

Evaluating outcomes of mass closure versus layered closure in midline laparotomy incisions – A single-center study



Anmol Bali¹, Arindam Das², Nizamuddin Ahamed³, Shampy Agarwal⁴

^{1,3}Postgraduate Resident, ²Assistant Professor, Department of General Surgery, ⁴Junior Resident, Department of Physical Medicine and Rehabilitation, Calcutta National Medical College, Kolkata, West Bengal, India

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ABSTRACT

Background: The majority of the surgeries performed by the general surgeons take place within the abdomen. Laparotomy is a common surgery performed in emergency as well as elective settings. Sudden disruption of the laparotomy wound is a big event in the life of a patient who has undergone an abdominal operation and a major cause of stress to the patient as well as the surgeon. Despite the advances in surgical techniques and materials, the ideal method of abdominal wound closure remains to be discovered. **Aims and Objectives:** This study aims to compare layered closure versus mass closure of midline abdominal incision during laparotomy, especially to compare the time taken for wound closure, post-operative wound complications, and the pain perceived by study subjects during the post-operative period. **Materials and Methods:** The study was conducted over 1 ½ years and included 100 patients undergoing midline laparotomy in the General Surgery Department of Calcutta National Medical College, considering the inclusion and exclusion criteria. **Results:** Age, sex, residence, and religion of study subjects were not significantly associated with the type of closure ($P > 0.05$). Incidence of post-operative wound complications, including incisional hernia, was more in the layered closure group than in the mass closure group, but the results were not statistically significant ($P > 0.05$). Time for wound closure and post-operative pain were more in the layered closure group, results being statistically significant ($P < 0.05$). **Conclusion:** Mass closure is more effective than layered closure in laparotomy with a midline incision. Larger trials in a multicentric manner may be conducted in the future for better comprehension of the usefulness of the mass closure method.

Key words: Laparotomy; Mass closure; Layered closure; Midline incision

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INTRODUCTION

The majority of the surgeries performed by general surgeons are within the abdomen. Consequently, incision and suturing of the abdominal layers is the most common procedure done in operative surgery. Laparotomy is a common surgery performed in emergency as well as elective settings. Sudden disruption of the laparotomy wound is a traumatic event in the life of a patient who has undergone an abdominal operation and is a major cause of stress to the patient as well as the surgeon. The partial or

complete post-operative separation of abdominal wound closure is known as wound dehiscence or acute wound failure. Acute wound failure is defined as post-operative separation of the abdominal musculoaponeurotic layers, within 30 days after operation, and requires some form of intervention, usually during the same hospitalization.¹

Most burst abdomen cases occur between the 6th and 9th post-operative day.² Wound closure goals include obliteration of dead space, even distribution of tension along deep suture lines, maintenance of tensile strength

Address for Correspondence:

Dr. Arindam Das, Assistant Professor, Department of General Surgery, Calcutta National Medical College, Kolkata, West Bengal, India.
Mobile: +91-9674372575. **E-mail:** dasarindam1988@gmail.com

across the wound until tissue tensile strength is adequate, and approximation and eversion of the epithelial portion of the closure. A balance between the suture holding capacity of tissues and tissue holding capacity of sutures is an essential foundation on which the strength of the sutured abdominal wound depends. The suture length to wound length ratio of <4:1 has been associated with an increased incidence of incisional hernia. It may also expose the patient to an increased risk of burst abdomen.³

The best abdominal closure technique should be fast, easy, and cost-effective while preventing both early and late complications.⁴ The ideal method of abdominal wound closure should be technically simple enough to obtain similar good results both in the hands of trainees as well as master surgeons, should not come in the way of the pathophysiology of wound healing, and should have the least possible post-operative complications.

Wound dehiscence involves the partial or complete separation of wound edges, often leading to acute wound failure.⁵ The choice of incision and closure technique in abdominal surgery significantly impacts surgical success, considering factors such as ease, time, costs, and wound complication rates.

Closure of laparotomy wounds can be done by various techniques – Mass Closure, Layered Closure, Retention sutures, Smith–Jones technique. While layer-by-layer closure was traditionally accepted, recent studies suggest that the mass closure technique offers superior outcomes. Mass closure involves all the layers closed *en masse*, except for the skin, which is sutured separately. The primary advantage is less operating time and a good approximation, minimizing tension across the wound edges.⁶ However, it may lead to inadequate vascularization of the deeper tissues, impairing wound healing and increasing the risk of surgical site infection (SSI) due to limited wound inspection.

Aims and objectives

This study aims to compare layered closure versus mass closure of midline abdominal incision during laparotomy. The specific objectives are to compare the postoperative wound complications, to estimate the incidence of incisional hernia, to calculate the time taken for wound closure in intraoperative stage, to compare the pain perceived by study subjects during postoperative period in two study groups.

MATERIALS AND METHODS

This hospital-based, prospective, comparative study was conducted in the Department of General Surgery, Calcutta National Medical College and Hospital over a duration

Table 1: The demographic profile of study subjects

Demographic profile				
Age group (in years)	Total sample (n=100)	Group M (n=50)	Group L (n=50)	P-value
18–36	8	3	5	0.595
36–54	58	28	30	
>54	34	19	15	
Gender				0.069
Male	57	33	24	
Female	43	17	26	
Residence				0.086
Urban	55	42	13	
Rural	45	8	37	
Religion				0.846
Hindu	46	23	23	
Muslim	36	19	17	
Others	18	8	10	

Table 2: The distribution of post-operative complications

Post-operative complications				
Surgical site infections	Total sample (n=100)	Group M (n=50)	Group L (n=50)	P-value
Detected	11	3	8	0.110
Not detected	89	47	42	
Seroma				0.295
Detected	9	3	6	
Not detected	91	47	44	
Burst abdomen				0.400
Detected	6	2	4	
Not detected	94	48	46	
Incisional hernia				0.307
Detected	4	1	3	
Not detected	96	49	47	

Table 3: Comparison of the time for wound closure and pain scores between the two groups

Wound closure time and pain scores			
Wound closure time	Group M (Mean±SD)	Group L (Mean±SD)	P-value
Time (in minutes)	18.30±1.182	34.66±3.578	0.000
Visual analog scale (VAS) score			
VAS Day 1	4.86±1.107	6.36±0.942	0.000
VAS Day 5	2.32±0.819	3.04±1.160	0.001
VAS Day 15	2.58±0.971	3.30±0.763	0.000
VAS Day 30	2.16±0.997	3.22±1.148	0.000
VAS Day 90	2.10±0.614	3.38±0.725	0.000
VAS Day 180	1.96±0.669	2.86±0.783	0.000

of 18 months – from June 2023 to December 2024. The study population included patients admitted to the Department of General Surgery, Calcutta National Medical College, with intra-abdominal pathology and undergoing laparotomy via midline abdominal incision.

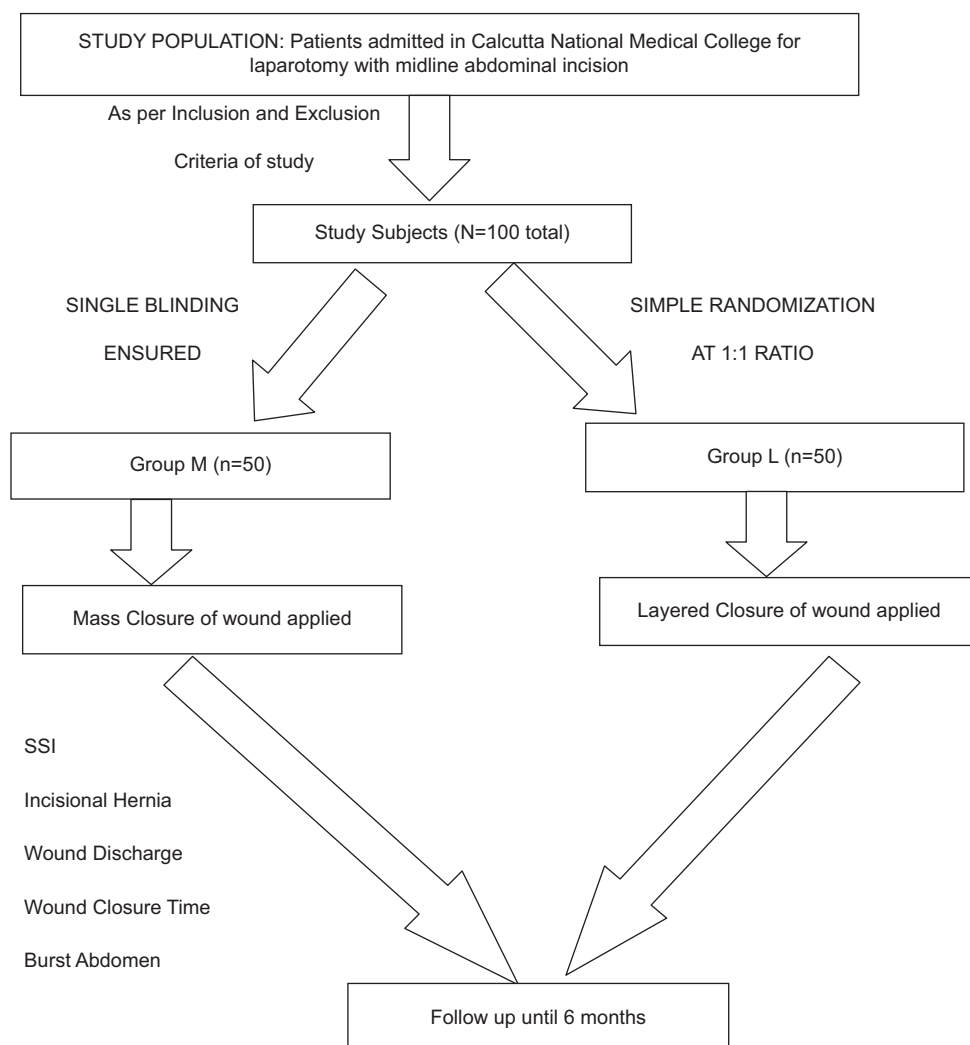


Figure 1: Flowchart representation of materials and methods

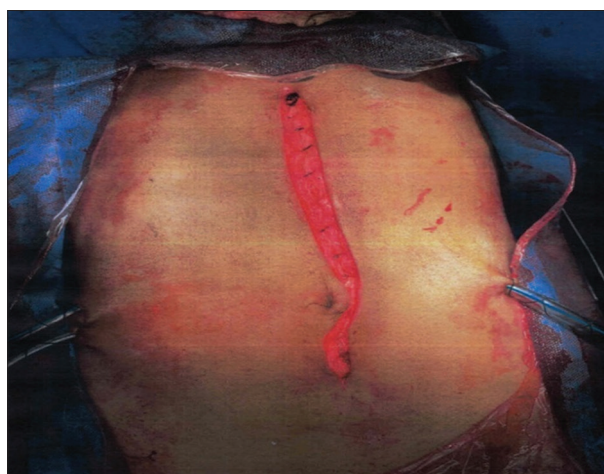


Figure 2: Mass closure following laparotomy

Sample size was calculated as follows:

As per a similar study by Kumar and Raju,⁷ taking the mean duration of abdominal closure (in minutes) as the major

outcome variable, the sample size (N) was calculated by the following formula: $N > 2 \times (Z\alpha + Z1-\beta)^2 \times (SD)^2 / d^2$

Where mean duration of abdominal closure seen in layered closure group=23 (min), mean duration of abdominal closure seen in mass closure group=14 (min), $Z\alpha=1.96$ (at 95% confidence interval), d =effect size=(35–20)=9, SD =Pooled standard deviation assumed to be 10. $\alpha = 0.05$.

$Z1-\beta=1.28$ (when β [power]=80%). Calculated sample size (N) was thus in each group ≈ 37 . Considering an anticipated dropout rate of 10%, the sample size in each group was ≈ 50 . Hence, the total sample size became $(50 \times 2)=100$.

Patients were randomly allocated to the two study groups. Simple randomization was done using a computer-generated random number table at a 1:1 ratio. Patients in group M underwent mass closure, and patients in group L underwent layered closure.

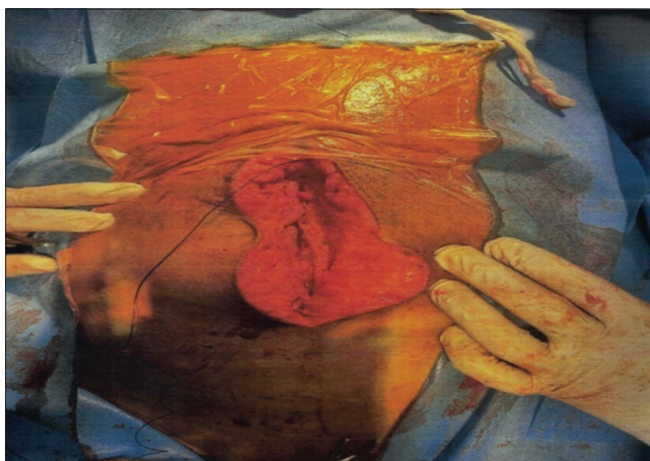


Figure 3: Layered closure following laparotomy (Posterior rectus sheath)



Figure 4: Layered closure following laparotomy (Anterior rectus sheath)

Data were collected after ethical clearance by the Institutional Ethics Committee of Calcutta National Medical College (IEC No. EC-CNMC/2023/297 dated May 30, 2023). The patients with intra-abdominal pathology admitted to the general surgery department for laparotomy with a midline abdominal incision were selected for the study. A thorough pre-anesthetic check-up was performed with detailed clinical history, physical examination, and investigations. Eligible candidates were included in the study after proper consent. After selection, patients were explained about the procedure to be done, the risks and benefits associated with the study, and their right to opt out of the study at any point in time. Written informed consent was obtained from each of the study participants. Study participants were evaluated a day before surgery.

The study was conducted among 100 study subjects, and they were randomly allocated into two study groups at a 1:1 ratio – 50 candidates in each study group. Single blinding was ensured. The study participant was kept unaware of the wound closure process. Two study groups were present – In

group M – midline abdominal incisional wound closure was done by the mass closure method (Figure 2). In group L – midline abdominal incisional wound closure was done by the layered closure method (Figures 3,4). In the post-operative period, patients were examined on days 1, 5, and 15. After that, patients were followed up at the General Surgery outpatient department on days 30, 90, and 180.

Inclusion criteria

1. Patients admitted to the department of General Surgery in Calcutta National Medical College with intra-abdominal pathology and undergoing laparotomy via midline abdominal incision
2. Age within 18–60 years.

Exclusion criteria

1. Not giving informed consent
2. Past history of midline laparotomy
3. Co-existing cardiac, respiratory, liver and kidney diseases, diabetes mellitus
4. Malignancy
5. Coagulation disorder.

Statistical analysis

Collected data were checked for completeness and consistency, and then entered into a Microsoft Excel sheet. Qualitative data were expressed in proportion. Data analysis was done using the Statistical Package for Social Sciences version 23. Appropriate statistical tests (Chi-square test and independent t-test) were done to check statistical significance. $P \leq 0.05$ was considered statistically significant.

RESULTS

Of 100 study subjects, 8 (8%) patients were of 18-36 years age, 58 (58%) patients were of 36-54 years age, 34 (34%) patients were of >54 years age. Age of study subjects was not significantly associated with the type of closure ($P=0.595$). 57% of the subjects were male, 43% were female. Gender of study subjects was not significantly associated with the type of closure ($P=0.069$). 55% of the subjects resided in urban areas, 45% in rural areas. No significant association was found between the residence of study subjects and the type of closure ($P=0.086$). 46% of the subjects were Hindus, 36% were Muslims, whereas 18% followed other religions. Religion of study subjects was not significantly associated with the type of closure ($P=0.846$) (Table 1).

Incidence of seroma (post-operative wound complication) was 6% in group M and 12% in group L. Seroma development was not significantly associated with the type of closure ($P=0.295$). Incidence of SSI was 6% in group M and 16% in group L. SSI was not significantly

associated with the type of closure ($P=0.110$). Incidence of burst abdomen was 4% in group M and 8% in group L. Development of a burst abdomen was not significantly associated with the type of closure ($P=0.400$). Incidence of incisional hernia was 2% in group M and 6% in group L. Development of incisional hernia was not significantly associated with the type of closure ($P=0.307$) (Table 2).

In group M, the mean time needed for wound closure (18.3 min) was much less than in group L (34.66 min). Time needed in wound closure was statistically significantly different in the two study groups ($P=0.0000$). Mean Visual Analog Scale (VAS) scores in group M were consistently lower than in group L patients during the entire post-operative follow-up period at post-operative day-1, day-5, day-15, day-30, day-90, and day-180. There was a statistically significant difference in VAS score between the two study groups ($P=0.0000$) (Table 3).

DISCUSSION

Our study compared mass closure and layered closure techniques for closure of midline abdominal incision during laparotomy in a tertiary-care centre of West Bengal, India. In our current study, the majority of the study subjects were within the 36–54 years age group. Male and Hindus predominance was evident. Patients were mainly from urban areas. Educational status among the study subjects was basically low (mostly mid-school level). Study subjects were mostly presented from the middle and lower middle class.

At the pre-operative stage, with respect to baseline demographic characteristics, both groups were comparable to each other. Regarding post-operative wound complications, both groups were statistically different from each other. Incidents of complications such as seroma, wound site infection, and burst abdomen were on the higher side in the layered closure method. The incidence of incisional hernia was higher in the layered closure group on 6-month follow-up. Time taken for wound closure in the mass closure group was significantly less than in the layered closure group. Regarding pain perceived by study subjects during the post-operative period, both groups were statistically different from each other. VAS scores were significantly lower in the mass closure group.

All these findings hint at the better outcomes following the mass closure technique for midline abdominal incision. In the current prospective study, the wound infection rate in the mass closure group was 6% which was comparable with other studies.^{8,9} As compared to the study by Murtaza et al.,¹⁰ it was less possible because of the small sample

size in the present study. In the study conducted by Chauhan et al.,¹¹ and Paul et al.,¹² the incidence of wound infection was 9.4% and 7.7%, respectively, in the mass closure group. In the present study, the wound infection rate in the layered closure group is 16%. As compared to the study by Paul et al.,¹² (10%) and Nasir et al.,¹³ (10%), the rate of infection in the present study was higher. As compared to mass closure, wound infection was higher in layered closure, possibly due to excessive tissue trauma and entrapment of tissue blood supply during the layered closure technique.¹⁴ Other factors predisposing to wound infection were local trauma from excessive retraction, extensive electrocoagulation, and defective hemostasis. The presence of foreign material due to the presence of a single piece of sterile silk suture material doubled the chance of a contaminated wound becoming infected, and finally, diminished perfusion was another important factor.

The incidence of burst abdomen in the mass closure group is 4% in the current study. It was comparable with studies conducted by Hassan et al.¹⁵ The incidence of burst abdomen for the layered closure group was 8%, which was comparable with other studies.¹⁶ The incidence of incisional hernia for mass closure was 2% in the present study; it was comparable with other studies. The incidence of incisional hernia in the layered closure group is 6% which was quite comparable to the study by El-Sharkawy et al.,¹⁷ but higher as compared to other studies.¹⁸

Mean wound closure time in the mass closure group was 18.3 min in the present study. This figure was comparable with Paul et al.,¹² and Deshmukh and Maske¹⁹ study. Mean closure time for the layered closure group in the present study is 34.66 min. The time needed in the layered closure group in the present study was slightly higher, and this might be due to personal variation among faculty members involved in the treatment of patients. In the present study, the mass closure technique was found to be more effective as compared to layered closure technique. Similar findings were noted in the studies carried out by Chauhan et al.,¹¹ Paul et al.,¹² Kumar and Hastir,²⁰ in comparison with layered closure, the mass closure technique is less time-consuming, associated with less post-operative complications, less costly, safe, and an effective method for closure of midline laparotomy incisions.

A study in India by Kumar and Hastir²⁰ showed that the mean time for the closure of laparotomy wound through a midline or para-median incision by mass closure technique was 14 min, and by the layered closure, the technique was 23 min. There was a difference of 9 min statistically significant ($P=0.001$). In post-operative period patients closed by mass closure technique 8 patients (16%) had post-operative complications in the form of seroma in

2 patients (4%), infection in 3 patients (6%), wound gaping in 2 patients (4%) and incisional hernia in 1 patient (2%) and no patient had burst abdomen whereas in layered closure total 16 (32%) patients had complications as seroma in 5 patients (10%), wound infection in 4 patients (8%), gaping in 4 patients (8%) burst abdomen in 1 patient (2%) and incisional hernia in 2 patients (4%).

Single-layered closure technique was found to be better than layered closure in terms of operation time and post-operative complications such as a seroma, infection, wound gaping, burst abdomen, and incisional hernia in that study. The current study was one of those rare studies in West Bengal that compared mass closure with layered closure for wound closure in laparotomy following midline incision surgery. The study was unicentric. But this should not deter future researchers from conducting larger studies in this domain, particularly for studies with a longitudinal design in a multicentric manner and a larger sample size. This study actually paved the way for future studies to diminish gaps in authenticating proper use of the mass closure technique in wound closure in laparotomy.

Limitations of the study

As it was a single-center study conducted within one tertiary care hospital, cultural diversity across regions might not be captured adequately. A multi-centric study with a larger sample size might provide more information.

CONCLUSION

Mass closure was found to be more effective in wound closure during laparotomy with a midline incision. Mass closure was associated with lesser wound complications and a lower rate of incisional hernia. Mass closure was completed in a much shorter time than layered closure. Pain perceived by patients during the post-operative period was less following the mass closure method. Mass closure was more effective than layered closure in laparotomy with a midline incision. Larger trials in a multicentric manner may be conducted in the future for better comprehension of the usefulness of the Mass closure method.

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REFERENCES

- Xing L, Culbertson EJ, Wen Y and Franz MG. Early laparotomy wound failure as the mechanism for incisional hernia formation. *J Surg Res.* 2013;182(1):e35-e42. <https://doi.org/10.1016/j.jss.2012.09.009>
- Jaiswal NK and Shekhar S. Study of burst abdomen: It's causes and management. *Int Surg J.* 2018;5(3):1035-1040. <https://doi.org/10.18203/2349-2902.isj20180826>
- Kvist M, Jensen TK, Snitkjær C and Burcharth J. The clinical consequences of burst abdomen after emergency midline laparotomy: A prospective, observational cohort study. *Hernia.* 2024;28(5):1861-1870. <https://doi.org/10.1007/s10029-024-03104-x>
- Bhavikatti GS and Gupta GH. Comparative study of mass closure and layered closure techniques in midline and paramedian laparotomies. *Acad J Surg.* 2019;2(1):42-46. <https://doi.org/10.21276/ajs.2019.2.1.12>
- Sandy Hodgetts K, Carville K and Leslie GD. Determining risk factors for surgical wound dehiscence: A literature review. *Int Wound J.* 2015;12(3):265-275. <https://doi.org/10.1111/iwj.12088>
- Cengiz Y, Gislason H, Svanes K and Israelsson LA. Mass closure technique: An experimental study on separation of wound edge. *Eur J Surg.* 2001;167(1):60-63. <https://doi.org/10.1080/110241501750069846>
- Kumar KL and Raju MS. A comparative study of mass closure versus layered closure in midline laparotomy incisions. *Int J Surg Sci.* 2022;6(1):39-41. <https://doi.org/10.33545/surgery.2022.v6.i1a.816>
- Kumari S and Parashar A. Comparative evaluation of the advantages of single-layer closure to en-masse closure in the surgeries of the abdomen. *Int J Health Sci.* 2022;6(S2):10911-10916. <https://doi.org/10.53730/ijhs.v6nS2.7931>
- Gupta H, Srivastava A, Menon GR, Agrawal CS, Chumber S and Kumar S. Comparison of interrupted versus continuous closure in abdominal wound repair: A meta-analysis of 23 trials. *Asian J Surg.* 2008;31(3):104-114. [https://doi.org/10.1016/s1015-9584\(08\)60069-x](https://doi.org/10.1016/s1015-9584(08)60069-x)
- Murtaza B, Khan NA, Sharif MA, Malik IB and Mahmood A. Modified midline abdominal wound closure technique in complicated/high risk laparotomies. *J Coll physicians Surg Pak.* 2010;20(1):37-41.
- Chauhan S, Nand B, Mourya AK and Chauhan B. A comparative study between closure by layers vs mass closure in midline laparotomy incision. *Int J Health Clin Res.* 2021;4(11):9-13.
- Paul B, Saha AK and Debbarma MR. Comparative study between mass closure and layered closure of midline abdominal incisions at surgery department of AGMC and GBP hospital, Agartala, Tripura. *Int J Pharm Clin Res.* 2024;16(5):506-510.
- Nasir GJ, Shams AN and Aram F. Mass closure comparison with layered closure in midline laparotomy incisions. *Eur J Med Health Sci.* 2022;4(1):18-23. <https://doi.org/10.34104/ejmhs.022.018023>
- Chhabra P, Maheswari M and Kumar D. A comparison between mass closure and layered closure in laparotomy wounds. *Int J Med Health Res.* 2020;6(2):8-11.
- Hassan U, Raza W, Naqvi AZ, Abdullah N and Ranjan R. Layered closure versus retention closure technique for abdominal wall in midline laparotomy. *Int J Life Sci Biotechnol Pharma Res.* 2023;12(3):681-687.
- Saadia A, Hussain MZ, Shaheen S, Mujahid D, Murtaza G and Nawaz I. Comparison of continuous versus modified continuous SMEAD jones "far-near-near-far" suturing technique for abdominal wall closure in emergency midline laparotomy wound in terms of wound dehiscence. *Prof Med J.*

2024;31(10):1418-1822.

<https://doi.org/10.29309/tpmj/2024.31.10.8253>

17. El-Sharkawy AI, Al Zamek MM and Ahmed IM. Comparative study of mass closure and layered closure techniques in abdominal incisions. *Afr J Biol Sci.* 2024;6(14):3603-3618.
<https://doi.org/10.48047/afjbs.6.14.2024.3603-3618>
18. Murugan A, Karthik M and Nilakantan A. Layered closure versus retention closure technique for the abdominal wall in midline laparotomy: A longitudinal cohort study. *J Clin Diagn Res.* 2021;15(10):PC01-PC05.

<https://doi.org/10.7860/jcdr/2021/50007.15497>

19. Deshmukh SN and Maske AN. Mass closure versus layered closure of midline laparotomy incisions: A prospective comparative study. *Int Surg J.* 2018;5(2):584-587.
<https://doi.org/10.18203/2349-2902.isj20180357>
20. Kumar R and Hastir A. Prospective clinical study: Mass closure versus layer closure of abdominal wall. *Int J Surg Med.* 2017;3(4):228-233.
<http://doi.org/10.5455/ijsm.mass-closure-versus-layer-closure-abdominal-wall>

Authors' Contributions:

AB- Definition of intellectual content, literature survey, implementation of study protocol, data collection, data analysis, and manuscript preparation;
AD- Concept, design, study protocol implementation, preparation of first draft of manuscript, manuscript preparation, editing and revision, and submission of article; **NA**- Statistical analysis and interpretation, coordination and manuscript revision; **SA**- Statistical analysis and interpretation.

Work attributed to:

Department of General Surgery, Calcutta National Medical College, Kolkata, West Bengal, India.

Orcid ID:

Anmol Bali- <https://orcid.org/0009-0002-9766-9116>

Arindam Das- <https://orcid.org/0009-0002-5541-5580>

Nizamuddin Ahamed- <https://orcid.org/0009-0007-0674-2653>

Shampy Agarwal- <https://orcid.org/0009-0003-1420-9753>

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