



A COMPARATIVE STUDY BETWEEN SKIN STAPLER AND CYANOACRYLATE GLUE IN CLEAN ELECTIVE SURGICAL SKIN CLOSURE

General Surgery

Dr. Dharshini. R	PG Resident, Department Of General Surgery, Sri Siddhartha Medical College, Tumkur, Karnataka
Dr. Srinivas Arava	Professor, Department Of General Surgery, Sri Siddhartha Medical College, Tumkur, Karnataka
Dr. Shivakumar. T	Professor, Department Of General Surgery, Sri Siddhartha Medical College, Tumkur, Karnataka
Dr. Kakul Kalita*	Senior Resident, Department Of General Surgery, Sri Siddhartha Medical College, Tumkur, Karnataka *Corresponding Author

ABSTRACT

Background: Wound closure is done to close dead space, to approximate the wound edges, to support and strengthen the wound until healing, to reduce infection and bleeding. The choice of wound closure is concerned with easy closure, fast and comfortable recovery of patient, and the better cosmetic outcome of the scar. Historically, sutures have been the mainstay method for wound closure, in recent years, alternative techniques such as skin staples and cyanoacrylate adhesives have gained popularity. Surgical stapler and cyanoacrylate glue provide a needle-free method of wound closure that is easy to use and offers a flexible skin closure. **Objectives:** The objective of the study is to do a comparative analysis of the ease of usage and time taken for incision closure, overall postoperative pain and cosmetic outcome of using skin staplers to cyanoacrylate glue in clean elective surgical skin closures. **Methods:** The study was conducted on 80 patients who underwent clean elective surgery in Sri Siddhartha Medical College. The patients were divided into two groups of 40. One of the groups received closures using skin staplers whereas the other group received closures of skin with cyanoacrylate glue. The study was conducted to compare the ease and duration of closure, postoperative pain overall cosmetic outcome between the two groups for a period of 18 months between August 2022 to February 2024. The duration of wound closure assessed by stopwatch. Post operative, pain is assessed using visual analogue scale on POD 0, 1, 2, 3, 7, 14 and 28. The wound cosmetic outcome assessed using modified Hollander Cosmesis scale assessed on POD 2, 4, 7, 14 and 28. **Results:** Participants were equally distributed (n=80) between the cyanoacrylate glue and stapler groups. The majority of participants (77.5%) were men. Hernioplasty (78.8%) was the most prevalent surgery, followed by Excision biopsy (11.3%). Compared to glue (mean 1.44), stapler showed considerably quicker wound closure times (mean 1:14). Post-operative pain was assessed on POD 0, 1, 2, 3 and on follow-up based on Visual Analogue Score. The participants in the cyanoacrylate glue group reported significantly less pain on initial post-operative days as compared with the stapler group. (p = 0.041). After POD 5, the postoperative pain ratings for the glue and stapler groups were comparable. Post-operative follow-up was done till POD 28, and cosmesis assessment using the Modified Hollander Scale revealed a highly statistically significant difference between the skin stapler and glue groups (p < 0.05), suggesting that the glue group has a superior cosmetic outcome compared to the stapler group. **Conclusion:** This study evaluated the effectiveness of staplers and cyanoacrylate glue in closing surgical wounds. Results showed that staplers were faster and is time efficient thereby reducing operative time. However, cyanoacrylate glue excelled in pain management and cosmetic outcomes, eliminating the need for dressing and allowing patients to shower after surgery. Both methods have advantages, Staplers are time-saving, while cyanoacrylate glue provides better pain management and superior cosmetic outcomes. Individual patient factors and surgeon preferences will continue to play a critical role in the choice of closure method.

KEYWORDS

Cyanoacrylate Glue, Skin Stapler, Skin Closure, Wound Healing

INTRODUCTION

Sutures have been a gold standard for closure of surgical incision. The skin closure technique has been evolving with various methods of skin closure being available in place of sutures like stapler, tapes, and adhesives which have shown to be useful as well.¹

The goal of wound closure is to close dead space, support and strengthen wound until it heals and gains its tensile strength, approximation of skin edges for cosmetically pleasing and functional results, and minimising the risk of bleeding and infection.² The optimal method of surgical closure must be a simple, safe, fast, economic, painless and aesthetically appealing outcome of scar.¹

Closure materials can be categorised as sutures, staplers, adhesive tapes and adhesive glues. Skin suturing is economical but time taking. Staplers reduced this time taken by a huge margin. Now a days, stapler are disposable which are of plastic or reusable and are made of stainless steels or titanium which are more commonly used. They provide speedy closure, reduced chances of infectivity, better wound eversion with no tissue strangulation, with minimal crosshatch scarring and reduced foreign body reaction. It excludes the risk of needle stick injury in patient with unknown history.³

Adhesive glue are quick, trouble free, water resistant, needle-free skin closure which is cosmetically better and also has anti-microbial properties and needs no further addition antiseptic bandaging. Reduced pain was noted in post-operative period. The wound disappears naturally, leaving no incision mark and no removal is required. Probability of infection of wound with adhesive glue, are less. It also has appropriate features for closing wound such as adequate strength, barrier proficiency in tissues, and potential to bind

in clammy environment there are certain downsides of cyanoacrylates, like a lesser amount of tensile strength and probability of discharge if the ends are not adequately approximated.²

Aim And Objectives

To compare the use of skin stapler and adhesive glue in clean elective surgical skin closure in clean elective surgery

Objectives:

To compare the duration taken for closure of surgical incision between cyanoacrylate glue and skin stapler.

To compare the cosmetic appearance of the scar after closure by cyanoacrylate glue and skin stapler.

To compare post-operative pain between skin staples and cyanoacrylate glue.

MATERIALS AND METHODS

The study was conducted on 80 patients who underwent clean elective surgery at Sri Siddhartha Medical College. The patients were divided into two groups of 40. One of the groups received closures using skin staplers whereas the other group received closures of skin with cyanoacrylate glue. The study was conducted for a period of 18 months between August 2022 to February 2024.

Inclusion Criteria:

- Patients undergoing clean elective surgery where skin closure is done using staplers / adhesive glue.
- Age group between 18 to 80 years.

Exclusion Criteria:

- Patients with history hypersensitivity to Cyanoacrylate or formaldehyde.
- History of contact dermatitis.

The duration of wound closure assessed by stopwatch in minutes. Postoperative, pain is assessed using Visual Analogue Scale (VAS) on POD 0,1, 2, 3, 7, 14 and 28. The wound cosmetic outcome assessed using Modified Hollander Cosmesis Scale(MHCS; range 0-6) assessed on POD 2, 4, 7, 14 and 28.

ID	Step-off of borders (Edges not on the same plane)	Contour irregularities (Wrinkled skin near the wound)	Margin separation (Gap between the sides)	Edge inversion (Wound not properly everted)	Excessive distortion (Swelling or infection)	Patient satisfaction score (1-10)	Operator satisfaction score (1-10)
A							
B							
C							
D							
E							

Is the overall appearance? ☐ Acceptable ☐ Not acceptable

Figure 1: Modified Hollanders Cosmesis Score

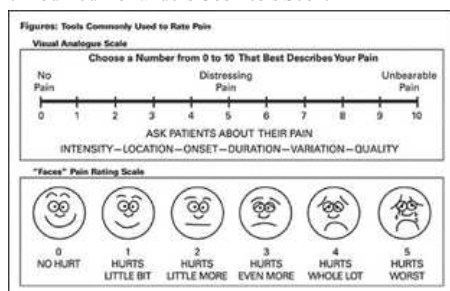


Figure 2: Visual Analogue Score

Statistical Analysis

The data collected are entered in excel spreadsheet. Descriptive statistical analysis is performed by mean and standard deviation for quantitative variables and frequency and percentages for categorical variables. The association between categorical variables is analyzed by using the chi-square test. Treatment effects are compared by applying independent sample t-test, statistical software SPSS VERSION-20 will be used for the analysis. The level of statistical significance was set at p-value of <0.05

Ethical approval was obtained from the Institutional Ethical Committee at Sri Siddhartha Academy Of Higher Education, Tumkur.



Figure 3: closure with stapler



Figure 4: Closure with cyanoacrylate glue

RESULTS:**Gender And Age Distribution :**

There is equal distribution of male and female in both groups with male being the highest percentage of cases (77.5%) than female (22.5%). Majority of patients (23.8%) fell within the 31-40 age range, followed by the 61-70 age range (20%).

Distribution Of Cases By Operative Procedure :

Table 1: Distribution of cases by Operative Procedure

OPERATIVE PROCEDURE	STAPLER	GLUE	TOTAL
Hernioplasty	30 (37.5%)	33(41.25%)	63 (78.8%)
Excision Biopsy	6 (7.5%)	3 (3.75%)	9 (11.2%)
Herniorrhaphy	2 (2.5%)	2 (2.5%)	4 (5%)
Thyroidectomy	2 (2.5%)	2 (2.5%)	4 (5%)
Total	40	40	80

The distribution of surgical procedures performed on the participants throughout the study shows, the most common procedure was hernioplasty, which accounted for 78.8% of the cases (63 patients) followed by Excision biopsy of lipoma / breast lump was conducted on 9 of the subjects (11.2%), and herniorrhaphy (5%), Thyroidectomy (5%).

Length Of Incision:

The average length of incision in the stapler group was 6.43 cm, compared to 6.35 cm in the glue group. There is no significant difference in incision length between the groups (p-value - 0.67), suggesting that the choice of closure method (stapler or glue) does not have a significant impact on the length of the incision.

Table 2: Length of incision among both groups

LENGTH OF INCISION	N	MEAN, $\pm$ SD	t- value	P -value
stapler	40	6.43 $\pm$ 1.15	0.43	0.67
glue	40	6.35 $\pm$ 1.06		

Comparison Of Time Taken For Closure Of Surgical Incision

Table 3: Comparison of Duration Of Closure

DURATION OF CLOSURE	N	MEAN, $\pm$ SD	t- value	P -value
stapler	40	1.14 $\pm$ 0.24	3.43	<0.001
glue	40	1.44 $\pm$ 0.37		

The results showed a statistically significant difference in closure time between the stapler group (mean time: 1.14 minutes $\pm$ 0.24) and the glue group (mean time: 1.44 minutes $\pm$ 0.37), (p-value - <0.001), indicating that using a stapler significantly reduces the time required for wound closure compared to using glue.

Comparison Of Cosmetic Outcome Using Modified Hollanders Cosmesis Score (MHCS)

Table 4: Comparison Of Cosmetic Outcome Using MHCS

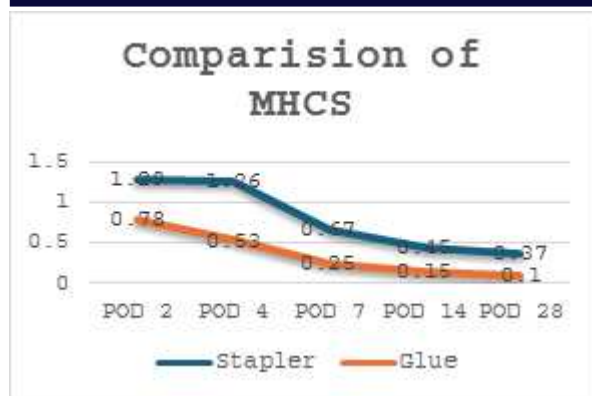
MHCS	Stapler	Glue	P- value
POD 2	1.29 $\pm$ 1.288	0.78 $\pm$ 1.03	0.013
POD 4	1.26 $\pm$ 1.049	0.53 $\pm$ 0.75	<0.001
POD 7	0.675 $\pm$ 0.888	0.25 $\pm$ 0.44	0.021
POD 14	0.45 $\pm$ 0.638	0.15 $\pm$ 0.36	0.007
POD 28 (Overall Appearance)	0.375 $\pm$ 0.540	0.10 $\pm$ 0.30	0.002
P-value (Between-group effect)*			<0.001

* Repeated Measure ANOVA

The mean MHC scores for the stapler group were 1.29, 1.26, 0.67, 0.45, and 0.37 at postoperative days (POD) 2, 4, 7, 14, and 28, respectively.

While the glue group had Showed a significant reduction in scores, with mean MHC scores of 0.78, 0.53, 0.25, 0.15, and 0.10 simultaneously, indicating better cosmetic outcomes.

The differences between the groups were significant (p < 0.05) at all point of time, which suggests that the glue group had a superior cosmetic outcome compared to the stapler group



Graph 1: Comparison of cosmetic outcome using MHCS

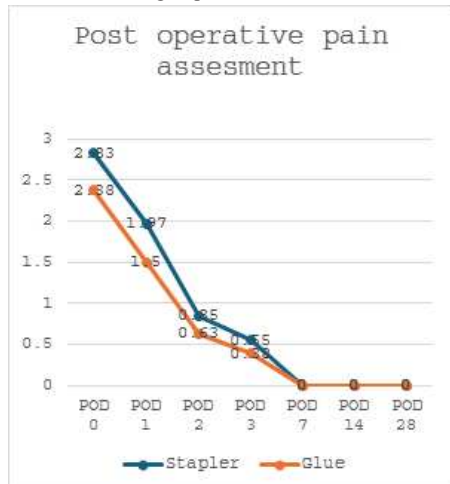
Comparison Of Post-Operative Pain Using VAS

Table 5: Comparison of Pain between groups with VAS

VAS	Stapler	Glue	P- value
POD 0	2.83 ±0.84	2.38 ±0.87	0.029
POD 1	1.97 ±1.03	1.50 ±0.73	0.003
POD 2	0.85 ±0.86	0.63 ±0.77	0.012
POD 3	0.55 ±0.64	0.38 ±0.54	0.036
POD 7	0.00±0.00	0.00 ±0.00	
POD 14	0.00±0.00	0.00 ±0.00	
POD 28	0.00±0.00	0.00 ±0.00	
P-value (Between group effect)*	0.041		

* Repeated Measure ANOVA

The results show a significant reduction in pain in the glue group compared to the stapler group on POD 0, 1, 2, and 3 (p-values: 0.029, 0.003, 0.012, and 0.036, respectively), suggesting that glue may be a better option for patients who prioritize comfort and pain control during the initial post-op period. However, by day 7, pain levels were comparable between both groups.



Graph 2: Comparison of post-operative pain using VAS

DISCUSSION

Various factors are considered when selecting a closure method, including the cost, time taken for skin closure, post-operative pain and patient satisfaction of wound scar. The search for the ideal technique has resulted in the development of alternatives to traditional sutures, such as staples and tissue adhesives. While staples offer advantages like reduced closure time and lower risk of contamination, they have limitations in achieving precise alignment in complex wounds. Tissue adhesives, like cyanoacrylate, have become popular consequently of their distinctive properties, including bacteriostatic and haemostatic characteristics.^{4,5}

Gender And Age Distribution

Our study had 40 participants, with 77.5% males and 22.5% females. The age range was 18-80 years, with a diverse distribution. The demographic characteristics were consistent across other studies.

Ananda BB et al.,¹ and Tengli ND et al.,² Showed similar gender distribution. Ananda BB et al.,¹ (2019) studied participants aged 31-50 years, with mean ages ranging from 38.38 to 43.30 years. Other studies, such as Pawar et al.,³ and Tengli et al.,² reported younger mean ages, with ranges of 18-50 years and 19-23 years, respectively.

Length Of Incision:

Our study found similar mean incision lengths (6.43 cm and 6.35 cm) in both stapler and glue groups, with no significant difference ($p = 0.67$), indicating that the choice of closure method did not significantly impact incision length. Ananda et al.,¹ study (2019) used adhesive glue for small to medium-sized wounds (0-10 cm), indicating its suitability for smaller wounds. In contrast, Chibbaro and Tacconi's⁷ study reported successful use of adhesive closure for larger wounds (median length 20 cm, range 14-30 cm), with comparable cosmetic outcomes to traditional methods. These findings collectively suggest that adhesives are a viable alternative to staples and sutures, offering similar outcomes across a range of incision lengths. The choice of closure method may depend on wound size and other factors, but adhesives have shown promise in various scenarios.

Time Taken For Skin Closure:

Ananda BB et al.,¹ The mean closure time for staplers (53.30 ± 8.93 seconds) was substantially shorter than for glue (103.97 ± 17.22 seconds). Ridgway DM et al.,⁶ provides additional evidence supporting our findings, demonstrating that tissue glue closures significantly longer than stapled closures in neck surgeries. The mean difference of 67 seconds (ranging from 42 to 91 seconds). Chibbaro S, Tacconi L et al.,⁷ appears to be an outlier, as it found no significant difference in closure time between surgical adhesive glue (115 seconds) and skin staples (105 seconds) for scalp incisions in neurosurgical procedures. Chibbaro et al.'s findings are an exception, showing less pronounced differences between the two methods.⁷

Our study is consistent with Ananda et al.,¹; Ridgway et al.,⁶; Khan et al.,⁸ demonstrating that skin staplers are significantly faster and more time-efficient than surgical adhesive glue for wound closure, with mean closure time of 1.14 minutes $\pm$ 0.24, whereas the glue group had a mean closure time of 1.44 minutes $\pm$ 0.37. Overall, the cumulative evidence from these studies supports the use of skin staplers as a faster and more efficient option for wound closure, with a few exceptions (Chibbaro et al.⁷) where the difference may be less pronounced.

Wound Cosmesis Score:

In our study the mean MHCS score of stapler group on POD 2, 4, 7, 14 and 28 is 1.29, 1.26, 0.67, 0.45 and 0.37 and in the glue group is 0.78, 0.53, 0.25, 0.15 and 0.10 respectively. The difference between the two groups was statistically significant ($p < 0.05$) at all time points, indicating that the glue group had a better cosmetic outcome and less noticeable scarring compared to the stapler group.

Ananda BB, et al.,¹ assessed cosmetic outcomes at three time points, showing that the glue group had non-significantly higher scores on day 7, Significantly higher scores (95.63) at 1 month, Slightly higher scores (96.13) compared to staples (92.93) at 3 months, with statistical significance, suggesting that the glue group had a slightly better cosmetic outcome.¹ Pawar AA, et al.,⁹ study the mean Modified Hollander Cosmesis Scale (MHCS) score for the skin adhesive group on day 7 was 4.83, which was significantly higher than the stapler group's score of 3.97. This trend continued on days 14 and 28, indicating superior cosmetic outcomes with the skin adhesive.⁹ Agrawal SN.¹⁰ study found that uneven scars were more common in the stapler group (21.21% and 69.69%) compared to the adhesive group (0% and 46.15%). Wound gaping was more prevalent in the adhesive group (6.06%) compared to the stapler group (0%). The difference in cosmetic outcomes between the two groups was statistically significant ($P < 0.0218$), with adhesive glue yielding superior results.¹⁰ Agarwal S, Bhayana S, Gupta M et al.,¹¹; and Chibbaro S, Tacconi L et al.,⁷ found that patients reported significantly higher satisfaction with adhesive glue compared to stapler suggesting that patients perceived glue as providing superior cosmetic outcomes and a more satisfactory overall experience. Overall, our study aligns with other research indicating that adhesive is a better option than staples for wound closure, resulting in better cosmetic outcomes, higher patient satisfaction, and less noticeable scarring.

Post Operative Pain:

Our study revealed a significant reduction in postoperative pain in the

glue group compared to the stapler group on days 0, 1, 3, and 4, with p-values of 0.029, 0.003, 0.012, and 0.036, respectively, indicating that glue is superior to staplers in managing postoperative pain.

Ananda BB et al.¹ The mean Visual Analog Scale (VAS) scores at 12, 24, 48, and 72 hours were 63.13, 42.10, 16.94, and 7.27, respectively, and 4.73 at 7 days. The study demonstrated a strong statistically significant difference ($P < 0.001$), indicating that pain was minimal with glue compared to staples.¹ Similar study by Pawar AA, et al.⁹ and Tengli ND et al.² also suggest that Adhesive glue group had significantly less pain up to 72 hours after surgery.²

The findings consistently show that adhesive glue is associated with less postoperative pain compared to staples, especially in the early stages (up to 72 hours). Additionally, staples require removal after wound healing, which can cause additional discomfort, whereas adhesive glue does not require removal. Thereby Suggesting that adhesive glue may be a better option for wound closure, in terms of postoperative pain management.

CONCLUSION

The study aimed to compare the effectiveness of staplers and cyanoacrylate glue in closing surgical wounds in clean elective surgeries.

The findings of this study indicate that staple closure is a more rapid method of skin closure compared to cyanoacrylate glue, leading to reduced operative times and enhanced surgical efficacy.

In terms of post-operative pain and scar aesthetics, glue is considered superior. Moreover, the use of glue eliminates the need for dressing and allows early showering following surgery. Additionally, the glue does not need to be removed, as it gradually disappears as the incision heals, eliminating the need for further intervention.

Both staplers and cyanoacrylate glue have distinct benefits in skin closure. Staplers offer time efficiency, while cyanoacrylate glue excels in pain management and cosmetic outcomes. The choice of closure method will be influenced by individual patient needs and surgeon preferences, highlighting the importance of personalized decision-making in surgical care.

REFERENCES:

1. Ananda BB, Vikram J, Ramesh BS, Khan HM. A comparative study between conventional skin sutures, staples adhesive skin glue for surgical skin closure. *Int Surg J*. 2019;6:xxx-xx.
2. Tengli ND, Tanga SM, Rashmi D. Comparative study between skin closures with adhesive skin glue 2-octyl cyanoacrylate and suture material in clean elective surgeries. *New Indian J Surg*. 2019;10(1):49-54.
3. Mastud K, Lamture Y, Nagtode T, et al. A comparative study between conventional sutures, staples, and adhesive glue for clean elective surgical skin closure. *Cureus*. 2022 Nov 7;14(11):e31196. DOI: 10.7759/cureus.31196.
4. Kumar TRD, Mohanty S, Chaudhary Z, Sahoo BL, Dabas J. Conventional skin suture, skin staple versus contemporary tissue adhesive for maxillofacial elective wound care—A single blind prospective randomized comparative study. *Am J Otolaryngol*. 2020;41(5):102797. doi: 10.1016/j.ajoms.2020.08.007.
5. Lekic N, Dodds SD. Suture materials, needles, and methods of skin closure: what every hand surgeon should know. *J Hand Surg Am*. 2021;46(10):930-7. doi: 10.1016/j.jhssa.2021.09.019.
6. Ridgway DM, Mahmood F, Moore L, Bramley D, Moore PJ. A blinded, randomised, controlled trial of stapled versus tissue glue closure of neck surgery incisions. *J Laryngol Otol*. 2007;121(9):842-7. doi: 10.1308/003588407X179062.
7. Chibbaro S, Tacconi L. Use of skin glue versus traditional wound closure methods in brain surgery: a prospective, randomized, controlled study. *J Clin Neurosci*. 2009;16(1):105-9. doi: 10.1016/j.jocn.2008.08.004.
8. Khan RJ, Fick D, Yao F, Tang K, Hurworth M, Nivbrant B, Wood D. A comparison of three methods of wound closure following arthroplasty: a prospective, randomised, controlled trial. *J Bone Joint Surg Br*. 2006;88(2):238-42. doi: 10.1302/0301-620X.88B2.16923.
9. Pawar AA, Joshi MA, Gadhire M, Shetriya R, Phad B, Singh J. Prospective randomized comparative study of skin adhesive glue (2-methyl-2-cyanopropionate or cyanoacrylate) versus conventional skin suturing by suture material/skin stapler in clean surgical cases. *Int Surg J*. 2018;5:16873.
10. Agrawal SN. A comparative study of use of adhesive glue versus skin staplers for closure of skin incisions. *Int J Recent Trends Sci Technol*. 2016 Mar;18(2):346-8.
11. Agarwal S, Bhayana S, Gupta M. A comparative study of skin closure cyanoacrylate vs conventional methods. *MedPulse Int Med J*. 2015 Dec;2(12):[page numbers]. Available from: <http://www.medpulse>.