

# Comparative study between classical two-layer and one-layer extra-mucosal intestinal anastomosis in elective and emergency abdominal operations

John Chol Ajack<sup>1</sup>,  Galal Abouelnagah<sup>2</sup>, Haytham Fayed<sup>2</sup>

## Author Affiliation:

1. Department of Surgery, Juba Teaching Hospital and School of Medicine, University of Juba, South Sudan
2. Department of Surgery, College of Medicine, Alexandria University, Egypt

## Correspondence:

John Chol Ajack  
[johncholajack@gmail.com](mailto:johncholajack@gmail.com)

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## ABSTRACT

**Introduction:** Intestinal anastomosis can be done in various ways, including the use of staples and hand-sewn methods. The hand-sewn method includes a one-layer technique and a two-layer technique. The safety and efficacy of one-layer or two-layer are controversial. This study aimed to compare the outcomes of these techniques.

**Method:** Fifty patients were included in the study: 30 males and 20 females. The patients were categorized into two groups: 33 underwent elective surgery, and 17 underwent emergency surgery. Outcome measures included the mean time to anastomosis, mean operative time, anastomotic leak rate, mortality rate, and hospital stay duration. Statistical analysis used the Chi-square test, Fisher's exact or Monte Carlo correction, Student's t-test, and Mann-Whitney U test.

**Results:** 32 patients were managed with the classical two-layer technique, and 18 with the one-layer extra-mucosal technique. The total operation time ranged from 1.0 to 5.0 hours for single-layer extra-mucosa anastomosis and 0.83 to 4.17 hours for classical two-layer anastomosis. Most wound infections and deaths occurred with the two-layer techniques, accounting for 8 (16%) and 5 (10%), respectively. The most common complications were wound infections, 11 (22%), and anastomotic leaks, 10 (20%), which mainly occurred under emergency conditions with the two-layer technique.

**Conclusion:** The one-layer technique requires less time to perform compared to the two-layer technique, with no significant differences in the rate of anastomotic leaks. In terms of safety, the one-layer method may be superior to the classical two-layer technique.

**Keywords:** intestinal anastomosis, anastomotic leak, extra-mucosal, mortality rate.

## Introduction

By the beginning of the 20th century, several methods for intestinal suturing had been described, and the essential principles of intestinal anastomosis were firmly established.

<sup>[1]</sup> These principles are: a well-nourished patient with no systemic illness; no faecal or purulent contamination; adequate exposure and access; gentle tissue handling; well-vascularized tissues; absence of tension and distal obstruction; approximation of well-vascularized bowel ends; and meticulous surgical technique.<sup>[2]</sup>

Two-layered anastomosis consists of an inner layer of continuous or interrupted absorbable sutures and an outer layer of interrupted absorbable or non-absorbable sutures. A one-layer anastomosis consists of a single layer of interrupted or continuous absorbable sutures.<sup>[3]</sup>

The objections to the classical two-layer anastomosis are that it is costly and takes longer to perform, it ignores the principles of accurately apposing the cut edges, and a large amount of ischaemic tissue is incorporated in the suture line, increasing the risk of a leak. The inner layer increases the risk of mucosal strangulation due to damage to the submucosal vascular plexus, and the outer seromuscular layer may lead to narrowing at the site of anastomosis.<sup>[4]</sup>

Many studies have reported that one-layer anastomosis takes less time to create, lowers cost, allows more accurate tissue apposition, incorporates the strongest submucosal layer,<sup>[5]</sup> causes the least damage to the submucosal vascular plexus, has the least chance of narrowing the lumen, and has fewer complications of anastomotic leaks.<sup>[6]</sup> Anastomotic leak is defined as “an escape of content or a communication between intra- and extraluminal compartments at the anastomotic site.”<sup>[7]</sup>

## Method

This study was conducted in the surgical units of Alexandria's main University Hospital from December 1, 2016, to July 31, 2017. Patients with malignancy, inflammatory conditions, trauma, strictures, or ischaemia were included in the study, and those with faecal peritonitis, septic shock, those with proximal diversion, and those who were transferred from outlying hospitals with a leak were excluded.

Prophylactic antibiotics were given at the time of induction of anaesthesia. A 3-0 polyglactin absorbable suture on a round-body needle was used in all cases. The one-layer technique was performed by taking all layers except the mucosa in an inverted, interrupted manner. Two-layer anastomosis was carried out by a transmural inner layer of continuous/interrupted inverted sutures and an outer layer of interrupted seromuscular sutures. All anastomoses were performed by the hand-sewn technique.

## Results

Fifty patients were included in this study, comprising 30 males and 20 females. Their ages ranged from 16 to 76 years. The average age for the one-layer extra-mucosal technique was  $46.72 \pm 15.52$  years, while for the traditional two-layer method, it was  $45.97 \pm 15.62$  years.

Thirty-three patients were operated on under elective conditions and 17 under emergency conditions; 32 patients were managed using the two-layer technique, and 18 using the one-layer extra-mucosal technique.

The distribution of the studied cases, based on operation time and anastomotic time, is shown in Table 1. The total

**Table 1. Distribution of the studied cases according to operation time and anastomotic time**

|                         | One layer<br>(n = 18) | Two layers<br>(n = 32) | Test of sig. | p-value |
|-------------------------|-----------------------|------------------------|--------------|---------|
| Operation time (hour)   |                       |                        |              |         |
| Min.                    | 1.0                   | 0.83#                  | U= 174.5*    | 0.018*  |
| Max.                    | 5.0                   | 4.17                   |              |         |
| Mean $\pm$ SD.          | $1.98 \pm 1.03$       | $2.35 \pm 0.72$        |              |         |
| Anastomotic time (min.) |                       |                        |              |         |
| Min.                    | 15.0                  | 23.0                   | t= 9.559*    | <0.001* |
| Max.                    | 29.0                  | 45.0                   |              |         |
| Mean $\pm$ SD.          | $18.56 \pm 3.93$      | $31.34 \pm 4.84$       |              |         |

\*: Statistically significant at  $p \leq 0.05$

**Table 2. Complications and their distribution in relation to anastomotic technique**

| Complication            | One layer<br>(n = 18) | Two layers<br>(n = 32) | Total<br>(n = 50) | X <sup>2</sup> | FE**p |
|-------------------------|-----------------------|------------------------|-------------------|----------------|-------|
|                         | n (%)                 | n (%)                  | n (%)             |                |       |
| Wound infection         | 3 (6.0)               | 8 (16.0)               | 11 (22.0)         | 0.466          | 0.724 |
| Wound dehiscence        | 0 (0.0)               | 2 (4.0)                | 2 (4.0)           | 1.172          | 0.530 |
| Prolonged ileus         | 1 (2.0)               | 2 (4.0)                | 3 (6.0)           | 0.010          | 1.000 |
| Anastomotic leak        | 3 (6.0)               | 7 (14.0)               | 10 (20.0)         | 0.195          | 0.730 |
| Intra-abdominal abscess | 2 (4.0)               | 3 (6.0)                | 5 (10.0)          | 0.039          | 1.000 |
| Re-exploration          | 2 (4.0)               | 5 (10.0)               | 7 (14.0)          | 0.195          | 1.000 |
| Mortality               | 2 (4.0)               | 5 (10.0)               | 7 (14.0)          | 0.195          | 1.000 |

FE: p-value for Fisher's Exact for Chi-square test

**Table 3. Complications and their distribution in relation to the type of surgery**

| Complication            | Elective<br>(n = 33)   |                       | Emergency<br>(n = 17)  |                      | Total<br>(n = 50) | X <sup>2</sup> | MC**p  |
|-------------------------|------------------------|-----------------------|------------------------|----------------------|-------------------|----------------|--------|
|                         | Two layers<br>(n = 21) | One layer<br>(n = 12) | Two layers<br>(n = 11) | One layer<br>(n = 6) | n (%)             |                |        |
| Wound infection         | 3 (6.0)                | 2 (4.0)               | 5 (10.0)               | 1 (2.0)              | 11 (22.0)         | 4.035          | 0.245  |
| Wound dehiscence        | 0 (0.0)                | 0 (0.0)               | 2 (4.0)                | 0 (0.0)              | 2 (4.0)           | 4.665          | 0.061  |
| Prolonged ileus         | 2 (4.0)                | 0 (0.0)               | 0 (0.0)                | 1 (2.0)              | 3 (6.0)           | 2.794          | 0.326  |
| Anastomotic leak        | 1 (2.0)                | 1 (2.0)               | 6 (12.0)               | 2 (4.0)              | 10 (20.0)         | 11.536*        | 0.004* |
| Intra-abdominal abscess | 0 (0.0)                | 1 (2.0)               | 3 (6.0)                | 1 (2.0)              | 5 (10.0)          | 6.271*         | 0.049* |
| Re-exploration          | 1 (2.0)                | 1 (2.0)               | 4 (8.0)                | 1 (2.0)              | 7 (14.0)          | 5.629          | 0.074  |
| Mortality               | 3 (6.0)                | 1 (2.0)               | 2 (4.0)                | 1 (2.0)              | 7 (14.0)          | 0.915          | 0.940  |

\*: Statistically significant at  $p \leq 0.05$

\*\*MCp: p-value for Monte Carlo for Chi-square test

operation time ranged from 1.0 to 5.0 hours for single-layer extra-mucosal anastomosis, with an average of 1.98 hours  $\pm$  1.03 hours standard deviation (SD). In contrast, the overall operation time ranged from 0.83 to 4.17 hours for classical two-layer anastomosis, with a mean of 2.35 hours  $\pm$  0.72 hours SD. Anastomotic times for the cases are listed in Table 1.

The distribution of complications in relation to the anastomotic techniques is presented in Table 2. Most wound infections and deaths occurred with the two-layer techniques, accounting for 8 (16%) and 5 (10%), respectively.

The complications and their distribution related to the type of surgery, whether elective (33) or emergency (17), are presented in Table 3. The most common complications were wound infections, 11 (22%), and anastomotic leaks, 10 (20%), which mainly occurred under emergency conditions with the two-layer technique.

Operators were categorized into three levels based on experience: Senior Surgeons (A), Senior Junior Surgeons (B), and Junior Surgeons (C) (Table 4). With 10 anastomotic cases in this study, leaks were more frequently observed among junior surgeons, accounting for six of these cases.

**Table 4. The relation between anastomotic leak and the operator**

| Operator                   | Complications (n = 17)      |                                | X <sup>2</sup> | MCp    |
|----------------------------|-----------------------------|--------------------------------|----------------|--------|
|                            | No AL**<br>(n = 7)<br>n (%) | With AL**<br>(n = 10)<br>n (%) |                |        |
| Senior Surgeons (A)        | 6 (85.7)                    | 1 (10.0)                       | 9.956*         | 0.003* |
| Senior Junior Surgeons (B) | 1 (14.3)                    | 3 (30.0)                       |                |        |
| Junior Surgeons (C)        | 0 (0.0)                     | 6 (60.0)                       |                |        |

\*: Statistically significant at  $p \leq 0.05$

\*\* = Anastomotic leak.

## Discussion

The time taken for anastomosis using the one-layer extra-mucosal method in both elective and emergency conditions was less than that taken to perform the classical two-layer anastomosis (Table 1). This finding aligns with various studies, which concluded that a one-layer extra-mucosal anastomosis can be performed significantly faster than the classical two-layer anastomosis.<sup>[8,9]</sup>

Various studies have reported no difference in anastomotic failure rates between one- and two-layer techniques.<sup>[10]</sup> However, other studies comparing the two techniques have found that the one-layer extra-mucosal method is superior to the two-layer method in terms of safety and leakage.<sup>[11]</sup> In our study, three disruptions occurred with the one-layer extra-mucosal method, while seven happened with the classical two-layer anastomosis technique (p-value 0.730) (Table 2). Hence, there may be a slight increase in the leak rate when the two-layer technique is used compared to the one-layer technique.

Six out of ten leaks occurred in the hands of junior surgeons during emergency cases. Three of ten leaks occurred in the hands of senior juniors, two in emergency conditions and one in an elective condition. Only one leak happened in the hands of senior surgeons. The anastomotic leak rate was significantly higher (p-value 0.003) in the hands of junior surgeons (Table 4). This finding correlates with those of others, who reported that leakage rates varied significantly between surgeons, with lower rates observed among more experienced surgeons.<sup>[12]</sup>

Reported mortality rates after major abdominal surgery vary. In our study, we observed that death occurred among the severely ill patients, and the overall mortality rate was 14%. Regarding mortality rate, by technique, five deaths

occurred in the classical two-layer group and two in the one-layer extra-mucosal group; this difference was not significant. This result is consistent with other reported findings, which show no mortality differences between the two techniques.<sup>[13,14]</sup>

## Conclusion

The one-layer extra-mucosal anastomosis technique requires less time compared to the classical two-layer technique. Regarding the rate of anastomotic leaks, the differences did not reach statistical significance. There was no significant difference in mortality between the methods.

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