of wounds in thirty patients as presented in Table 2.

**Table-2: Techniques of closure of wounds in included patients**

Type of wound closure	Number of cases	percentage
Primary wound closure	24	36.4
Open & delayed wound closure	12	18.2
Partial closure of wounds	30	45.4

Table 3 reveals the incidence of surgical wound infection and the duration of hospitalization days. On the other hand, table 4 shows the incidence of

surgical wound infection and duration of hospitalization days in patients presented with perforated appendix.

**Table-3: Clinical presentation, incidence of wound infection and duration of hospital stay in included patients**

Clinical presentation	Number of patients	Incidence of infection of wounds		Duration of hospitalization (days)
		Number	%	
Free from appendicitis	68	3	4.4	1.5
Uncomplicated appendicitis	226	18	6.2	2
Perforated appendicitis	66	15	22.8	7

**Table-4: Type of wound closure, incidence of wound infection and hospitalization days in patient with perforated appendicitis**

Type of closure	Number of patients	Incidence of infection of wounds		Duration of hospitalization (days)
		Number	%	
Primary closure	24	9	37.5	7
Open wound	12	2	16.7	8
Partial closure of wounds	30	4	13.3	4

## DISCUSSION

One of the most common complications encountered with any surgical intervention is surgical wound infection. Surgical wound infection possesses a great burden on the healthcare system worldwide [8, 9]. This is due to increased postoperative morbidity and mortality, longer hospital stay and higher cost of healthcare services [10]. Surgical wound is classified into main 4 classes depending on type of surgical procedure and bacterial load of the wound. These 4 classes include class one (clean wounds), class two (clean/contaminated wounds), class three (contaminated wounds), and class four (dirty/infected wounds) [11]. Inflamed appendix without complications is classified as class four wound with < 10% infective risk which came into agreement with our study. In the current study, wound infection rate in uncomplicated and negative appendicitis was 6.25% and 4.41% respectively. On the other hand, perforated appendicitis is categorized between class III and IV with 20-40% infective risk [12] which is also in agreement with our study (22.7% rate of wound infection following appendectomy for perforated appendicitis). Previous literature reports mentioned the beneficial role of antibiotics administration pre and post-operative. It was reported that antibiotics administration can decrease the risk of infection up to 3-4% [13]. Unfortunately, despite using proper antibiotics with patients included in the current study we didn't observe this effect. This can be explained with inclusion of several other risk factors that affect rate of infection of wounds as patients' health condition in general, other comorbid chronic diseases and delay in proper diagnosis and intervention.

Several factors control the incidence of wound infection in clinical practice. Prophylactic antibiotic use showed a significant role in decreasing wound infection as previously mentioned. Other preoperative measures include choice of proper surgical technique and control of co-morbid chronic diseases present in operated patients [14, 15]. Proper surgical technique includes purulent material drainage, necrotic tissue debridement and clearance of foreign bodies in wound site [16, 17]. Moreover, type of closure of wounds is very important in limiting risk of wounds' infection, especially when dealing with perforated appendicitis [18]. The selection of primary wound closure in such situations showed a drawback of development of closed space infection. Therefore, an alternative method of wound closure must be selected with emergence of open wound with delayed primary closure technique. This technique involves cleaning and irrigation of wounds with normal saline then gauze packing with insertion of interrupted fine nylon sutures. Delayed wound closure is then done 3-5 days postoperative [19-21].

It was considered that the open surgical wound with delayed wound's primary closure is ideal for management of perforated appendix, as it significantly

reduced the incidence of wound infection. However, this technique is disadvantageous regarding longer hospital admission and higher cost of treatment [22]. The current study revealed higher incidence of wound infection with open wound technique (16.7%) compared to previous literature (4%). This can be explained with the fact that open wound method was applied in our study in only fulminant cases of appendix perforation that is accompanied with excessive inflammation and sepsis. Considering the cons of the open wound technique, and with the usage of powerful antibiotics, the surgical decision was changed back into preference of primary wounds' closure [19, 21, 27, 28]. In addition, mentioned studies had recommended primary closure of wounds and reported that there was minimal significant improvement in wound infection incidence between these two closures. Currently, primary wounds' closure is the preferred choice in patients with perforated appendicitis in pediatric surgeries [26, 29, 30]. The aforementioned literature in this field mentioned various rates of wounds' infection with the primary way of wound closure. These articles reported better rates include 44%, 55.7, 48.1%, and 37.1%, while those reporting worse rates were of 0%, 1.5, 7.8%, and 11.1%. [16, 20, 26, 28, 31-33]. The current study reported very high incidence of wound infection (37.4%).

In the current study, we also considered application of partial wound closure in some of patients presented with perforated appendicitis. Considering that technique, the wound was scrubbed using normal NaCl solution and washed by iodine solution then closed by deep interrupted sutures, and about 50% of the last part of the wound was left unsutured (to be self-drained) and covered with aseptic dressing. This way necessitates full and every-other day on clinic examination of these wounds from the third day post-operative until the wound become dry with acceptable cosmetic appearance. Regarding patients included in our study and received this type of wound closure, significant lower infection rates were observed compared to primary incision closure (13.3% vs. 37.5%) (P value= 0.03) and non-significant lower infection rates rate compared to delayed incision closure (13.3% vs. 16.7%) (P value = 0.7). Moreover, the partial wound closure method had less hospitalization days compared to other techniques (four days) vs. (seven days) in primary wounds' closure way and (eight days) in the open incision with delayed primary closure) and therefore less health care burden. Included patients who showed wound sepsis with partial wounds' closure were bedside treated by widening of the lowermost part of the wound edges using an artery forceps then wound cleaning with an anti-sepsis irrigation and finally covered by sterile covering.

## CONCLUSION

The current study revealed the beneficial role of partial wound closure during appendectomy for perforated appendicitis. Patients undergoing partial wound closure exhibited lower wound infection rate, lower hospital stays duration and higher overall patients and healthcare provider satisfaction. Moreover, partial wound closure had very acceptable cosmetic prognosis with minimal scar formation.

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## Conflict of interest

The authors declared no conflict of interest.

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