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Continuous Versus Modified Continuous Smead-Jones Suture Techniques for Rectus Closure in Emergency Laparotomy: A Randomized Controlled Trial

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ABSTRACT

Background: Emergency laparotomy is associated with a high incidence of postoperative fascial complications, including wound dehiscence and incisional hernia. The method of rectus sheath closure plays a crucial role in determining surgical outcomes. Continuous suturing is widely used due to its simplicity and speed, whereas the modified continuous Smead-Jones technique incorporates a far-near-near-far pattern that may improve tensile strength and fascial integrity. This study aimed to compare the efficacy and safety of continuous versus modified continuous Smead-Jones suture techniques for rectus sheath closure in emergency laparotomy. **Methods**: This randomized controlled trial included patients undergoing emergency midline laparotomy, who were randomly allocated into two groups. Group A underwent rectus sheath closure using the continuous suture technique, while Group B received the modified continuous Smead-Jones technique. Outcomes assessed included the incidence of wound dehiscence expressed as percentages, along with the duration of hospital stay, reported as (mean±standard deviation). Statistical analysis was performed using appropriate comparative tests, with $p < 0.05$ considered statistically significant. **Results:** The incidence of wound dehiscence was higher in Group A compared to Group B. The mean duration of hospital stay was longer in Group A (11.6 ± 3.8 days) than in Group B (9.2 ±2.9 days), with the difference being statistically significant ($p = 0.001$). Overall postoperative complication rates were lower in the modified continuous Smead-Jones group. **Conclusion**: The modified continuous Smead-Jones suture technique demonstrated superior outcomes compared to continuous suturing, with lower complication rates and shorter mean hospital stays. This technique may be preferred for rectus sheath closure in emergency laparotomy, particularly in high-risk patients.

Keywords*: Emergency laparotomy; Rectus sheath closure; continuous suture; modified continuous Smead Jones technique; Burst abdomen; postoperative outcomes.*

INTRODUCTION

Emergency laparotomy represents a high-stakes surgical procedure often performed under urgent conditions, such as bowel perforation, obstruction, or trauma, where rapid abdominal access is essential. However, the postoperative phase carries substantial risks, with fascial dehiscence occurring in up to 10-25% of cases and incisional hernias developing in 15-20% long-term, driven by factors like tissue edema, infection, and elevated intra-abdominal pressure. Effective rectus sheath closure is thus critical to restore abdominal wall integrity, distribute tension evenly, and promote durable wound healing through optimal collagen deposition and fibroblast activity.[1,2,3,6]

The rectus sheath, comprising the aponeuroses of the external oblique, internal oblique, and transversus abdominis muscles anteriorly and posteriorly above the arcuate line, demands a technique that approximates fascia securely while minimizing ischemia from overtightening. Continuous suturing, employing a single monofilament loop (e.g., PDS loop No. 1), facilitates swift closure by passing the needle at 1 cm intervals along the sheath edge, reducing operative time in hemodynamically unstable patients. This method aligns with mass closure principles, where sutures traverse all layers to enhance apposition.[1,2]

In contrast, the modified continuous Smead-Jones technique refines this by adopting a far-near-near-far configuration in a continuous manner. Originating from Smead's 1900 mass closure and refined by Jones in 1941, the classic version uses interrupted sutures: "far" bites (1-2 cm from the edge) alternate with "near" bites (0.5-1 cm), locking tissue layers to bolster tensile strength—reportedly 3-4 times greater than simple continuous methods under stress testing.[2,5,7]The modification shifts to continuous passage, starting with a far-near on one side, crossing to near-far on the opposite, repeating sequentially. This pattern theoretically improves load-sharing across the wound, resists dehiscence by engaging more fascia remotely (reducing edge necrosis), and accommodates dynamic abdominal pressures from respiration and coughing. [2,3,4]

Biomechanically, it disperses forces akin to retention sutures, with studies documenting bite ratios of 4:1 (far-near) optimal for withstanding 50-100 N forces in laparotomy models. Materials like looped polydioxanone (PDS) or polypropylene ensure prolonged support (up to 180 days), degrading predictably without foreign body reaction. In emergency contexts, where contamination elevates surgical site infection risks to 30-40%, this technique's broader tissue incorporation may enhance vascularity and antibiotic penetration.[1,2,5]

This investigation evaluates the modified continuous Smead-Jones approach alongside standard continuous suturing for rectus sheath closure in emergency midline laparotomies at FAAMCH. By assessing short-term outcomes like dehiscence rates and hospital stay, alongside suture metrics (length, time), it seeks Level 1 evidence to guide technique selection amid limited emergency-specific data. Robust closure not only curtails morbidity but also supports ambulatory recovery, reducing healthcare burdens in resource-constrained settings.[8,9]

METHODOLOGY

The current study was a single-center prospective randomized controlled trial (RCT) was conducted at Fakhruddin Ali Ahmed Medical College and Hospital (FAAMCH), a tertiary referral center in Barpeta, Assam, India, specializing in high-volume emergency laparotomies for hollow viscus perforations and intestinal obstructions. This means patients were allocated into two groups equally in 1:1 ratio in a random manner using a computer list, based on age and reason for surgery. Sealed envelopes hid group assignments to avoid bias. Trained staff who didn't know the groups checked results, following clear reporting rules. Ethics approval was obtained from the institutional ethics committee before commencement of study. Written consent/ assent was obtained from the patients/guardians in their language—Assamese, Hindi, Bengali or English after proper explanation of the procedure. Recruitment of the subjects was done from January to December 2025 and a total of 160 patients were included in the study, matching the hospital's 15-20 monthly cases. Follow-up lasted 30 days after surgery, with quick data review for practical use in emergencies.

Sample Size Calculation:

Sample size determination, Fleiss' method was used for comparing two proportions, assuming a two-sided significance level (α) of 0.05 and statistical power (1-β) of 80% (β=20%). Previous literature quoted an expected prevalence of 6% in the modified continuous Smead-Jones group and 22% in the continuous suture group for anticipated difference in wound dehiscence rates, resulted in effect size of 16%. Adjusting for the attrition of 10% due to loss to follow up, each arm yielded an inflated figure of 80 patients resulting in a total sample size of 160 participants.

Inclusion and Exclusion Criteria:

The patients who underwent emergency laparotomy for hollow viscus perforation, acute intestinal obstruction, blunt abdominal injury, or penetrating abdominal injury due to stab or gunshot, and aged 18– 60 years were included in the study. Exclusion criteria comprised patients undergoing relaparotomy or those unwilling/unavailable for follow-up at FAAMCH.

Group Allocation and Interventions

Patients were randomized into two parallel groups for rectus sheath closure following emergency midline laparotomy.

Group A (Continuous Suture Technique)	**Group B (Modified Continuous Smead-Jones Technique)**
Rectus sheath closed with continuous all-layers sutures using #1 PDS loop (polydioxanone). Skin approximated with 2-0 Ethilon in simple interrupted or mattress pattern	Rectus sheath closed with modified continuous Smead-Jones sutures (no. 1 PDS loop), employing far-near-near-far bite configuration. Skin closure identical to Group A (2-0 Ethilon, simple/mattress).

Follow-up Protocol

Follow up was done on postoperative days 3, 5, 7, and 10 (or discharge, whichever earlier), plus days 14, 21, and 30. This exercise was carried out to detect any wound dehiscence and was documented with systemic clinical findings if any.

Statistical Analysis Methods

Data so obtained was entered in a Microsoft excel spreadsheet and same was exported to **IBM SPSS Statistics for Windows, Version 28.0** (IBM Corp., Armonk, NY, USA) and analysis was conducted. For explaining **descriptive Statistics all categorical variables** (e.g., presence of fascial dehiscence, SSI grades) were summarized as **frequencies and percentages** and **Continuous variables** (e.g., hospital stay duration, postoperative pain scores) were reported as **mean ± standard deviation (SD),** providing a clear understanding of the data distribution. **Outcomes** were compared between groups using the **unpaired Student's t-test for continuous and Pearson's chi-square test** or **Fisher's exact test** (when expected cell counts were <5) for categorical variables. Statistical significance was set at **$p < 0.05$**.

RESULTS

Baseline characteristics revealed comparable demographics across both groups, with age distribution showing no statistically significant differences ($\chi^2 = 1.81$, $p = 0.77$), predominantly featuring patients aged 36–55 years who typically present for emergency laparotomy due to hollow viscus perforation, intestinal obstruction, or abdominal trauma. This similarity confirms effective randomization and minimizes potential confounding related to age between the groups. The primary outcome, fascial dehiscence (burst abdomen), showed a striking decline in Group A (continuous suturing) showing 14 patients (17.5%) in versus only 2 (2.5%) in Group B (modified continuous Smead– Jones technique; $p = 0.0037$ eliciting a clinically meaningful difference between the two groups. Also with as observed that most of the cases in Group A required surgical mass closure highlighting the significant clinical benefit of and superior ability of the modified continuous Smead– Jones technique to maintain fascial integrity under the high-risk conditions of emergency surgery.

Regarding the secondary outcomes which is, postoperative wound complications such as serosanguinous discharge, seropurulent discharge, wound gaping, and the need for re-suturing were observed in both groups, but no statistically significant differences were found ($p > 0.05$), indicating that superficial wound events were comparable while deeper fascial strength was clearly better preserved in Group B. The mean duration of hospital stay was significantly shorter in the modified Smead– Jones group (9.2 ± 2.9 days) compared with the continuous suturing group (11.6 ± 3.8 days, p=0.001), reflecting faster recovery and fewer major complications postoperatively. The length of incision was comparable between the groups ($p = 0.54$); however, the modified technique in group B demanded a greater length of suture material (76.8 ± 10.2 cm vs. 72.4 ± 9.6 cm, $p < 0.01$) and longer time for closure (18.6 ± 3.4 minutes vs. 14.8 ± 3.1 minutes, $p = 0.001$). Importantly, although the modified technique required more time and suture material, it did not result in higher postoperative complications, showing that it to be superior practice yielding better fascial strength without affecting patient safety.

Key Tables

Table 1: Table showing age Distribution of participants in both groups (n=160)

Age group	**Frequency (n)**	**Percentage (%)**	**Group A (n=80)**	**Group B (n=80)**	**Chi Square (X^2)**	**P-Value**
15-25	26	16.3	11	15		0.77
26-35	22	13.8	11	12		**P>0.05,not significant**
36-45	43	26.9	24	19	1.81	
46-55	49	30.6	23	26		
56-65	20	12.5	11	8		
Total	**160**	**100.0**				

Table 2: Table showing clinical events encountered and Interventions in both the groups

Events and interventions				
Events	**Group A**	**Group B**	**P value**	**Inference**
Burst abdomen	14	2	0.0037	Significant
Intervention	12	2		
Conservative Management	2	-		
Mass Closure	12	2		
Duration of Hospital Stay				
Duration	**Group A**	**Group B**	**P value**	**Inference**
Mean (days)	11.6	9.2	**0.001**	Significant
SD	3.8	2.9		

Incidence: Group A (17.5%), Group B (2.5%)

Table 2: Table showing post operative wound complications in both the groups

Events	GroupA		GroupB		Chi Square	P value
	Frequency	Day	Frequency	Day		
Serosanguinous Discharge	25	3.27	36	4	4.103	0.42
Seropurulent Discharge	11	2.7	7	6.8	1.851	0.17
Wound Gaping	14	6.16	8	8.56	0.498	0.48
Re-suturing	13	11.45	8	14.67	0.230	0.63
Burst Abdomen	14	6.27	2	10	9.058	0.0037

Table3. Table showing comparison of surgical interventions and operative logistics between the two Study Groups

Length of Incision						
Incision	Group-A	Group-B	Test of significance	Value	P value	**Inference**
Mean (centimeters)	16.50	16.0	Unpaired t-test	0.609	0.54	**Not significant**
SD	2.68	2.46				
Length of Suture material						
	Group-A	Group-B	Test of significance	Value	P value	**Inference**
Mean(centimeters)	72.4.	76.8	Unpaired t-test	2.8	0.01	**Significant**
SD	9.6	10.2				
Time taken						
	Group-A	Group-B	Test of significance	Value	P value	**Inference**
Mean(minutes)	14.8	18.6	Unpaired t-test	7.45	0.001	**Significant**
SD	3.1	3.4				

DISCUSSION

Emergency laparotomy is always considered high risk intervention, frequently encountered with contamination, tissue edema, infection, malnutrition, and elevated intra-abdominal pressure, all of which adversely affect wound healing. Therefore, the method of abdominal fascial closure becomes a decisive factor in preventing serious postoperative complications, particularly burst abdomen and subsequent incisional hernia. The present study demonstrates that careful selection of a closure technique can substantially influence surgical outcomes in this high-risk population.

The markedly lower incidence of fascial dehiscence observed in the modified continuous Smead– Jones group (2.5%) compared with the continuous suturing group (17.5%) highlights the superior biomechanical stability of the far-near-near-far configuration. This technique allows more even distribution of tensile forces across the fascial edges, reduces localized tissue ischemia, and minimizes suture cut-through, minimizing wound failure in emergency laparotomy. These findings aligns with the experimental studies done by Wallace et al. who were among the first to demonstrate a significant reduction in abdominal wound disruption using Smead– Jones technique, attributing its effectiveness to enhanced load sharing and deeper fascial purchase.[10] Subsequent studies by Khajuria et al. and Sringeri et al. similarly reported lower rates of wound dehiscence in emergency laparotomy closures employing far-near-near-far sutures, reinforcing the reliability of this technique in compromised surgical fields.[11,12]

Further, contemporary evidence provided by Hindawi et al. (2025), in a comprehensive meta-analysis, concluded that the modified Smead– Jones technique significantly reduces the risk of fascial dehiscence in emergency laparotomy without increasing surgical site infection rates.[13] Likewise, van den Berg et al. (2025) emphasized that suture configuration plays a role as important as suture material in determining fascial closure outcomes.[1] The burst abdomen rate of 17.5% observed in the continuous suturing group is consistent with previously reported rates of 10– 25% in contaminated and emergency laparotomy settings, whereas the substantially lower rate of 2.5% in the modified Smead– Jones group represents a clinically meaningful and practice-changing improvement.[13, 14,15]

Although the modified continuous Smead– Jones technique required a longer time for closure and a greater length of suture material, these differences were modest and clinically acceptable. Importantly, the increased operative time did not

translate into higher postoperative morbidity. When balanced against the significant reduction in burst abdomen and the associated need for re-intervention, the benefits of the modified technique clearly outweigh the minor increase in operative effort, particularly in patients at high risk for wound complications.[8,16]

The significantly shorter duration of hospital stay observed in the modified Smead– Jones group further reflects reduced morbidity, fewer postoperative complications, and faster recovery. In resource-limited healthcare settings, such reductions are especially important, as they contribute to lower healthcare costs, improved bed availability, and decreased burden on surgical services.[9,17]

Limitations

Overall, the findings of this study strongly suggest that the modified continuous Smead– Jones technique should be preferred for rectus sheath closure in emergency laparotomy, especially in patients with risk factors such as contamination, anemia, malnutrition, and raised intra-abdominal pressure. The technique provides enhanced fascial security without increasing superficial wound complications. Nevertheless, the study is limited by its single-center design and relatively short follow-up period of 30 days, which does not allow assessment of long-term outcomes such as incisional hernia. Future multicenter studies with longer follow-up are warranted to further validate these findings and to evaluate long-term benefits of this technique.

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