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## Original article

# Comparison between conventional and modified Smead Jones method for abdominal mass closure in emergency midline laparotomy

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### ABSTRACT

**Background:** The way the abdomen was closed and the sutures that were employed may have an impact on wound dehiscence. To increase the benefits, we suggested changing the original Smead-Jones technique to be performed continuously. We discovered that this method was quicker, more affordable, equally effective at controlling wound infection, and better than interrupted technique at preventing wound dehiscence. The purpose of the study was to evaluate the Modified Smead Jones technique's efficacy in emergency midline laparotomies compared to the traditional continuous closure technique, as well as the incidence of wound dehiscence in each technique. **Methods:** Patients in this randomized clinical study who received an emergency laparotomy through a midline incision were included. Cases were then divided into: Group A: Linea alba was closed with Modified Smead Jones technique using a polypropylene 1 number with Far-near near-far technique. Group B: Linea alba was closed with conventional continuous technique using a polypropylene 1 number. Preoperative data, operative data, intra operative complications, early postoperative follow up and complications were recorded. **Results:** Pre-duodenal perforation, traumatic jejunal/ileal, colon, appendicular, ileal stricture/band, intestinal blockage, and intussusception were insignificantly different among the laparotomy indications between the two groups. Wound dehiscence was insignificantly different between both groups. Group A had a much shorter hospital stay than group B (P value <0.001). **Conclusions:** An emergency laparotomy necessitates careful attention to wound closure. When it comes to managing midline laparotomy closure, the modified Smead Jones technique outperforms the traditional continuous technique in terms of wound dehiscence and hospital stay.

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## Introduction

A significant catastrophe and severe psychological damage for the patient results from the rapid disruption of an abdominal wall laparotomy wound. After surgery, the abdominal musculoaponeurotic layers must separate within 30 days, and this is known as an acute wound dehiscence [1]. Malnutrition, anemia, hypoproteinemia, pre- and post-operative extended steroid therapy, peritonitis, malignancy, jaundice, uremia, and post-operative abdominal distension or cough were among the risk factors implicated in the cause of ruptured abdomen. [2]. The way the abdomen was closed and the sutures that were employed may have an impact on wound dehiscence. Several research have been done assessing various suture materials and closure methods [3].

Much research have looked at different suture types and closure methods to stop wound dehiscence after emergency midline laparotomies. In underdeveloped nations like India, the majority of patients who need emergency surgery experience wound dehiscence due to conditions like protracted intraperitoneal sepsis and malnutrition[4]. According to current thinking, a mass closure with non-absorbable or slowly absorbable suture should be used to close a midline incision. The length of the wound is evenly distributed with tension [5]. Following major abdominal surgery, they are frequent midline closure problems that result in considerable morbidity and poor quality of life[6]. A good abdominal closure should be effective, strong, and able to fend off infection. Low rates of fascial dehiscence, infection, hernia development, suture sinus formation, and pain around the wound should be present [7].

All layers of the abdominal wall, excluding the skin, are closed using the "mass closure" approach, which is often done with nonabsorbable sutures, however "slow-resorbing" sutures like polydioxanone (PDS) are also frequently employed[8]. The best outcomes in terms of incisional hernia rates following midline laparotomy come from slowly absorbing monofilament suture material used in continuous suture technique[9]. The Smead-Jones method of closure distributes stress between two loops so that the fascial borders are reasonably close. The procedure that was initially described was cut short. As a result of the dynamic distribution of increased tension in the postoperative

period caused by the see-saw effect, the continuous approach offers the advantages of being quicker and having a lower risk of wound dehiscence. To maximize the benefits, we suggested modifying the original Smead-Jones approach in a continuous manner. We discovered that this method is quicker, more affordable, equally effective at controlling wound infection, and better at preventing wound dehiscence than interrupted methods [10].

The purpose of the study was to evaluate the Modified Smead Jones technique's efficacy in emergency midline laparotomies compared to the traditional continuous closure technique, as well as the incidence of wound dehiscence in each technique.

## Patients and Methods:

This study was a prospective, simple randomized clinical trial carried out at Suhag University Hospital's General Surgery Department. one of the people using the emergency room. With the following risk factors for a weak scar: hypoproteinemia, malignancy, being on immunosuppressants, and malnutrition, 50 patients who underwent emergency laparotomy through a midline incision were included.

The Suhag University Faculty of Medicine's Ethics Committee gave the study the thumbs up. All patients provided their written, voluntarily informed consent. Medical research ethics committee of faculty of medicine Suhag university approval date 8/12/2021, ID NCT05199974 .

Exclusion Criteria were previous laparotomy and laparotomy through incisions other than midline incisions.

They were randomized in parallel manner using computer generated numbers by sealed envelopes into two equal groups: Group A: Linea alba was closed with Modified Smead Jones technique using a polypropylene 1 number with Farnear near-far technique. Group B: Linea alba was closed with conventional mass closure technique using a polypropylene 1 number.

All patients underwent the following procedures: a thorough medical history review, a clinical assessment of the cardiovascular, neurological, and respiratory systems, and laboratory tests including a complete blood count, Time to bleed, Blood glucose level, clotting time, lipid profile (total cholesterol level, HDL, LDL),

kidney function tests (urea, blood urea nitrogen, creatinine, uric acid), and liver function tests (ALT, AST, C-reactive protein).

All of the patients had the requisite radiological examinations, such as computed tomography and ultrasound, to confirm the diagnosis. In an emergency, the patient's general condition was improved by giving them fluids to restore electrolyte balance and dehydration, as well as antibiotics. Patients with hypertension received the proper care prior to surgery. Operational information and intraoperative complications

A vertical midline exploratory incision was made in both groups. Linea alba was closed using a polypropylene 1 number and the Modified Smead-Jones technique in group A and a traditional mass closure technique with a polypropylene 1 number in group B.

Patients in Group A received abdominal wall closure using the modified Smead Jones "far-near-far" approach. With a continuous suture, the rectus sheath, peritoneum, and muscle are all approximated in one layer. Prolene entered and left the body 2 cm from the borders of the wounds and 1 cm from either side of the edge of the linea alba.

Three centimeters separated the two adjacent sutures. The skin was stitched independently. The evaluating surgeon records the primary outcome, which is the frequency of wound infection and abdominal wall dehiscence, after 15 days.

In group B, the abdomen was stitched shut in a single layer over the peritoneum, posterior rectus sheath, and anterior rectus sheath using a continuous suture of No. 1 polypropylene. With the exception of the skin and subcutaneous tissues, the abdominal wall is stitched together as a single layer using a No. 1 polypropylene curved cutting needle in this method. The fascial edge was kept at least 1.5 cm away from the suture, and there was a 1 cm gap between each suture.

Sutures were knotted in both ways so that the fascial borders were well approximated but not pressed together. During surgery, the length of the wound, quantity of suture packs used, and amount of time (in minutes) needed for closure were all noted. If necessary, drains were inserted through a different stab wound.

Early postoperative problems and follow-up: All patients received 3rd generation cephalosporin antibiotics parenterally for 3 days,

then orally for 5-7 days. If necessary, antibiotics were maintained after 10 days. Moreover, analgesics were provided to manage post-operative pain (type of the analgesic and dose). Early wound complications like erythema, swelling, serous discharge, infection, separation of edges, and partial wound dehiscence (dehiscence of skin and subcutaneous tissue with intact musculoaponeurotic layer) were regularly checked for, and drains, if used, were taken out on the second or third postoperative day. If there was wound discharge, it was sent for culture and sensitivity testing. Up to the patients' discharge, wound infections and abdominal bursts were monitored. Between the seventh and tenth postoperative days, the suture was removed.

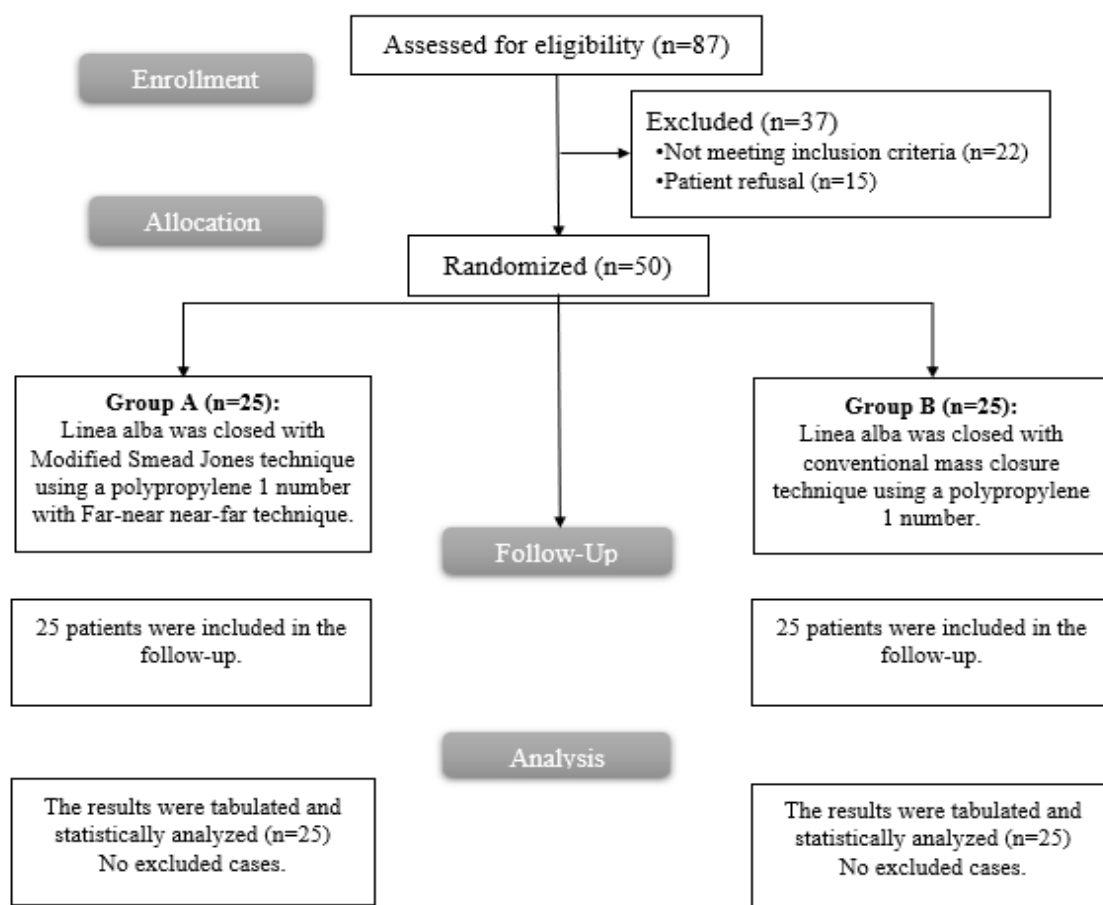
Patients were examined after surgery for symptoms such as nausea, hiccups, chest infections, and abdominal distension. In the postoperative period, it was especially important to watch out for indications of wound infection or abdominal burst. After one- and three-months following discharge, patients were contacted for follow-up appointments to check for late wound problems like suture sinus development and incisional hernia.

#### **Statistical analysis:**

SPSS (Statistical Program for the Social Sciences) version 25 was used for the statistical analysis (IBM Inc., Chicago, IL, USA). In order to determine whether parametric or nonparametric statistical testing should be utilised, the distribution of quantitative data was tested using the Shapiro-Wilks normality test and histograms. The three groups' parametric variables were compared using the F test, with the post hoc (Tukey) test used to compare each pair of groups. Parametric variables were represented as mean and standard deviation (SD). The paired T test was used to compare comparisons between two variables within the same group. The Kruskal-Wallis test was used to evaluate non-parametric variables, which were expressed as the median and interquartile range (IQR). Mann-Whitney (U) test was then used to compare each pair of groups. Wilcoxon test was used to compare two variables within the same group. Categorical variables were statistically examined using the Chi-square test and expressed as frequency and percentage. Statistical significance was defined as a two-tailed P value 0.05.

#### **Results:**

Flowchart of the enrolled patients are shown in Figure 1.



**Figure 1:** CONSORT flowchart of the enrolled patients

There was no statistically significant difference between the two groups for the following laparotomy indications: perforated peptic ulcer, traumatic jejunal/ileal, liver trauma, splenic rupture, mesenteric tear, colon perforation, appendicular perforation, ileal stricture/band, intestinal obstruction, and intussusception. Group A had a much shorter hospital stay than group B (P value <0.001).

Table 1: Indications for laparotomy and hospital stay of the studied groups

|                          | Group A<br>(n=25) | Group B<br>(n=25) |
|--------------------------|-------------------|-------------------|
| Perforated peptic ulcer  | 10 (40%)          | 9 (36%)           |
| Traumatic jejunal/ileal  | 4 (16%)           | 3 (12%)           |
| Liver trauma             | 0 (0%)            | 1 (4%)            |
| Splenic rupture          | 3 (12%)           | 3 (12%)           |
| Mesenteric tear          | 2 (8%)            | 3 (12%)           |
| Colon perforation        | 1 (4%)            | 0 (0%)            |
| Appendicular perforation | 1 (4%)            | 0 (0%)            |
| Ileal stricture/band     | 2 (8%)            | 1 (4%)            |
| intestinal obstruction   | 2 (8%)            | 4 (16%)           |
| Intussusception          | 0 (0%)            | 1 (4%)            |
| P value                  | 0.799             |                   |

When compared to group B, group A had a considerably lower incidence of postoperative wound dehiscence (P value= 0.037)

Table 2: Postoperative outcome of the studied groups

|                  |                  | Group A (n=25)    | Group B (n=25)    | P value           |
|------------------|------------------|-------------------|-------------------|-------------------|
| Wound dehiscence | <b>Yes</b>       | 5 (20%)           | 12 (48%)          | <b>0.037*</b>     |
|                  | <b>No</b>        | 20 (80%)          | 13 (52%)          |                   |
|                  |                  | Group A<br>(n=25) | Group B<br>(n=25) | P value           |
| Hospital stays   | <b>Mean ± SD</b> | 8.84 ± 2.59       | 12.64 ± 2.2       | <b>&lt;0.001*</b> |
|                  | <b>Range</b>     | 5 - 12            | 8 – 16            |                   |

## Discussion

A sudden rupture of the abdominal laparotomy wound after abdominal surgery is a significant catastrophe for the patient and a severe psychological trauma for both the patient and the surgeon [11, 12]. Risk variables such hypoproteinemia, cancer, immunosuppressants, and malnutrition were not statistically different between the two groups in the current study. Similar risk variables were noted by [21], whose goal was to create information-based scoring systems that could

predict the results of midline laparotomies. In their study population, they noticed that hypoproteinemia was widespread (21.7%) and that nearly one-third (31.4%) had been diagnosed with cancer either before or during the study. In our study, we found no statistically significant differences between the two groups for the following indications for laparotomy: pre-duodenal perforation (most common indication), traumatic jejunal/ileal (second most common indication), colon perforation,

appendicular perforation, ileal stricture/band, intestinal obstruction, and intussusception.

Like our findings, [19] discovered that prepyloric/duodenal perforation was the most frequent reason for laparotomy, accounting for 52% in group A (modified Smead Jones technique) and group B and 48% in group A. (conventional continuous closure technique).

Traumatic jejunal/ileal perforation was the second prevalent indicator. In line with the findings of our investigation, [1] found that post-traumatic hollow viscous perforation and duodenal ulcer perforation were the two most common causes of peritonitis. There were more post-traumatic perforations in the small intestine (jejunum followed by ileum) than the big intestine. Appendix perforation with widespread peritonitis brought on by an intra-abdominal abscess was the third prevalent cause. In addition, [22] cases of laparotomies needed for complicated/high risk abdominal diseases were investigated and included in the study. The midline abdominal wound was closed using a modified method. For the closure of the linea alba, interrupted Smead-Jones sutures with the non-absorbable suture material prolene were combined with a mass closure including all of the layers (also with prolene), and drains were inserted. For 3-23 months, patients were followed up on.

Incisional hernia development and postoperative wound dehiscence were found. There were also other local wound problems noted. In their study, they found that of the 36 patients who underwent this surgical procedure, 20 (55.55%) had inflammatory/intra-abdominal sepsis (including acute perforated appendicitis and perforated duodenal ulcer), 8 (22.22%) had trauma (including traumatic ileal perforation and traumatic jejunal perforation), 7 (19.44%) had neoplasia, and 1 (2.77%) had vascular etiology. When the suture material rips through the fascia, the wound dehisces. Smaller diameter sutures are more likely to tear through the tissue because the strength of a given suture material rises as its cross-sectional diameter decreases [23, 24]. Jenkins conducted experiments to demonstrate how various factors that raise intra-abdominal pressure can cause the length of a midline laparotomy incision to increase by as much as 30% during the healing process, and he came to the conclusion that the appropriate suture length-to-wound length ratio is 4:17 [25]. In our study, the incidence of postoperative wound dehiscence was considerably reduced in group A compared to group B (P value=0.037) in terms of postoperative results. Our findings are in line with [19] since wound dehiscence was observed in 7 patients treated with

group B's traditional continuous closure approach and 1 patient treated with group A's modified Smead Jones technique, with chi square values of 4.891 and 0.027, respectively. The 95% confidence interval for the relative risk of wound dehiscence was 0.0418 to 0.9059. Also, this had statistical significance. Investigators had to restart operations because to dehiscence. Due to dehiscence, 2 patients in group B needed re-suturing with prophylactic retention sutures, whereas no patients in group A required reoperation. The chi square value and p value for this study were 2.041 and 0.1531, respectively. With a 95% confidence interval of 0.00 to 1.322, the relative risk of reoperation due to wound dehiscence was 0. Statistics showed that this was not significant. Similar findings were seen in their study, where [1] results showed that wound dehiscence occurred in 14.9% of patients treated with Group A's conventional closure and 1% of those treated with Group B's modified Smead Jones (P = 0.01). 3.2 was the odd ratio. Also shown statistical significance for this. Notably, immediate mass closure was performed on every wound dehiscence in Group A. The odds were 3.2. The statistical significance of this was also demonstrated. Notably, the approach used in Group B underwent emergency mass closure on every wound dehiscence observed in Group A. Four of these patients had wound infections, which were treated with caution. They didn't all experience re-dehiscence. However, Group B did not have these patients. In the study, Modified Smead Jones also produced pleasing results [17].

100 patients in all were chosen, and the Smead Jones technique was used to close abdominal wounds using polypropylene suture No. 1. Double loop, near-far, far-near Smead Jones sutures are used on linea alba. Intravenous antibiotics were started for all of the patients. Antiseptic dressings applied daily helped to treat the wound. Following surgery, patients were checked on daily for 10 days, then every 15 days for the next 6 weeks to look for any disruptions in the suture line. Only 2 (2%) of 100 patients experienced wound dehiscence. One patient who had perforation peritonitis brought on by a duodenal ulcer perforation had dehiscence on the seventh post-operative day. Furthermore, [26] who conducted a randomized prospective study. 90 patients receiving emergency laparotomies through midline vertical incisions were randomly assigned to have the Hughes Far-and-Near, interrupted X, or continuous closure approach after giving their informed agreement. The main outcome factor is abdominal wall rupture risk as determined by a physician. Each group's risk of burst was evaluated, along with the relative risk (RR) of burst (using the continuous group as the reference

category). In the continuous suture group, the overall dehiscence rate was 1.6% compared to 2% in the interrupted suture group, which was statistically insignificant ( $p = 0.429$ ). They proposed the theory that even a single tissue bite removed during continuous suturing would cause the wound to completely rupture. This is most likely the cause of the significant occurrence of burst in the emergency laparotomy group using continuous sutures.

Furthermore, a study [27] comparing the midline laparotomy wound closure methods of continuous, interrupted-X, and modified Smead Jones in 348 surgical and gynecological patients discovered that interrupted suturing was significantly associated with a lower risk of burst abdomen than continuous closure technique ( $P < 0.05$ ). To evaluate a continuous with an interrupted approach for sealing an abdominal incision, trials from Western nations like [28] still carried out a randomised, prospective research. There were 571 patients who were randomly assigned. Although their data suggested otherwise, the dehiscence rate was 2.0% for the continuous group and 0.9% for the interrupted group. However, the difference was not statistically significant ( $p = 0.19$ ). It's possible that this discrepancy might be explained by the relatively higher recruited sample size and the absence of the modified Smead Jones technique in their study. The majority of emergency laparotomies for peritonitis are performed on sicker patients who have several risk factors, which has led to an increase in the occurrence of wound dehiscence in recent research.

It typically shows symptoms such as vomiting, coughing, retching, or sneezing when there is a sudden increase in intra-abdominal pressure. Indicators of rupture include a pink sero-sanguinous discharge from the laparotomy site in 23% to 84% of patients and a feeling of something giving way in the abdomen [1]. In the current study, we found that group A (modified Smead Jones) had a considerably shorter hospital stay than group B (conventional closure) ( $P$  value  $< 0.001$ ). In agreement with our study, [19] discovered that the mean hospital stay in group A (using the modified Smead Jones technique) was 9.86 days and in group B (using the conventional continuous closure technique) was 14.68 days. This difference had a  $p$  value of 0.0006 and was statistically significant, allowing us to draw the conclusion that the modified Smead Jones method reduces mean hospital stay in comparison to the conventional continuous closure. However, according to [1] data, the average hospital stay in Group A (traditional closure) was 15 days and in Group B it was 20 days (modified Smead

Jones). This discrepancy between the two studies may be explained by the larger number of patients involved and the ethnic distinction between Egyptians and Indians.

Limitations: One centre study with a tiny sample size. Insufficient follow-up prevented us from assessing an incisional hernia. We did not evaluate further issues such wound infection.

#### Conclusions:

An emergency laparotomy necessitates careful attention to wound closure. In terms of wound dehiscence and hospital stay, the modified Smead Jones technique performs better than the continuous technique when managing midline laparotomy closure.

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**Conflict of Interest:** Nil

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