

## **COMPARATIVE STUDY BETWEEN INTERRUPTED MATTRESS AND CONTINUOUS SUBCUTICULAR SKIN CLOSURE IN REGARDING POST-APPENDECTOMY WOUND INFECTION**

**Ahmed Abdul-Hadi Safar<sup>\*</sup>, Adnan Y Al-Adab<sup>#</sup> & Zeki A Al-Faddagh<sup>@</sup>**

<sup>\*</sup>MB,ChB, FICMS, Al-Sadir Teaching Hospital. <sup>#</sup>FRCS, Assist. Prof. of Surgery. <sup>@</sup>CABS, FRCS, Professor, Consultant Surgeon, Dept. of Surgery, Basrah Medical College, University of Basrah, IRAQ.

### **Abstract**

Historically, potentially infected surgical wounds, like in acute appendicitis, were recommended to be closed by interrupted skin suturing. However, this method of skin closure can leave a marked scar at the closure site after healing of the wound. On the other hand, there are no enough data about the potential risk increment in wound infection following skin closure by continuous subcuticular approach.

This is a prospective study aimed to compare the results of skin closure using interrupted mattress and subcuticular continuous approaches following appendectomy, in terms of postoperative wound infection rates.

One hundred and ten (110) patients with acute appendicitis admitted to Al-Sadir Teaching Hospital in the period between January 2013 and February 2014 were chosen for the study. The patients were divided into two groups. In one group, (58) patients, the appendectomy wound was closed by interrupted mattress, and patients in the other group, (52) patients, underwent continuous subcuticular skin closure. All patients were followed up for two days postoperatively in the hospital and seven days as outpatient follow-up for signs and symptoms of wound infection.

By assessing the effect of risk factors on the rate of post-appendectomy wound infection, the following results were obtained: Effect of gender on postoperative infection: Males: 8/59 (13.6%), Females 6/51 (11.8%), P value: 0.079. So the association between gender and rate of infection was not significant. Effect of smoking on postoperative infection: Smokers: 4/24 (16.7%), Non-smokers: 10/86 (11.6%), P value: 0.429. So the association between smoking and the rate of infection was not significant. Effect of family history of previous appendectomy on postoperative infection: Positive family history: 7/34 (20.6%), Negative family history: 7/76 (10.1%), P value: 2.738. So the association between family history and the rate of infection was not significant. Effect of history of previous abdominal operations on postoperative infection: Positive history: 1/7 (16.7%), Negative history: 13/103 (12.6%), P value: 0.066. Thus the association between history of previous abdominal operations and the rate of post-appendectomy wound infection was not significant.

In interrupted mattress skin closure group, 7/58 (12%) patients developed signs and symptoms of wound infection, whereas in the continuous subcuticular skin closure group, 7/52 (13.4%) patients developed wound infection.

In conclusion, there is no significant difference in the risk of wound infection between skin closure by interrupted mattress and continuous subcuticular approaches.

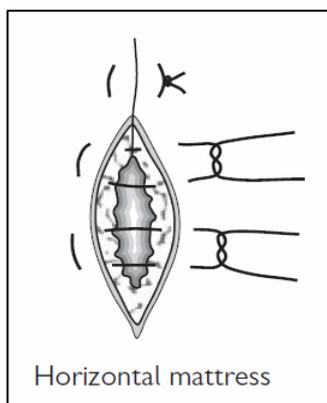
### **Introduction**

Acute appendicitis is a very common emergency condition, especially among young patients, with incidence of about 8.6% in males and 6.7% in females worldwide<sup>1</sup>. The highest incidence of acute appendicitis is found in persons

aged 10–19 years, with higher incidence in males than females<sup>2</sup>. It requires surgical intervention to remove the inflamed appendix. Thus, appendectomy represents one of the most common abdominal operations performed in surgical units<sup>3</sup>.

As appendectomy is considered a contaminated procedure, the currently recommended approach in skin closure is interrupted mattress<sup>4</sup> (Fig.1); thus, if the wound got infected postoperatively, only the suture overlying the infected area need to be removed to explore the wound.

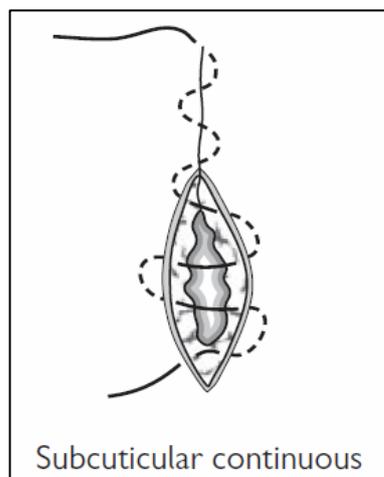
However, this method of skin closure carries a high rate of leaving scars and stitch markers after healing of the wound in most of the patients<sup>5</sup>, that can be of significant psychological stress for patients, especially for teen age female patients<sup>6</sup>.



**Figure 1: Interrupted mattress skin closure**  
(Adapted from Oxford Handbook of Clinical Surgery)

On the other hand, there is another approach can be used in skin closure following appendectomy called subcuticular continuous skin closure<sup>6</sup> (Fig.2), in which the stitch sites located under the epidermis of the skin and no stitch markers are visible externally<sup>5</sup>. This approach carries a much lower risk of developing an obvious scar or stitch

markers on healing<sup>7,8</sup>, but the disadvantage of this method of skin closure is that, should the wound get infected postoperatively, the whole length of the wound should be reopened and explored, then to be closed using interrupted mattress skin closure. Add to that, postoperative infection prolongs hospital stay and cost<sup>9</sup>.



**Figure 2: Continuous subcuticular skin closure**  
(Adapted from Oxford Handbook of Clinical Surgery)

Despite these significant cosmetic differences in outcomes between the two approaches, there is not enough data or studies to demonstrate the approximate incidence of wound infection when continuous subcuticular skin closure is used after appendectomy. Hence, this study was done to estimate the possible increase in rate of wound infection following appendectomy, should the traditional interrupted mattress skin closure approach be replaced by continuous subcuticular skin closure.

Many signs and symptoms should be considered in following up post appendectomy patients, like developing local increasing redness, tenderness and/or swelling at the wound site, yellowish or greenish pus discharge, foul smell from the wound and developing high grade fever or body chills<sup>10</sup>. Different studies showed different incidence in wound infection postoperatively; however, most studies showed figures less than 10% if the patient was given preoperative antibiotics, and 20-30% in patients not given antibiotics<sup>11-13</sup>.

There are also some risk factors that might affect or increase the risk of infection, like the age of patient, gender, the severity of inflammation of appendicitis, the operation condition, using some medicines, using antibiotics around the time of operation, and some diseases like diabetes mellitus, renal diseases, liver diseases, and immune system diseases<sup>14,15</sup>. Therefore, should accurate result be obtained, these risk factors should be also taken in consideration and unified between the study groups<sup>16</sup>.

Postoperative infections affect the prognosis and outcomes of the surgery, increase other complication risks and prolong hospitalization time and costs<sup>17,18</sup>.

## **Patients & Methods**

Patients with predisposing factors, such as chronic use of some drugs, like steroids, and patients with some diseases,

like diabetes mellitus and renal diseases were excluded from the study.

In this prospective study, 126 patients with emergency appendicitis, admitted to the emergency room in Al-Sadir Teaching Hospital between January 2013 and February 2014, were selected. All patients were within the age group of 10-35 years. Ten patients with ruptured appendix, discovered at time of operation, were excluded. Six patients were not complying with the study and did not come for the follow up visits; therefore, they were also excluded from the study.

To assess the possible effects of other factors on the rate of postoperative infection, like sex, smoking, family history of appendectomy and previous abdominal operations, tests of significance on postoperative infection rate were done for each of these factors.

The patients were then divided into two groups, those who underwent interrupted mattress closure group involved 58 patients, and the group of patients who had continuous subcuticular skin closure, involved 52 patients; the method of skin closure was chosen randomly. Male and female distribution was comparable between the two groups. Patients in both groups received a single dose of antibiotics (ceftriaxone) one hour before surgery, and parenteral ceftriaxone and metronidazole, were used postoperatively for two days in the hospital; then oral metronidazole and cephalexin for three days after discharge.

All surgeries were performed by the same surgeon, general anesthesia, antiseptic skin preparation, and the same suture material was used for skin closure.

All patients were followed up for signs and symptoms of wound infection like fever, yellowish or greenish fluid discharge (pus), foul smell, increasing tenderness, redness or swelling around the wound, for 9 days postoperatively, 2 days inside the hospital and 7 days at home; stitches were removed on the 9th day.

Patients that developed postoperative infections were treated accordingly; for example, some patients treated with antibiotics only; others with pus discharge or increasing swelling underwent wound drainage and repeated dressing till infection subsided. Some patients that required drainage also needed secondary closure later on.

Data in the study were fed on computer using SPSS (Statistical Package for Social Science version 15). If P value of the study is more than 0.05, no significant association between the variables.

In the study, two approaches for skin closure were chosen, interrupted mattress and subcuticular suturing. In interrupted

mattress skin closure, non-absorbable suture, like prolene 3/0 was used and suturing was horizontal mattress. In the continuous subcuticular group, also non-absorbable suture, like prolene 3/0 was used.

Intraoperative drain was not required for any patient in either group.

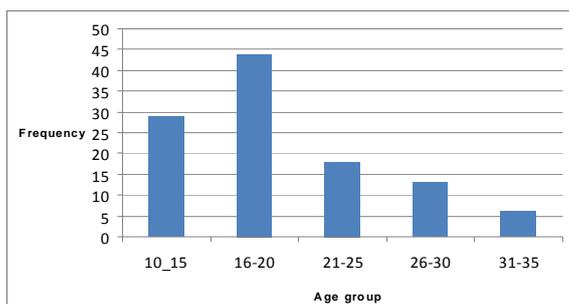
**Results**

Of the 110 patient considered in the study, 58 (52.7%) underwent interrupted mattress skin closure, and 52 (47.3%) had continuous subcuticular skin closure, with comparable gender distribution between the two groups Table (I).

**Table I: Gender distribution of patients selected for the study in both groups.**

	Males	Females	Total
Interrupted Mattress Group	35 (59.3%)	23 (45%)	58 (52.7%)
Continuous Subcuticular Group	24 (40.6%)	28 (54.9%)	52 (47.3%)
Total	59 (53.63%)	51 (46.36%)	110 (100%)

**Figure 3: Age distribution of patients involved in the study. Majority of patients were in the 15-25 age groups.**



Different factors that might affect the rate of infection were compared and tested for significance between patients who developed postoperative infection, and those who did not develop postoperative infection. The data and comparison are shown in the tables and charts.

As shown in table II, 8 (13.6%) males developed postoperative wound infection, 5 had subcuticular continuous skin closure, and 3 had interrupted mattress. This is in comparison to 6 (11.8%) females, 2 with subcuticular continuous and 4 with interrupted mattress.

**Table II: The effect of gender of patient on the risk of developing postoperative infection. S.C.: subcuticular continuous. I.M.: interrupted mattress**

Type of suture	Infection		No infection		Total
	S.C.	I.M.	S.C.	I.M.	
Males	5	3	21	30	59 (53.6%)
Females	2	4	24	21	51 (46.4%)
Total	14 (12.7%)		96 (87.3%)		110 (100%)

P value( chi-square value) = 0.079 ; df=1

Among patients who smoke, 4 (16.7%) patients developed post-operative wound infection, 6 had subcuticular continuous skin closure and 4 had interrupted mattress Table (III).  
 1 from the subcuticular continuous group and 3 from the interrupted mattress; this is in comparison to 10 (11.6%) non-smoker

**Table III: The effect of smoking status on the risk of postoperative infection.**

Smoking	Infection		No infection		Total
	S.C.	I.M.	S.C.	I.M.	
Smokers	1	3	9	11	24 (21.8%)
Non-smokers	6	4	36	40	86 (78.2%)
Total	14 (12.7%)		96 (87.3%)		110 (100%)

P value (chi-square value) = 0.429 ; df = 1

Considering family history of appendectomy, 7 (20.6%) of patients who has family history, developed postoperative wound infection, 3 of them within the subcuticular continuous group and 4 within the interrupted mattress; and 7 (10.1%) of patient who do not have family history of appendectomy developed postoperative wound infection, 4 had subcuticular continuous skin closure and 3 of them had interrupted mattress skin closure (Table IV).

**Table IV: The effect of family history of appendectomy on the risk.**

Family history	Infection		No infection		Total
	S.C.	I.M.	S.C.	I.M.	
Positive	3	4	12	15	34(30.9%)
Negative	4	3	33	36	76(69.1%)
Total	14(12.7%)		96(87.3%)		110(100%)

P value ( chi-square value) = 2.738 ; df=1

Of the 7 patients who had history of previous abdominal surgeries, 1 (16.7%) patient developed postoperative wound infection, who underwent interrupted mattress skin closure; this is in comparison to 13 (12.6%) of patients, 7 subcuticular continuous and 6 interrupted mattress group, who do not have history of previous surgeries developed postoperative wound infection (Table V).

**Table V: Effect of having a history of previous surgery on the risk of infection.**

Previous abdominal surgeries	Infection		No infection		Total
	S.C.	I.M.	S.C.	I.M.	
Type of suture					
Yes	0	1	3	3	7(6.3%)
No	7	6	42	48	103(93.7%)
Total	14(12.7%)		96(87.3%)		110(100%)

P value (chi-square value) = 0.066 ; df=1

Within the follow up period, 7/58 patients (12%) of the interrupted mattress group developed wound infection and 7/52 patients (13.4%) in the continuous subcuticular group developed wound infection Table (VI). Distribution of wound infection according to the postoperative day of their occurring is shown in Table (VII). The methods by which patients with postoperative wound infection treated are shown in Table (VIII).

**Table VI: Incidence of wound infection related to the type of suture.**

	Infection	No Infection	Total
Interrupted Mattress Group	7(12%)	51(88%)	58(52.7%)
Continuous Subcuticular Group	7(13.4%)	45(86.6%)	52(47.3%)
Total	14(12.7%)	95(87.3%)	110(100%)

P value (Chi-square value)= 0.085; df= 1

**Table VII: Infection distribution according to day of their occurrence.**

	4th Day	5th Day	6th Day	7th Day	Total
Interrupted Mattress Group	3	2	2	0	7
Continuous Subcuticular Group	0	4	2	1	7
Total	3	6	4	1	14

**Table VIII: Fate of patients developed wound infection and way of management.**

	Treated by antibiotics only	Treated by incision and drainage; intention and closure	secondary and delayed	Total
Interrupted Mattress Group	3	4		7
Continuous Subcuticular Group	2	5		7
Total	5	9		14

## Discussion

After obtaining the results; data from interrupted mattress skin closure and

subcuticular continuous skin suturing groups were analyzed to assess the significance of the type of skin closure on the risk of post-appendectomy wound infection.

Analyzing the effect of risk factors (age, gender of patient, smoking status, family history of previous appendectomy, and history of previous abdominal surgeries) on the rate of infection showed no significant association between these factors and the rate of post-appendectomy wound infection. Additionally, the two groups (interrupted mattress skin closure and subcuticular continuous skin closure) were well matched for sex, age, preoperative preparation, operating time, surgical technique, and postoperative care. Therefore, the variation in wound infection rates between the two groups was solely resulted from the type of skin closure.

The effects of risk factors were assessed as the following:

Gender was one of the risk factors compared in both groups in this study, there is a difference in incidence of wound infection postoperatively between males and females due to hormonal variation; however, P value was 0.079. So the association between gender and rate of infection is not significant. This result is consistent with the results obtained in other studies<sup>19-21</sup>.

Smoking was one of the risk factors compared in both groups in this study, as we know, smoking has effect on tissue oxygenation and chemotactic effect of neutrophil that lead to impair phagocytosis and impair immune response in postoperative patient; P value between smokers and non-smokers in this study that developed postoperative wound infection was 0.429, indicating that no significant association between smoking and the rate of infection in this study. This

was consistent with other studies assessing smoking on postoperative wound infection<sup>21</sup>.

The other risk factor compared between the two groups was family history of previous appendectomy. There was low incidence of acute appendicitis due to genetic predisposition factor, these hereditary factors may associated with familial connective tissue disease in rare cases that might lead to wound disruption and postoperative wound infection. P value between the two groups was 2.738; thus, P value indicates that the association is not significant. Similar conclusion was reached in other studies<sup>21</sup>.

The last risk factor studied was the history of previous abdominal surgeries, any patient exposed to previous abdominal surgery will have more risk of developing postappendectomy wound infection than those with negative history of previous abdominal surgery due to that the greater omentum in patients with previous abdominal surgery will lose its function in containing the inflamed appendix, and that lead to more progressive course of acute appendicitis and more risk of wound infection postoperatively. However, in this study P value was 0.066, meaning that the association is not significant; a result obtained in other similar studies<sup>21</sup>.

As the aim of this study was to assess the influence of type of skin closure, whether interrupted mattress or subcuticular continuous suturing, on the rate of post-appendectomy infection; therefore, data from the two groups were compared and test of significance, using SPSS software, was done. As P value was more than 0.05, which means that the association between the type of skin closure and infection is not significant.

Thus, the results showed no significant difference in the rate of postoperative wound infection between patients underwent skin closure by interrupted mattress, and patients with continuous subcuticular skin closure.

Similar results were obtained in studies done by Hopkinson et al<sup>22</sup> and Onwuanyi et al<sup>23</sup>. In the first study, the infection rate among patients underwent continuous subcuticular suturing was 3/43 (7%), while the rate of infection among patients underwent interrupted mattress suturing was 4/34 (11.8%). In Onwuanyi et al study, the rate of infection was the same in both groups (6%). So, in both studies, there was no significant effect of the technique used in skin closure on the rate of postoperative skin closure during appendectomy. This further supports the results obtained in our study where the rates of infection were 7/58 (12%) and 7/52 (13.4%) in the interrupted mattress

group and the continuous subcuticular group respectively.

### **Conclusion and recommendations**

As the results of the study showed no significant association between the type of skin closure and postoperative rate of infection, it is safe to close the skin by continuous subcuticular suture following appendectomy for cases with non-perforated appendicitis. In other words, no preference is given to either type, and it is the surgeon's sole preference, or other factors like cosmetic effect, that determines the type of skin closure to be used after appendectomy.

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