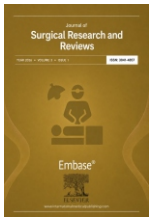
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Research Article

Section: General Surgery

A Comparative Study of Conventional Standard Technique Vs Modified Technique of Abdominal Wall Closure in Midline Laparotomies

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HIGHLIGHTS

- Reduced wound complications.
- Lower seroma and hematoma.
- Reduced burst abdomen.
- Comparable pain and operative time.
- Promising alternative closure technique.

Key Words:
Midline laparotomy
Small-bite closure
Abdominal wall closure
Burst abdomen
Wound complications

ABSTRACT

Introduction: Abdominal wall closure following midline laparotomy is essential for maintaining fascial integrity and preventing postoperative complications. Conventional long-bite closure may be associated with wound-related morbidity, including seroma, hematoma, wound dehiscence, and burst abdomen. This study aimed to compare the outcomes of modified small-bite closure with conventional standard closure. **Material & Methods:** Sixty adult patients undergoing elective or emergency midline laparotomy were included and divided into two groups of 30 each. Group A underwent modified small-bite closure using Vicryl 2-0, with 2-mm tissue bites placed 3 mm apart, while Group B underwent conventional long-bite mass closure. Postoperative pain, surgical site infection, seroma or hematoma, wound dehiscence, burst abdomen, hospital stay, and incisional hernia at follow-up were assessed. Statistical analysis was performed using SPSS, with $p<0.05$ considered statistically significant. **Results:** The mean operative duration was comparable between Group A and Group B (2.04±0.51 versus 2.28±0.52 hours; p=0.071), while intraoperative blood loss was significantly lower in Group A (p=0.005). Mean postoperative pain scores were similar (5.30±0.95 versus 5.13±0.82; p=0.470). Seroma or hematoma occurred significantly less frequently in Group A than Group B (10.0% versus 40.0%; p=0.007). Burst abdomen was also significantly reduced (3.3% versus 33.3%; p=0.024). Surgical site infection and wound dehiscence were less frequent in Group A, but differences were not statistically significant. Hospital stay and incisional hernia at three months were also comparable. **Conclusion:** Modified small-bite closure was associated with significantly lower rates of burst abdomen and seroma or hematoma formation, with comparable postoperative pain and operative duration. It represents a promising alternative to conventional closure, although larger studies with longer follow-up are needed to confirm its effectiveness.

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INTRODUCTION

Abdominal wall closure is a crucial component of abdominal surgery because it restores the integrity of the musculofascial layers and promotes satisfactory wound healing. An effective closure technique minimizes postoperative complications, facilitates recovery, and reduces morbidity, whereas inadequate fascial approximation may result in wound dehiscence, surgical site infection, and incisional hernia. Consequently, the selection of an appropriate closure technique and suture material remains an important consideration in surgical practice [1,2].

Midline laparotomy is widely used in elective and emergency abdominal surgeries because it provides rapid access to the abdominal cavity, allows adequate exposure of intra-abdominal organs, and can be extended when necessary. It is frequently performed for conditions such as perforation peritonitis, intestinal obstruction, abdominal trauma, and malignancies. In India, where emergency abdominal procedures constitute a substantial proportion of general surgical practice, improving the safety and effectiveness of midline laparotomy closure is particularly important. Even a modest reduction in postoperative complications could benefit numerous patients by reducing hospitalization, treatment costs, and the need for additional surgical interventions [3,4].

Wound-related complications following laparotomy remain clinically significant. Wound dehiscence, commonly referred to as burst abdomen, represents a serious failure of fascial healing and may require urgent surgical intervention. Incisional hernia is another important complication, with reported incidence varying according to patient characteristics, follow-up duration, surgical indication, and closure technique. Surgical site infections further compromise wound healing and increase the risk of fascial disruption and subsequent hernia formation. Important risk factors include obesity, malnutrition, diabetes mellitus, smoking, emergency surgery, wound contamination, and prolonged operative duration. These complications may cause considerable discomfort, prolong hospital stays, increase healthcare expenditure, and adversely affect patients' quality of life [5–7].

The abdominal wall comprises several anatomical layers, including skin, subcutaneous tissue, muscles, fascia, extraperitoneal tissue, and peritoneum. During midline laparotomy, the linea alba and associated fascial structures are particularly important because they provide the principal strength required to withstand intra-abdominal pressure. Wound healing progresses through inflammatory, proliferative, and remodeling phases, during which collagen deposition and reorganization gradually restore tissue strength. Factors that impair collagen synthesis, tissue perfusion, or inflammatory responses may compromise healing and predispose patients to postoperative complications. Therefore, an appropriate closure technique should maintain fascial approximation while minimizing tissue trauma and excessive tension [8,9].

Conventional closure methods include continuous mass closure and interrupted or layered suturing. Although widely practiced, traditional large-bite techniques may produce uneven tension distribution, excessive tissue compression, and localized ischemia. Continuous closure using an appropriate slowly absorbable suture has been supported by evidence-based recommendations, particularly when performed with an adequate suture-to-wound length ratio. The small-bite technique involves taking smaller fascial bites at shorter intervals, thereby distributing tension more evenly and reducing tissue strangulation. Randomized clinical evidence has demonstrated that small-bite closure can reduce the incidence of incisional hernia compared with conventional large-bite closure [10,11].

The modified small-bite technique evaluated in the present study aims to improve fascial healing by minimizing tissue injury and promoting uniform tension distribution. Its potential advantages include reduced seroma or hematoma formation, fewer wound

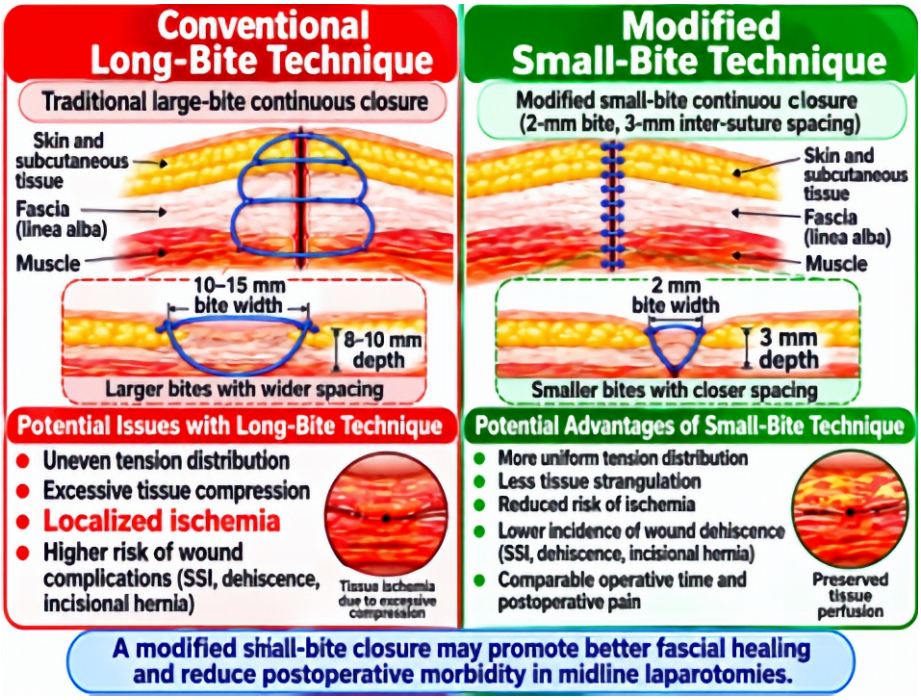


Figure 1. Comparison of long-bite and small-bite fascial closure techniques.

complications, and improved postoperative recovery without substantially increasing operative duration or pain. These benefits are particularly relevant in resource-constrained settings, where preventing complications can reduce the need for prolonged hospitalization and reoperation. However, its effectiveness should be assessed through systematic comparison with conventional closure techniques rather than assumed from theoretical advantages alone [12].

Therefore, the present study compares modified small-bite closure with conventional long-bite closure in patients undergoing midline laparotomy. The evaluation focuses on postoperative pain, surgical site infection, seroma or hematoma formation, and wound dehiscence. The findings may contribute to identifying a safe, reproducible, and cost-effective closure technique that minimizes postoperative morbidity and supports evidence-based surgical practice [6,12].

The study aimed to evaluate and compare the effectiveness of the modified small-bite abdominal wall closure technique (2-mm bite and 3-mm inter-suture spacing using Vicryl 2-0) with conventional closure in patients undergoing midline laparotomy. The primary objective was to compare the incidence of wound dehiscence (burst abdomen), while secondary objectives included assessing surgical site infection, seroma and hematoma formation, postoperative pain using the Numerical Rating Scale, duration of hospital stay, incidence of incisional hernia during follow-up, and overall postoperative morbidity associated with both techniques.

MATERIAL & METHODS

This prospective comparative study was conducted at the Department of General Surgery, Gwalior for 18 to 24 months. Ethical approval has been obtained from the Ethical Approval Committee of Jayarogya Group of Hospitals (J.A. Group), G.R. Medical College, Gwalior (M.P.), a tertiary care teaching hospital.

Study Population

The study included adult patients undergoing emergency or elective midline exploratory laparotomy in the Department of Surgery during the study period. A total of 60 patients were enrolled, with 30 patients in each group. Group A underwent modified small-bite closure, while Group B received conventional standard closure. Patients aged 18 years or older who provided informed consent were included, whereas pediatric patients, individuals refusing consent, severely immuno-compromised patients, and those with previous midline incisional hernia were excluded.

Data Analysis

The collected data were analyzed using SPSS software. Quantitative variables were expressed as mean ± standard deviation, while qualitative variables were summarized using frequencies and percentages. Categorical variables were compared using the Chi-square test or Fisher's exact test, as appropriate. Continuous variables were analyzed using the Student's t-test. All statistical tests were conducted using appropriate methods, and a p-value of less than 0.05 was considered statistically significant for the study.

RESULTS

The study included 60 patients, with 30 in each group. The mean age was 47.87 ± 17.97 years in Group A and 44.50 ± 15.01 years in Group B (p = 0.434). Males predominated (63.3%), and housewives (30.0%) and farmers (28.3%) were the most common occupational groups. Smoking was the most frequently reported habit (38.3%). Perforation peritonitis (53.3%) was the leading diagnosis, followed by intestinal obstruction (36.7%). Mean BMI was comparable between groups (25.60 ± 3.15 vs. 24.96 ± 4.01 kg/m²; p = 0.496). Differences in gender, occupation, personal history, and diagnosis were statistically nonsignificant, indicating comparable baseline characteristics. Preoperative parameters were comparable between both groups, with no significant differences in pulse, blood pressure, Hb, TLC, sodium, potassium, or creatinine (p>0.05), except for significantly higher blood urea in Group B than Group A (34.77±18.75 vs. 24.51±17.22 mg/dL; p=0.031) **(Table 1)**.

Radiological findings showed that perforation peritonitis was the most common diagnosis (55.0%), affecting 53.3% of patients in Group A and 56.7% in Group B, followed by intestinal obstruction (36.7%). Gastric outlet obstruction and ileocecal pathology each accounted for 3.3% of cases, while other findings constituted 1.7%. The difference in radiological diagnosis between the groups was statistically insignificant (p = 0.523), indicating comparable radiological profiles among patients undergoing midline laparotomy.

Preoperative serum protein and albumin levels were comparable between Group A and Group B, with no statistically significant differences (5.99±1.03 vs. 6.33±1.12 g/dL, p=0.230; and 3.35±0.67 vs. 3.41±0.71 g/dL, p=0.737, respectively) **(Table 2)**.

The duration of surgery was comparable between Group A and Group B (2.04±0.51 vs. 2.28±0.52 hours; p=0.071), whereas intraoperative blood loss was significantly lower in Group A than Group B (2.93±1.14 vs. 3.77±1.04 mops; p=0.005) **(Table 3)**.

Postoperative outcomes showed that moderate pain was predominant in both groups (93.3% in Group A and 96.7% in Group B), with comparable mean VAS scores (5.30 ± 0.95 vs. 5.13 ± 0.82; p = 0.470). Surgical site infections occurred in 20.0% and 43.3% of patients, respectively (p = 0.052). Seroma/hematoma was significantly less frequent in Group A than Group B (10.0% vs. 40.0%; p = 0.007). Wound dehiscence was also less common in Group A (16.7% vs. 30.0%), although the difference was statistically nonsignificant (p = 0.183).

Burst abdomen occurred significantly less frequently in Group A than Group B (3.3% vs. 33.3%), with 96.7% and 66.7% of patients remaining free of this complication, respectively (p=0.024), indicating better outcomes with the modified short-stitch technique **(Figure 2)**. The mean hospital stay was shorter in Group A than Group B (12.40±3.74 vs. 13.50±3.41 days), but the difference was not statistically significant (p=0.239), indicating comparable hospital stays between the groups **(Table 4)**. Group A had significantly more stitches, a higher suture-to-wound

length ratio, & longer closure time, while Group B had a significantly greater wound length; total suture length was comparable between groups (p=0.556) **(Table 5)**. Recurrence was lower in Group A than Group B (3.3% vs. 13.3%), with 96.7% and 86.7% of patients remaining recurrence-free, respectively; however, the difference was not statistically significant (p=0.161) (**Figure 3)**. At 3-month follow-up, incisional hernia was less frequent in Group A than Group B (3.3% vs. 13.3%), while 96.7% and 86.7% of patients, respectively, remained hernia-free; however, the difference was not statistically significant (p=0.161) **(Table 6)**.

Table 1: Comparison of preoperative parameters between the groups

Parameters	Group A (mean±SD)	Group B (mean±SD)	t / U value	p value
Pulse	86.8±12.37	86.07±13.86	0.216	0.830
Diastolic Blood Pressure	117.2±15.14	112.3±12.57	1.364	0.178
Systolic Blood Pressure	73.4±8.14	70.47±7.08	1.4893	0.142
Hb%	11.12±0.81	11.04±1.32	0.3126	0.756
TLC*	10276.53±4044.01	15050.67±18141.87	364.50	0.206
Sodium	132.7±3.01	133.67±3.83	-1.087	0.281
Potassium	3.63±0.56	3.56±0.47	0.500	0.618
Urea	24.51±17.22	34.77±18.75	-2.206	0.031
Creatinine	0.98±0.45	0.86±0.35	1.203	0.234

Table 2: Comparison of Preoperative Biochemical Parameters between the groups

Parameters	Group A (mean±SD)	Group B (mean±SD)	t / U value	p value
Serum Protein (g/dL)	5.99±1.03	6.33±1.12	-1.213	0.230
Serum Albumin (g/dL)	3.35±0.67	3.41±0.71	-0.337	0.737

Table 3: Comparison of duration of surgery and blood loss between groups

Parameters	Group A (mean±SD)	Group B (mean±SD)	t value	p value
Duration of Surgery (hrs)	2.04±0.51	2.28±0.52	-1.840	0.071
Blood Loss (No. of mops)	2.93±1.14	3.77±1.04	-2.954	0.005

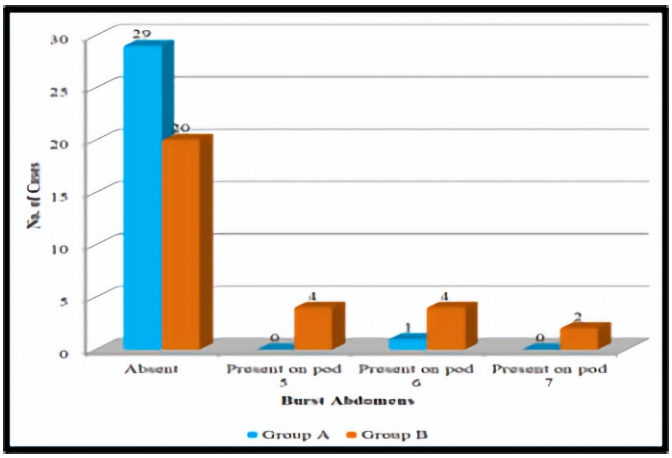


Figure 2: Distribution of cases according to Burst Abdomen between the groups

Table 4: Comparison of Hospital stay between the groups

Group	Number of Cases	Hospital Stay (days) [Mean±SD]	t-value	p- value
Group A	30	12.40±3.74		
Group B	30	13.50±3.41	1.190	0.239
Total	60	12.95±3.59	Not Significant	

Table 5: Comparison of closure parameter between the groups

Parameters	Group A (Mean±SD)	Group B (Mean±SD)	t-value	p-value
No. Of Stitches	44.27±6.62	21.8±12.02	8.9708	0.000
Suture Length (cm)	69.77±7.78	70.93±7.48	-0.591	0.556
Wound Length(cm)	15.4±2.18	16.7±1.68	-2.588	0.012
Suture Length : Wound Length Ratio	4.56±0.39	4.25±0.14	4.140	<0.001
Duration of Closure (min)	11.87±1.81	11±1.26	2.1492	0.036

Table 6: Distribution of cases according to Status at 3 Months Follow-up

Status at 3 Months Follow-up	Group A		Group B		Total	
	No.	%	No.	%	No.	%
Incisional Hernia	1	3.3%	4	13.3%	5	8.3%
No Hernia	29	96.7%	26	86.7%	55	91.7%
Total	30	100.0%	30	100.0%	60	100.0%

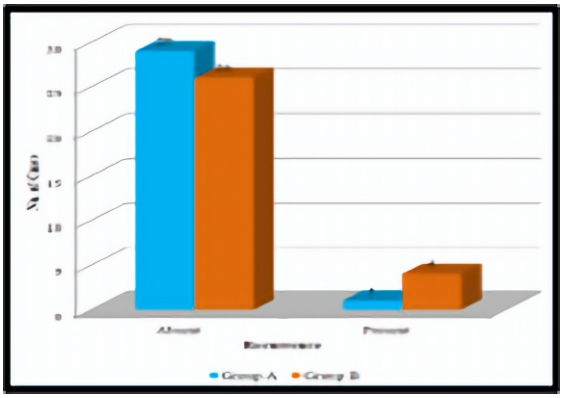


Figure 3: Distribution of cases according to Recurrence between the groups

DISCUSSION

Midline laparotomy is widely used in elective and emergency abdominal surgery; however, the optimal method of abdominal wall closure remains a subject of debate because of complications such as surgical site infection, seroma, hematoma, wound dehiscence, and burst abdomen. These complications increase postoperative morbidity, prolong hospitalization, and may necessitate reoperation. The present study compared a modified small-bite technique, using 2 mm tissue bites placed 3 mm apart with Vicryl 2-0, against conventional long-bite mass closure. Baseline characteristics, including age, gender, occupation, body mass index, clinical diagnosis, and preoperative parameters, were comparable between the groups, with no statistically significant differences ($p > 0.05$). This comparability supports a meaningful assessment of postoperative outcomes, although it does not independently establish successful randomization [3, 13]. Operative findings showed that the duration of surgery was comparable between the groups ($p = 0.071$), indicating that the modified technique did not significantly increase operative time. However, intraoperative blood loss was significantly higher in the conventional closure group ($p = 0.005$). This difference may reflect greater tissue manipulation or injury associated with the closure technique, although the precise mechanism cannot be established from these results alone. Postoperative pain was also comparable, with mean visual analogue scale scores of 5.30 ± 0.95 in Group A and 5.13 ± 0.82 in Group B ($p = 0.470$). These findings suggest that the modified technique can be performed without a demonstrable increase in operative duration or postoperative pain [14,15].

The incidence of postoperative surgical site infection was 20.0% in the small-bite group compared with 43.3% in the conventional group. Although this difference approached statistical significance, it did not meet the predefined threshold ($p = 0.052$). Nevertheless, the observed difference may warrant further investigation in larger studies. In contrast, seroma or hematoma formation was significantly lower with small-bite closure, occurring in 10.0% of patients compared with 40.0% in the conventional group ($p = 0.007$). Improved tissue approximation, reduced tissue trauma, and more uniform tension distribution may contribute to this finding, although these mechanisms were not directly measured. Wound dehiscence was also less frequent in Group A than Group B (16.7% versus 30.0%), but the difference was not statistically significant ($p = 0.183$). Dehiscence occurred on different postoperative days in the two groups; however, these timing patterns should be interpreted cautiously because of the limited number of events [16,17].

The most notable finding was the significantly lower incidence of burst abdomen in the small-bite group compared with the conventional group (3.3% versus 33.3%; $p = 0.024$). This substantial difference suggests a potential advantage of the modified technique in maintaining early fascial integrity. Smaller bites placed at closer intervals may distribute mechanical forces more evenly and reduce localized tissue strangulation. Jenkins emphasized the importance of maintaining an adequate suture-length-to-wound-length ratio to minimize wound failure, while subsequent clinical evidence has supported meticulous fascial closure as an important determinant of postoperative outcomes [10,11]. **Deerenberg EB, et. al; 2015,** demonstrated that small-bite closure reduced the incidence of incisional hernia compared with large-bite closure [11]. **Millbourn D, et. al; 2009,** reported fewer wound complications with shorter stitch lengths in midline incisions [10]. However, these studies evaluated established small-bite methods and longer-term outcomes, whereas the present study used a modified technique involving 2 mm bites at 3 mm intervals. Therefore, direct equivalence between the techniques cannot be assumed, and **Silecchia G, et. al; 2015,** established the long-term effectiveness of this modification, particularly regarding incisional hernia [18].

Yii E, et. al; 2023, suggested that modified small-bite closure is a promising alternative to conventional long-bite mass closure in midline laparotomy. Its association with significantly lower rates of seroma or hematoma and burst abdomen, together with comparable operative duration and postoperative pain, supports its potential clinical utility. Nevertheless, the nonsignificant differences in surgical site infection and wound dehiscence should not be interpreted as proof of equivalence. Larger studies with adequate follow-up are needed to confirm these findings and assess long-term outcomes. If validated, this simple and reproducible technique could contribute to reducing postoperative morbidity and improving the quality of abdominal wound closure in both elective and emergency surgical settings [19,20].

CONCLUSION

The present study demonstrates that modified small-bite closure using Vicryl 2-0 significantly reduces burst abdomen ($p= 0.024$) and seroma or hematoma formation ($p = 0.007$) compared with

conventional long-bite closure. Surgical site infections showed a favorable but statistically nonsignificant trend. Postoperative pain and operative duration were comparable between groups. The technique promotes uniform tension distribution, preserves tissue vascularity, and minimizes trauma. Its safety, simplicity, reproducibility, and cost-effectiveness support its use in elective and emergency midline laparotomies to reduce postoperative complications and improve patient outcomes.

CLINICAL SIGNIFICANCE

The clinical significance of this study lies in its potential to bridge the gap between research findings and practical health-care, diagnosis, and treatment outcomes. By highlighting real-care applications. It emphasizes the importance of translating scientific observations into meaningful improvements in patient world relevance, the study contributes to evidence based medical practice and supports informed clinical decision making. Ultimately, the findings aim to enhance patient quality of life, optimize therapeutic strategies, and promote better disease management in clinical settings.

ABBREVIATIONS

SPSS: Statistical Package for the Social Sciences
SSI: Surgical Site Infection
P: Probability Value

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AUTHOR CONTRIBUTIONS

All authors significantly contributed to the study conception and design, data acquisition, or data analysis and interpretation. They participated in drafting the manuscript or critically revising it for important intellectual content, consented to its submission to the current journal, provided final approval for the version to be published, and accepted responsibility for all aspects of the work. Additionally, all authors meet the authorship criteria outlined by the International Committee of Medical Journal Editors (ICMJE) guidelines.

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CONFLICT OF INTEREST

Authors declared that there is no conflict of interest.

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None

ETHICAL APPROVAL & CONSENT TO PARTICIPATE

All necessary consent & approval was obtained by authors.

CONSENT FOR PUBLICATION

All necessary consent for publication was obtained by authors.

DATA AVAILABILITY

All data generated and analyzed are included within this research article. The datasets utilized and/or analyzed in this study can be obtained from the corresponding author upon a reasonable request.

USE OF ARTIFICIAL INTELLIGENCE (AI) & LARGE LANGUAGE MODEL (LLM)

The authors confirm that no AI & LLM tools were used in the writing or editing of the manuscript, and no images were altered or manipulated using AI & LLM.

AUTHOR'S NOTE

This article serves as an important educational tool for the scientific community, offering insights that may inspire future research directions. However, they should not be relied upon independently when making treatment decisions or developing public health policies.

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