

# Comparative study of skin closure with adhesive skin glue, staplers and conventional suture materials for skin incisions in clean elective surgeries with respect to efficacy, cosmesis and cost effectiveness

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## Abstract

The scar is the signature of the surgeon. Apart from cosmetically good scars it is also necessary that the skin closure technique should be technically easy, acceptable, speedy and economical. The choice of wound closure after surgery has always been a matter of debate. Wound closure techniques have evolved from the earliest development of natural suturing materials through synthetic sutures (absorbable and non-absorbable), staplers, and tapes to the newest modality of adhesive compounds. This prospective randomized study compared time efficacy, post-operative pain, wound complication rate, cosmesis and cost-effectiveness between sutures, staplers and 2-octyl cyanoacrylate skin adhesive in closure of skin incisions of different sizes (1-10cm) in 150 patients who underwent clean elective surgery between January 2011 and January 2012 in our department.

**Keywords:** 2-octyl cyanoacrylate, ASEPSIS wound score, Modified Hollander cosmesis scale, Visualanalog scale for cosmesis.

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Received Date: 20/11/2015 Revised Date: 24/12/2015 Accepted Date: 27/01/2016

Access this article online	
Quick Response Code:	Website: <a href="http://www.statperson.com">www.statperson.com</a>
	DOI: 04 February 2016

## INTRODUCTION

A basic need of skin closure is good approximation. Good tissue union and cosmetically acceptable scars are vital for ideal surgical practice. Wound closure techniques have evolved from early developments in suturing materials to advanced resources that include synthetic sutures, absorbable sutures, staples, tapes, and adhesive compounds. Various other techniques are used to close skin incisions after surgeries. Suturing techniques include

simple or mattress sutures, sub-cuticular stitches. Skin staplers are also in use. The Food and Drug Administration (FDA) has approved 2-octyl cyanoacrylate for closure of incised skin. The traditional skin suturing with suture materials is cost-effective but time consuming. Staplers reduced this time factor to a great extent. Skin adhesive glue fits the bill as it provides a fast, easy, cosmetic, water resistant sealed needle free skin closure and because of its anti-microbial property, it needs no antiseptic bandaging. It also gives less pain during post-operative period, patients can have shower, needs no suture or stapler removal, and the wound disappears naturally as the incision heals leaving no mark. Chances of wound infection are also less with adhesive glue. Our study aims towards a comparison between the different modalities of skin closure after a clean elective surgery with skin incisions of different sizes with respect to their efficacy, cosmesis and cost-effectiveness.

## MATERIAL AND METHOD

The study was conducted in the Department of General Surgery, N.R.S. Medical College & Hospital, Kolkata. Cases (patients) getting operated electively through clean incisions of varying sizes (1-10 cm), undergoing primary closure under the antibiotic coverage of choice according to the site of surgery were selected. Between 6<sup>th</sup> January 2011 and 30<sup>th</sup> January 2012, total 135 patients were selected. Every alternate patient was offered the three modes of skin closure respectively. All patients were informed in details about different modes of skin closure and were taken up for the study with informed consent duly signed by the subject and the principal investigator. Patients were divided into 3 groups classifying incisions as small (1-3 cm), moderate (3-6 cm) and large (6-10 cm) incisions, each group comprising of 45 patients. Each of these groups were further divided into 3 sub-groups according to the method of closure of skin incision with suture materials, staplers and glue respectively, each such sub-group comprising of 15 patients.

## Parameters studied were

- Time required to close the skin and the sub-cutaneous tissue in the different groups of incision length.
- Post-operative pain assessment through Visual Analog Scale.
- Post-operative scoring of wound using ASEPSIS wound score.
- Cosmesis of the wound using Modified Hollander Cosmesis scale on 7<sup>th</sup> post-operative day and by same single independent observer using Visual Analog Scale for Cosmesis of 0-100 at 1<sup>st</sup> month, 3<sup>rd</sup> month and 6<sup>th</sup> month.
- Cost-effectiveness of the different materials used in skin closure in terms of material cost and total duration of hospital stay after surgery for wound healing and wound complications.
- Student's t-test have been used for comparison of the averages.

## RESULT AND ANALYSIS

### Time taken to close the skin

Time required to close the skin using different materials is depicted in Table 1. Time taken to approximate the skin and the sub-cutaneous layer was considered.

**Table 1a:** Mean time taken to close the skin

Length of incision (cm)	Time taken with sutures (sec)				Time taken with staplers (sec)				Time taken with adhesive glue (sec)			
	Mean	SD	Max.	Min.	Mean	SD	Max.	Min.	Mean	SD	Max.	Min.
Small (< 3cm)	12.6	5.58	32	9	10.87	17.84	61	2	46.73	11.52	78	36
Moderate (3-6cm)	93.47	29.61	170	70	24.2	20.49	98	16	58.00	20.65	80	33
Large (6-10cm)	198.6	138.68	495	110	113.13	27.76	134	20	132.87	7.18	140	113

**Table 1.b.** Significance of the difference in time taken for closure

Length of incision	Suture vs Stapler	Suture vs Glue	Stapler vs Glue
Small	t = 0.36 (NS)	t = 10.33 (p<0.001)	t = 6.54 (p<0.001)
Moderate	t = 7.45 (p<0.001)	t = 3.81 (p<0.01)	t = 4.50 (p<0.001)
Large	t = 2.34 (p<0.05)	t = 1.83 (n.s.)	t = 2.76 (p<0.05)

NS = not significant (p>0.05)

### Post-operative pain score

The post-operative pain is measured in both the groups using Visual Analog Scale by patients themselves. The pain score is observed at 0hours, 12 hours, 24hours, 36hours, 48hours, 72hours, and 7<sup>th</sup> day. The post-operative pain score is depicted in Table 2. All patients were given opioid analgesia as per the body weight and requirement of the patient in the post-operative period.

**Table 2.a:** Comparison of Post-operative pain on VAS score

Interval	Material	No.	Mean	SD	Max.	Min.
0hrs	Sutures	45	97.56	5.70	100	80
	Staplers	45	95.78	8.66	100	70
	Glue	45	94.22	11.58	100	60

12hrs	Sutures	45	80.67	9.63	100	60
	Staplers	45	71.11	11.91	90	40
	Glue	45	62.89	11.60	90	30
24hrs	Sutures	45	63.56	12.64	90	40
	Staplers	45	50.00	11.48	70	20
	Glue	45	40.67	11.36	60	10
36hrs	Sutures	45	47.78	14.60	80	20
	Staplers	45	31.78	11.34	60	10
	Glue	45	23.56	10.26	50	0
48hrs	Sutures	45	32.89	12.90	60	10
	Staplers	45	17.33	8.89	40	0
	Glue	45	11.78	7.77	30	0
72hrs	Sutures	45	12.11	8.72	40	0
	Staplers	45	7.11	7.27	30	0
	Glue	45	3.11	5.14	20	0
7days	Sutures	45	13.70	6.00	80	0
	Staplers	45	2.67	12.14	80	0
	Glue	45	0.22	1.49	10	0

Table 2.b: Significance of the difference

Interval	Comparison	t value	p value
0 hrs	Suture vs Stapler	1.15	> 0.05
	Suture vs Glue	1.74	> 0.05
	Stapler vs Glue	0.78	> 0.05
12 hrs	Suture vs Stapler	4.19	< 0.001
	Suture vs Glue	7.91	< 0.001
	Stapler vs Glue	3.32	< 0.01
24 hrs	Suture vs Stapler	5.33	< 0.001
	Suture vs Glue	9.04	< 0.001
	Stapler vs Glue	3.88	< 0.001
36 hrs	Suture vs Stapler	5.81	< 0.001
	Suture vs Glue	9.10	< 0.001
	Stapler vs Glue	3.61	< 0.001
48hrs	Suture vs Stapler	6.66	< 0.001
	Suture vs Glue	9.40	< 0.001
	Stapler vs Glue	3.15	< 0.01
72 hrs	Suture vs Stapler	2.95	< 0.01
	Suture vs Glue	5.96	< 0.001
	Stapler vs Glue	3.01	< 0.01
7 days	Suture vs Stapler	5.46	< 0.001
	Suture vs Glue	14.63	< 0.001
	Stapler vs Glue	1.34	> 0.05

At 0 hours, the mean post-operative pain scores do not differ significantly ( $p > 0.05$ ) with the materials used for wound closure but at all the succeeding periods, the average pain score differ significantly.

### Wound asepsis score

The outcome of wound is assessed at 3rd, 5th, 7th post-operative days using ASEPSIS score.

Table 3: Wound complications and ASEPSIS score

Intervals (Days)	Materials	No Complication	Serous Sexudate	Erythema	Purulent exudate	Deep Tissue separation	Max. ASEPSIS Score
3 <sup>rd</sup> Day	Suture	28	4	13	0	0	4
	Stapler	39	6	0	0	0	4
	Glue	43	2	0	0	0	2
5 <sup>th</sup> Day	Suture	38	0	5	2	0	6
	Stapler	43	1	0	1	1	8
	Glue	44	1	0	0	0	1
7 <sup>th</sup> Day	Suture	43	0	0	0	2	10
	Stapler	44	0	0	0	1	8
	Glue	45	0	0	0	0	0

**Wound cosmesis score**

Patients were followed up at time of suture removal usually 7 days, and then at 1<sup>st</sup> month, 3<sup>rd</sup> month and 6<sup>th</sup> month and the wound is assessed for Cosmesis on 7<sup>th</sup> post-operative day using Modified Hollander Cosmesis Scale which has 6 clinical variables as step-off borders, edge inversion, contour irregularities, excess inflammation, wound margin separation, and good overall appearance. A total cosmetic score was derived by adding the scores of variables. A score of 1 is given to each variable if not present in the wound.

**Table 4.a:** Comparison of post-operative wound cosmesis

Interval	Material Used	Total No.	Mean	S.D.	Max.	Min.
7 <sup>th</sup> Day	Suture	45	5.22	1.29	6	0
	Stapler	45	5.58	0.97	6	0
	Glue	45	5.84	0.37	6	5
1 <sup>st</sup> Month	Suture	45	82.22	11.85	100	50
	Stapler	45	91.33	9.91	100	40
	Glue	45	96.44	5.70	100	80
3 <sup>rd</sup> Month	Suture	45	90.89	9.96	100	60
	Stapler	45	98.00	5.48	100	70
	Glue	45	99.33	2.52	100	90
6 <sup>th</sup> Month	Suture	45	97.11	5.49	100	80
	Stapler	45	99.78	1.49	100	90
	Glue	45	100.00	0.00	100	100

**Table 4.b:** Significance of the difference

Interval	Comparison	t value	p value
7 <sup>th</sup> day	Suture vs Stapler	1.50	> 0.05
	Suture vs Glue	3.10	< 0.01
	Stapler vs Glue	1.68	> 0.05
1 <sup>st</sup> month	Suture vs Stapler	3.96	< 0.001
	Suture vs Glue	7.28	< 0.001
	Stapler vs Glue	3.00	< 0.01
3 <sup>rd</sup> month	Suture vs Stapler	4.20	< 0.001
	Suture vs Glue	5.51	< 0.001
	Stapler vs Glue	1.48	> 0.05
6 <sup>th</sup> month	Suture vs Stapler	3.15	< 0.01
	Suture vs Glue	3.53	< 0.001
	Stapler vs Glue	0.99	> 0.05

At 7<sup>th</sup> post-operative day cosmesis score after closure with suture and adhesive glue differ significantly. In the succeeding periods, the differences between each group are statistically significant except between stapler and adhesive glue groups at 3<sup>rd</sup> and 6<sup>th</sup> months.

**Cost-effectiveness of the different methods**

The material costs were suggestive of the fact that suture materials were the most cost-effective of the three methods of skin closure. The cost-effectiveness was further evaluated in terms of total post-operative hospital stay.

**Table 5.a:** Comparison of the duration of post-operative hospital stay

Material used	Mean duration (days)	S.D.	Maximum duration (days)	Minimum duration (days)
Suture	6.49	5.33	32	3
Stapler	5.82	4.87	35	3
Glue	3.49	0.99	7	3

**Table 5.b:** Significance of the difference

Comparison	t value	p value
Suture vs Stapler	0.62	>0.05 (n.s.)
Suture vs Glue	3.71	< 0.001
Stapler vs Glue	3.15	< 0.01

The duration of post-operative stay is statistically significant between suture and glue groups and stapler and glue groups. However post-operative stay does not differ significantly between suture and stapler groups.



Figure A:



Figure B:



Figure C:



Figure D:



Figure E:



Figure F:

Figure a and b: Depicts skin closure with glue

Figure C: Depicts skin closure with suture.

Figure D and E: Depicts skin closure with stapler

Figure F: Depicts skin closure with subcuticular sutures

## DISCUSSION

Traditionally, skin suturing with suture material was used because of cost-effectiveness. 2-octylcyanoacrylate is easier to use and provides a flexible, water resistant, sealed skin closure and provides a needle-free method of wound closure. It gives less pain during postoperative period, need no suture or staple removal, disappears naturally as incision heals. In traditional skin closure with suture material, patients experience more pain during postoperative period, cannot have a shower and have to come for suture removal. Removal of sutures causes pain and a high degree of patient anxiety associated with these procedures remains. Even after healing, there will be track marks of suture. However with increasing size of incision, time taken to close the skin with staplers became significantly less compared to the other two groups. Closure with subcuticular sutures took maximum time. On follow up 1<sup>st</sup> month, all the mean scores differ significantly between one group and another showing best cosmesis with glue followed by stapler and then suture group. On 3<sup>rd</sup> and 6<sup>th</sup> months there is no significant difference in the mean cosmesis score between the stapler and adhesive glue groups. The material costs were suggestive of the fact that suture materials were the most cost-effective of the three methods of skin closure. The

cost increased when closure was done with polyglactin sutures for subcuticular closure of skin. The glue group had a significantly lesser hospital stay compared to the other groups.

## CONCLUSION

The results from the present study show that the glue, octyl-cyanoacrylate and skin staplers are better in many ways than traditional skin sutures in an elective clean or clean/contaminated surgery. There was significant less pain with skin adhesive after the immediate postoperative period till 72 hours following surgery. Wound complication rate was maximum with sutures (37.78%, 17 cases) followed by staplers (15.56%, 7 cases) and skin adhesive (6.67%, 3 cases). Best cosmesis was achieved with glue followed by staplers and then sutures. The material costs suggested that suture materials were the most cost-effective. The skin suture group and stapler group needed post-operative wound dressing. There was minimal cost in post-operative management of the wounds closed with glue. The glue group had a significantly lesser hospital stay compared to the other groups. However it can be concluded that octyl-cyanoacrylate can be safely used in surgical skin closure in clean elective surgeries. Comparing skin staplers with

skin sutures, staplers are evidently a better option for closure of skin in clean elective surgeries.

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Source of Support: None Declared  
Conflict of Interest: None Declared