



Original Article

An Experimental Study to Compare Three Standardized Skin Closure Techniques of Laparoscopic 5mm Port Sites: N-Butyl-2-Cyanoacrylate Adhesive Skin Glue, Polyamide 3-0 Cutting Simple Interrupted Suture Versus Skin Stapler

Sohan Pal Singh¹, D D Mittal², Misbah Ahmed³, Lakshman Kumar⁴

¹Professor, Department of General Surgery, national capital region institute of medical sciences, meerut, u.p India.

²Professor, Department of General Surgery national capital region institute of medical sciences, meerut, u.p, India.

³Junior resident, Department of General Surgery national capital region institute of medical sciences, meerut, u.p, India.

⁴Junior resident, Department of General Surgery national capital region institute of medical sciences, meerut, u.p, India.

 OPEN ACCESS

Corresponding Author:

Dr Misbah Ahmed

Junior resident, Department of General Surgery national capital region institute of medical sciences, meerut, U.P, India.

Received: 16-02-2026

Accepted: 12-03-2026

Available online: 25-03-2026

Copyright © International Journal of Medical and Pharmaceutical Research

ABSTRACT

Background: Proper closure of laparoscopic port sites is essential for optimal wound healing and cosmetic outcome. Various techniques including sutures, staples, and tissue adhesives are used in clinical practice.

Aim: To compare three standardized techniques for closure of laparoscopic 5-mm port sites.

Materials and Methods: A prospective experimental study was conducted on 90 patients undergoing elective laparoscopic cholecystectomy. Patients were divided into three equal groups (n=30 each). Group A: Skin stapler; Group B: N-butyl-2-cyanoacrylate adhesive; Group C: Polyamide 3-0 simple interrupted sutures. Outcomes measured included time taken for closure, postoperative pain (VAS score), wound infection using ASEPSIS score, scar hypertrophy, and cosmetic outcome.

Results: Mean closure time was significantly lower in the adhesive group (7.8 ± 1.9 sec) compared with stapler (11.6 ± 2.4 sec) and sutures (32.5 ± 6.8 sec) ($p < 0.001$). Postoperative pain scores were slightly lower in the adhesive group. Infection rates were comparable across groups.

Conclusion: The present study concluded that Laparoscopic port sites closed using 2-octyl cyanoacrylate have better short-term cosmetic appearance.

Keywords: N-butyl-2-cyanoacrylate adhesive, laproscopic cholecystectomy, Wound closure, Skin closure.

INTRODUCTION

Laparoscopic surgery has transformed modern surgical practice by providing minimally invasive alternatives to conventional open procedures. These techniques are associated with smaller incisions, reduced postoperative pain, shorter hospital stay, faster recovery, and improved cosmetic results. Laparoscopic cholecystectomy has therefore become the gold standard treatment for symptomatic gallstone disease and is among the most frequently performed laparoscopic operations worldwide.

Despite the minimally invasive nature of these procedures, creation of abdominal wall port sites remains necessary for insertion of trocars and surgical instruments. Proper closure of these port sites is important to ensure optimal wound healing and to prevent complications such as infection, seroma formation, delayed healing, hypertrophic scarring, and rarely port-site hernia.

Several techniques are available for skin closure after laparoscopic surgery. Conventional suturing with non-absorbable materials such as polyamide remains widely practiced because of its reliability and familiarity among surgeons. However,

suturing requires technical precision, needle handling, and knot tying, which may increase operative time and require suture removal later.

Skin staplers provide a faster alternative for wound closure and allow rapid approximation of wound edges with uniform tension. However, staplers require special instruments and staple removal during follow-up visits.

More recently, tissue adhesives such as N-butyl-2-cyanoacrylate have been introduced as an alternative method of skin closure. These adhesives polymerize rapidly on contact with skin moisture and form a strong bond that approximates wound edges while acting as a microbial barrier. Their rapid application and elimination of suture removal make them attractive options for minimally invasive surgery.

Considering the importance of operative efficiency, patient comfort, and cosmetic outcomes in laparoscopic procedures, this study was undertaken to compare three standardized techniques for closure of laparoscopic 5-mm port sites: N-butyl-2-cyanoacrylate adhesive skin glue, polyamide 3-0 simple interrupted sutures, and skin staplers.

AIMS AND OBJECTIVES

To compare Skin staplers, Polyamide 3-0 cutting simple interrupted suture with tissue adhesive glue in surgical incisions less than or equal to 5mm in both adult and pediatric patients undergoing elective surgery in terms of:

- Time taken for closure of surgical incisions
- Post-operative pain perception
- Early and late wound complications including post-op wound infection.
- Cosmetic appearance of wound

MATERIALS AND METHODS

Study Design: Prospective experimental comparative study.

Sample Size: 90 patients undergoing elective laparoscopic cholecystectomy.

Grouping:

- Group A – Skin stapler (n=30)
- Group B – Tissue adhesive (n=30)
- Group C – Polyamide sutures (n=30)

Inclusion Criteria:

- Elective laparoscopic cholecystectomy
- Port-site wound \leq 5 mm

Patient of all age group

- Clean surgical wound
- Written informed consent

Exclusion Criteria:

- Wound $>$ 5 mm
- Diabetes mellitus or immunocompromised status
- Metabolic disorder
- Infected wounds
- Patients unwilling to participate

Outcome Measures:

1. Time taken for skin closure
2. Postoperative pain (VAS score on POD1 and POD2)
3. Wound infection (ASEPSIS score)
4. Scar hypertrophy (1 and 3 months)
5. Cosmetic appearance

Informed Consent

All the patients fulfilling selection criteria were explained about the details of the disease process, options of treatment, ultimate outcome, possible effects, complications and chances of recurrence in both procedure and a written informed consent was obtained before enrolment. They were informed of their right to withdraw from the study at any stage.

Data Collection

A detailed clinical history and physical examination was carried out on patients followed by a thorough review of their hospital records.

4. All the patients meeting inclusion criteria were included in the study.
5. Patients were divided into two groups based on the type of suturing. Group A: Port site closure with stapler Group B: tissue adhesive. Group C – Polyamide sutures
6. The necessary data was recorded and noted down in the master charts.
7. All the data was documented and analyzed by subjecting it to statistical analysis.

Statistical Analysis:

Data were analyzed using ANOVA for continuous variables and Chi-square test for categorical variables. $P < 0.05$ was considered statistically significant.

RESULTS

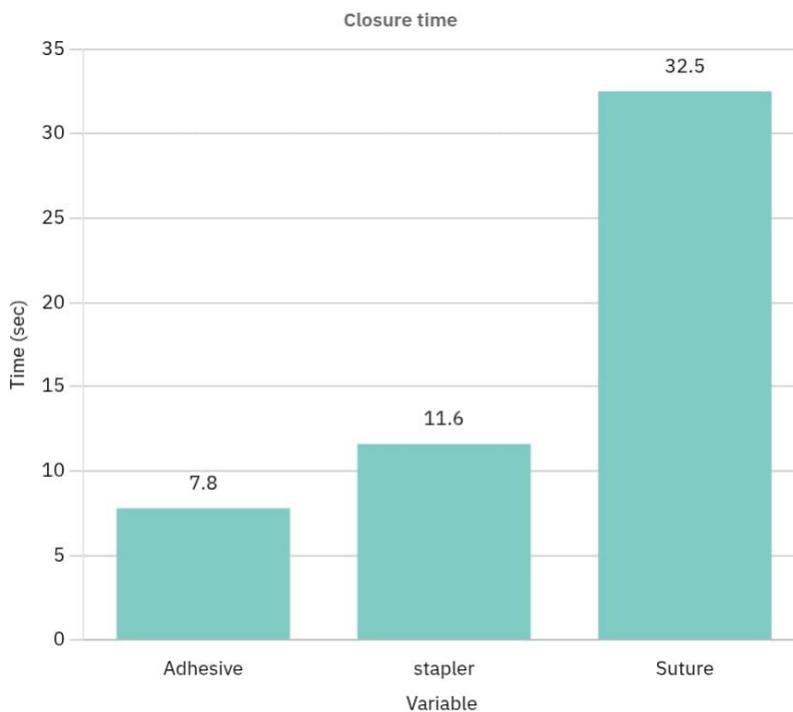
Demographic characteristics were comparable among the three groups with no significant difference in age distribution or gender composition. The mean age of patients in the stapler, adhesive, and suture groups was 41.3 ± 9.2 , 40.7 ± 10.1 , and 42.1 ± 8.8 years respectively.

Table.1: Demographic characteristics

Variable	Stapler (n=30)	Adhesive (n=30)	Suture (n=30)
Mean Age (years)	41.3 ± 9.2	40.7 ± 10.1	42.1 ± 8.8
Male	12	11	13
Female	18	19	17

The mean time required for wound closure differed significantly between the groups. The adhesive group demonstrated the fastest closure time (7.8 ± 1.9 seconds), followed by the stapler group (11.6 ± 2.4 seconds), while the suture group required the longest time (32.5 ± 6.8 seconds) ($p < 0.001$).

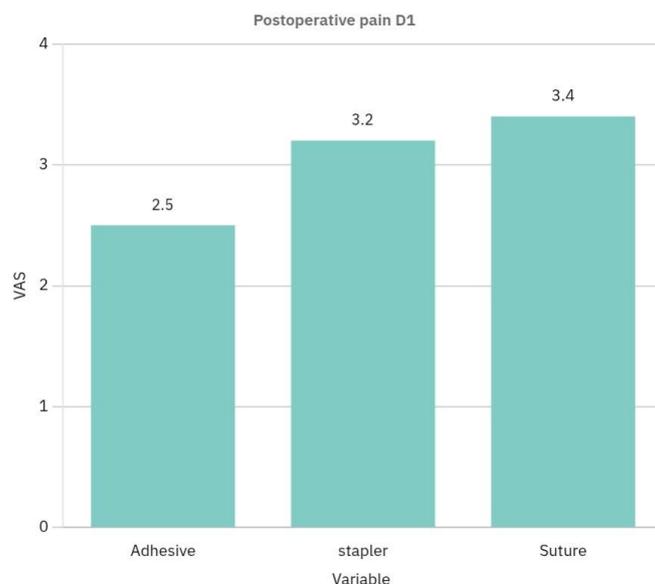
Table.2: Time taken for wound closure



One-way ANOVA showed statistically significant difference between groups ($p < 0.001$).

Postoperative pain assessed using the visual analogue scale showed slightly lower scores in the adhesive group. On postoperative day 1, the mean VAS scores were 3.2 ± 0.8 (stapler), 2.5 ± 0.7 (adhesive), and 3.4 ± 0.9 (suture). On postoperative day 2 the scores were 2.0 ± 0.6 , 1.5 ± 0.4 , and 2.2 ± 0.7 respectively.

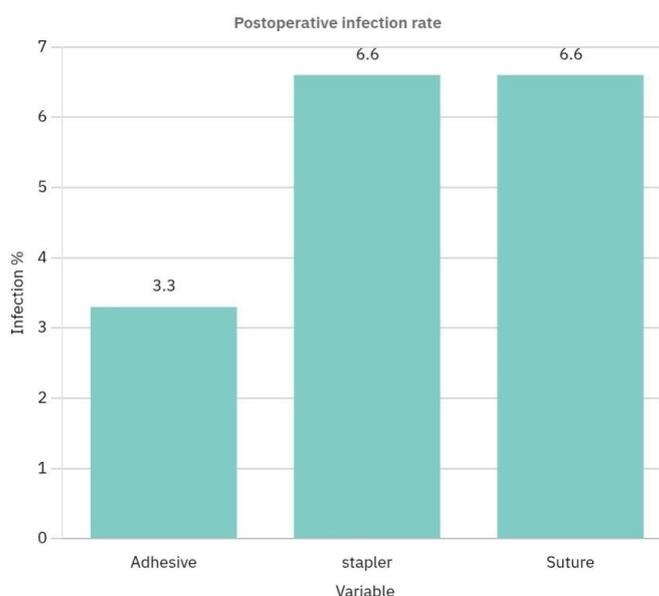
Table.3: Postoperative pain (VAS Score)



Pain scores were lowest in the adhesive group (p = 0.03).

Assessment of wound infection using the ASEPSIS scoring system revealed comparable results across all groups, with infection occurring in 2 cases (6.6%) in the stapler group, 1 case (3.3%) in the adhesive group, and 2 cases (6.6%) in the suture group.

Table.4: Wound infection (ASEPSIS score)



MASTER TABLE

Table 5- master table

Variable	Stapler (n=30)	Adhesive (n=30)	Suture (n=30)	P value
Mean Age (years)	41.3 ± 9.2	40.7 ± 10.1	42.1 ± 8.8	0.82
Male	12	11	13	0.91
Female	18	19	17	0.91
Closure Time (sec)	11.6 ± 2.4	7.8 ± 1.9	32.5 ± 6.8	<0.001
Pain POD1 (VAS)	3.2 ± 0.8	2.5 ± 0.7	3.4 ± 0.9	0.03
Pain POD2 (VAS)	2.0 ± 0.6	1.5 ± 0.4	2.2 ± 0.7	0.04
Infection cases	2	1	2	0.77
Infection (%)	6.6%	3.3%	6.6%	0.77

Wound gaping	1	0	2	0.41
Serous discharge	2	1	3	0.52
Purulent discharge	1	0	1	0.60
Excellent cosmesis (3 months)	18	22	14	0.04
Good cosmesis	9	7	10	0.29
Fair cosmesis	2	1	4	0.33
Hypertrophic scar	1	0	2	0.39

DISCUSSION

The present prospective experimental study compared three commonly used methods for closure of laparoscopic 5-mm port-site wounds—N-butyl-2-cyanoacrylate tissue adhesive, skin staplers, and polyamide 3-0 simple interrupted sutures. Parameters evaluated included time taken for wound closure, postoperative pain, wound infection using ASEPSIS score, scar hypertrophy, and cosmetic outcome. A total of 90 patients undergoing elective laparoscopic cholecystectomy were included and equally distributed among the three groups. The findings of the study demonstrate that tissue adhesive provides significantly faster wound closure with comparable postoperative complications and improved cosmetic outcomes when compared with sutures and skin staplers.

The demographic characteristics of the study population were comparable across all groups. The mean age in the stapler, adhesive, and suture groups was 41.3 ± 9.2 years, 40.7 ± 10.1 years, and 42.1 ± 8.8 years respectively, indicating a homogenous population without statistically significant differences. These findings are comparable with the study conducted by Ananda BB et al.¹, who also evaluated 90 patients undergoing various elective surgical procedures and reported a mean age of approximately 41 years with male predominance. The similarity in age distribution between the two studies indicates that the observed outcomes were unlikely to be influenced by age-related variations in wound healing. One of the most significant findings of the present study was the reduction in time required for wound closure when tissue adhesive was used. The mean closure time in the adhesive group was 7.8 ± 1.9 seconds, compared with 11.6 ± 2.4 seconds for staplers and 32.5 ± 6.8 seconds for sutures, which was statistically significant ($p < 0.001$). These findings indicate that adhesive closure was approximately 33% faster than staplers and nearly four times faster than conventional suturing. A similar trend was reported by Chawada MJ et al.³, who demonstrated that cyanoacrylate glue significantly reduced closure time compared with conventional sutures in elective surgical procedures. The rapid closure achieved with adhesives can be explained by the absence of needle manipulation, knot tying, and staple placement, making the technique particularly suitable for small laparoscopic incisions.

Postoperative pain is another important determinant of patient satisfaction and recovery. In the present study, postoperative pain measured using the Visual Analogue Scale showed lower scores in the adhesive group compared with staplers and sutures. On postoperative day 1 the mean VAS score was 2.5 ± 0.7 in the adhesive group, compared with 3.2 ± 0.8 in the stapler group and 3.4 ± 0.9 in the suture group. A similar reduction in postoperative pain associated with adhesive closure has been reported in several studies. Ananda BB et al.¹ demonstrated significantly lower pain scores in patients treated with tissue adhesive at 12, 24, 48, and 72 hours postoperatively with strong statistical significance ($p < 0.001$). The reduced pain may be attributed to the atraumatic nature of adhesive application, which avoids repeated punctures of skin by needles or staples and minimizes tissue handling.

The incidence of postoperative wound infection in the present study was low and comparable across all groups. Infection occurred in 2 patients (6.6%) in the stapler group, 1 patient (3.3%) in the adhesive group, and 2 patients (6.6%) in the suture group. Although the adhesive group demonstrated the lowest infection rate, the difference was not statistically significant. These findings are consistent with the large study conducted by Agarwal S and Bhayana S et al.⁴, who evaluated 300 patients and reported overall infection rates of 14% in the glue group, 18% in the stapler group, and 20% in the conventional suture group. Although adhesives showed slightly lower infection rates, the difference between closure techniques was not statistically significant. This suggests that infection rates are more dependent on surgical asepsis and patient factors rather than the closure material alone.

Assessment of wound healing using the ASEPSIS scoring system further supported the safety of tissue adhesives. In the present study, the adhesive group demonstrated the lowest ASEPSIS scores, indicating minimal erythema, discharge, or inflammatory changes. Similar observations were made by Ananda BB et al.¹, who reported significantly lower ASEPSIS scores in the adhesive group during the early postoperative period, particularly on postoperative day 3. These findings suggest that tissue adhesives may provide a protective microbial barrier and reduce early inflammatory responses in surgical wounds.

Cosmetic outcome is an important consideration in minimally invasive surgery, where the goal is to achieve minimal visible scarring. In the present study, cosmetic outcomes assessed during follow-up showed better scar appearance in the adhesive

group with minimal scar hypertrophy. None of the patients in the adhesive group developed significant hypertrophic scarring, whereas mild hypertrophic changes were observed in a small proportion of patients in the suture group. Similar findings have been reported by Agarwal et al⁴, who observed significantly improved cosmetic outcomes and higher patient satisfaction in the adhesive group compared with sutures and staples. The absence of suture marks, minimal tissue trauma, and uniform distribution of tension along wound edges may explain the superior cosmetic results associated with tissue adhesives.

CONCLUSION

Tissue adhesive provides the fastest closure time for laparoscopic 5-mm port sites while maintaining comparable infection rates and postoperative outcomes. Skin staplers are faster than sutures but require removal during follow-up, whereas polyamide sutures remain reliable though more time-consuming.

LIMITATIONS

This study contains relatively small number of participants

CONFLICT OF INTEREST/DISCLOSURE: None

ETHICAL COMMITTEE CLEARANCE: IEC NCRIMS DHR/2024/REF/022

SOURCE OF FUNDING: Self

REFERENCES

1. Ananda BB, Shetty A, Shetty V. Comparative study of sutures, skin staplers and tissue adhesive for skin closure in elective surgical procedures. *Int Surg J.* 2019;6(3):765–771.
2. Gupta AK, Sood S, Khanna S. A comparative study of tissue adhesive glue versus skin staplers for closure of surgical skin incisions. *Int J Res Med Sci.* 2017;5(5):1892–1897.
3. Chawada MJ, Patel KD, Shah HN. Comparative study of cyanoacrylate tissue adhesive and conventional sutures for skin closure in elective surgeries. *Int J Surg Sci.* 2018;2(2):24–28.
4. Agarwal S, Bhayana S, Sharma R. Comparison of tissue adhesive, skin staplers and conventional sutures for skin closure in surgical wounds. *J Clin Diagn Res.* 2015;9(9):PC01–PC04.
5. Batra J, Rattan KN, Sharma VK. Comparison of sutures and skin staples for closure of surgical incisions in head and neck surgeries. *Indian J Otolaryngol Head Neck Surg.* 2014;66(2):165–170.
6. Ridgway DM, Mahmood F, Moore R. Comparison of tissue adhesive and skin staples for closure of cervicotomy incisions. *J Laryngol Otol.* 2007;121(7):686–689.
7. Khan RJ, Fick D, Yao F. A comparison of surgical staples and tissue adhesive for skin closure in total hip and knee arthroplasty. *J Arthroplasty.* 2006;21(5):699–704.
8. Chibbaro S, Tacconi L. Use of skin glue versus staples for closure of neurosurgical scalp wounds: a prospective randomized study. *Acta Neurochir (Wien).* 2009;151(6):647–649.
9. Habib A, Mehanna A, Medra A. Use of cyanoacrylate tissue adhesive in oral and maxillofacial surgery. *J Oral Maxillofac Surg.* 2013;71(2):e1–e7.
10. Buckley MJ, Beckman EJ. Adhesive use in surgery: clinical aspects of cyanoacrylate tissue adhesives. *Surg Clin North Am.* 2000;80(1):53–66.
11. Hirst LW, Smiddy WE, Stark WJ. Corneal endothelial toxicity of cyanoacrylate adhesives. *Arch Ophthalmol.* 1982;100(11):1819–1821.
12. Leahey AB, Gottsch JD, Stark WJ. Clinical experience with cyanoacrylate adhesives in ophthalmic surgery. *Ophthalmology.* 1993;100(2):173–180.
13. Kamer FM, Joseph JH. Tissue adhesives in facial plastic and reconstructive surgery. *Laryngoscope.* 1989;99(9):976–979.
14. Vishwanathan PN, Bhat NA, Bhat MA. Tissue adhesive versus conventional sutures in otologic surgery. *Indian J Otolaryngol Head Neck Surg.* 2004;56(2):103–105.
15. Douglas DM. The healing of wounds: tensile strength of healing wounds. *Br J Surg.* 1952;40(164):79–84.