

## A COMPARATIVE STUDY OF ISOAMYL-2-CYANOACRYLATE (NOVOCRYL) WITH SUBCUTICULAR POLYAMIDE SUTURE FOR SURGICAL WOUND CLOSURE

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### ABSTRACT

#### BACKGROUND

There are several concerns while selecting the mode of wound closure after surgery, whether major or minor procedure. One of the concerns is how fast and comfortable will be the recovery. A new technology is surgical adhesives, cyanoacrylates, 2-octyl cyanoacrylate is easier to use and provides a flexible, water resistant, sealed skin closure, 2 octyl cyanoacrylate provides a needle free method of wound closure, an important consideration because of blood borne viruses (e.g. HIV).

The objectives of the study are- 1) To compare isoamyl-2-cyanoacrylate with subcuticular polyamide suture for skin closure in elective surgical procedures for the following characters. 2) To compare the cosmetic outcome. 3) To compare wound dehiscence & wound infection.

#### MATERIALS AND METHODS

This is a comparative study conducted on 50 patients in two groups at Bapuji Hospital and Chigateri General Hospital, Davangere in Department of General Surgery between 1<sup>st</sup> of January 2010 and 1<sup>st</sup> of July 2011. Cases undergoing clean elective surgical procedure were randomly selected and put into two groups. 1) Skin closure was done with 3-0 polyamide subcuticular sutures in one group. 2) Skin closure was achieved with 2-octyl cyanoacrylate in the other group.

#### RESULTS

Wound cosmesis assessment on day 7, the mean score for adhesive glue group was 5.84 which was slightly higher than the mean cosmesis score of 5.68 for subcuticular skin suturing (p=0.3). The cosmesis assessment at 1 month, the mean score for adhesive glue group was 5.9 and was 5.68 for subcuticular skin suturing group which was again not statistically significant (p=0.1). The mean wound ASEPSIS scores on day 3 for adhesive glue group was 0.28 and the same for subcuticular skin suturing group was 0.36 (p=0.7). The same score on day 5 for adhesive glue group was 0.12 and that of subcuticular skin suturing group was 0.28 (p=0.4). The results in both the groups were comparable in terms of wound infection rate.

#### CONCLUSION

Octyl cyanoacrylate provides an effective and reliable means of skin closure and yields similar cosmetic results as with subcuticular skin sutures. The incidence of infection and wound complications are comparable in both the groups. In addition, octyl cyanoacrylate provides certain practical advantages to the patients. The advice as to which method is used for closure of wound may come down to economics and operator preference.

#### KEYWORDS

2-octyl cyanoacrylate, octyl cyanoacrylate, Adhesive glue, wound ASEPSIS score, modified Hollander -cosmesis scale.

**HOW TO CITE THIS ARTICLE:** Dhotre M, Chetan SV. A comparative study of isoamyl-2-cyanoacrylate (Novocryl) with subcuticular polyamide suture for surgical wound closure. J. Evid. Based Med. Healthc. 2018; 5(29), 2184-2192. DOI: 10.18410/jebmh/2018/452

#### BACKGROUND

Care of wound in its simplest form and based on the contemporary knowledge, evolved along with the evolution of mankind.

*Financial or Other, Competing Interest: None.*  
*Submission 18-06-2018, Peer Review 21-06-2018,*  
*Acceptance 14-07-2018, Published 16-07-2018.*  
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*DOI: 10.18410/jebmh/2018/452*



The recorded history of wound closure is as old as that of medicine. The document is the first to mention surgical suturing in the passage interpreted "Thou shouldst draw together for him his gash with stitching". Wound closure techniques have evolved a great deal from the earliest development of suturing materials. These evolutions have provided us variety of suture materials, absorbable ones, staples, tapes and adhesive compounds.<sup>1,2</sup> The history of sutures begins more than 2000 years ago with the first records of eyed needles. The Indian plastic surgeon, Susruta (AD 380-450), described suture material made from flax, hemp and hair.<sup>2</sup>

A new technology that is available for wound closure is surgical adhesives. Cyanoacrylate provides patients the option of suture less skin closure and its use is fast catching

up. Presently 2 octyl cyanoacrylate, a longer chain polymer which gives a stronger bond is in use.<sup>3</sup>

The last generation of these adhesives is octyl cyanoacrylates, which results in less heat when applied, lower inflammatory reaction, and relatively higher tensile strength than the previous compounds.<sup>4</sup> The Cyanoacrylates are safe for clinical use with no reports of adverse effects or carcinogenicity.<sup>5,6,7</sup>

Cyanoacrylates may be very simplistically defined as solvent free, synthetic adhesives. They are reactive monomer liquids that polymerize into a film when initiated by moisture or certain chemicals. A key property of cyanoacrylates is that the monomer liquid actually polymerizes directly on the surface where it is applied, creating a high quality and very tenacious polymer film. Cyanoacrylates typically fix within a minute and achieve full bond strength in 24 hours.<sup>1,2,8</sup>

Choosing the proper material and wound closure technique ensures optimal healing. 2 octyl cyanoacrylate is the latest skin adhesive glue, used for faster skin closure. So it is essential to do a comparative study of the two techniques of skin closure.

## MATERIALS AND METHODS

### Study Design

This is a comparative study conducted on 50 patients in two groups.

### Inclusion Criteria

Cases undergoing clean elective surgical procedure and skin closure with polyamide subcuticular suturing or with 2-octyl cyanoacrylate adhesive glue under same antibiotic coverage during the period between 1<sup>st</sup> Jan 2010 and 1<sup>st</sup> July 2011.

### Exclusion Criteria

1. Surgical Incisions which require to be closed under tension.
2. Clean contaminated and contaminated surgeries
3. Traumatic wounds
4. Patients with diabetes mellitus
5. Known personal or family history of Keloid formation or scar hypertrophy
6. A known allergy to Cyanoacrylate compound.
7. Patients not coming for follow-up on 7<sup>th</sup> post – operative day or 1<sup>st</sup> month or 3<sup>rd</sup> post – operative month.
8. Surgical closures involving muco-cutaneous junctions like lips, oral cavity.

### Settings

Department of General Surgery at Bapuji Hospital and Chigateri General Hospital, Davangere.

### Source of Data

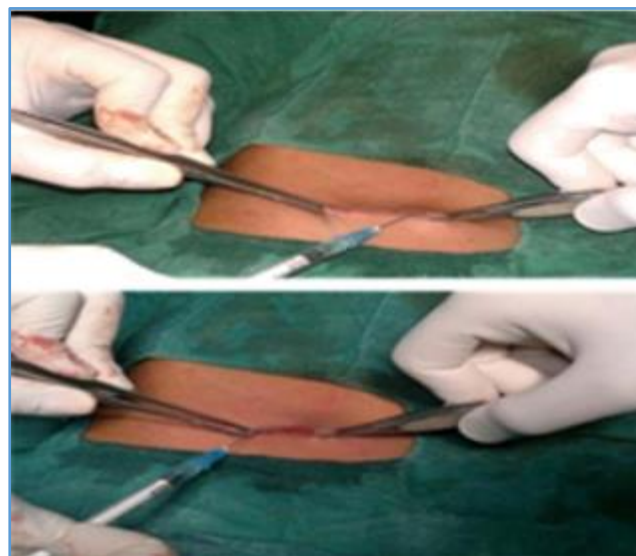
50 patients (25 in each group) undergoing clean elective surgery with no focus of infection on the body admitted in the department of general surgery in Bapuji Hospital and

Chigateri General Hospital from 1<sup>st</sup> of January 2010 to 1<sup>st</sup> July 2011.

### Method of Collection of Data

This is a comparative study in which patients were studied in two groups. One group comprised of incision closure with subcuticular 3-0 polyamide suture material and the other group comprised of closure with 2 – octyl cyanoacrylate adhesive glue. For all patients, subcutaneous sutures were applied to relieve tension, close dead space and appose wound edges, then the wound was closed by subcuticular stitches using polyamide 3-0 or using Isoamyl-2-cyanoacrylate.

The adhesive was applied in a single layer while keeping the two ends of the incised wound stretched using forceps. This will approximate the two edges of the incised wound. In each patient of both the groups, detailed history was taken and routine investigations like haemoglobin, total count, differential count, ESR, Blood sugar were done. In all the recruited patients Inj. Ceftriaxone 2gm IV was started one hour before surgery and repeated with 1gm IV at 8 hrs and 24 hrs post operatively.



**Figure 1. Application of Adhesive Glue**

### Subcuticular Skin Suturing Group

Comprised of 25 patients with sub-cuticular polyamide suture skin closure in clean elective surgery.

### Adhesive Glue Group

Comprised of 25 patients with 2-octyl cyanoacrylate skin closure. The same brand name (Novocryl) glue was used in every patient of this group.

In both the groups the outcome of wound is assessed at 3<sup>rd</sup>, 5<sup>th</sup>, 7<sup>th</sup> post-operative days using ASEPSIS score. Wound is scored from 0 to 10, according to the proportion of wound involved and presence of serous collection, erythematous changes, purulent exudates and separation of deep tissues.<sup>8,9,10,11</sup>

Wound characteristic	Proportion of Wound Affected					
	0	< 20	20-39	40-59	60-79	> 80
Serous exudate	0	1	2	3	4	5
Erythema	0	1	2	3	4	5
Purulent exudate	0	2	4	6	8	10
Separation of Deep tissues	0	2	4	6	8	10
<b>ASEPSIS Wound Score</b>						

The wound is assessed for cosmesis on 7<sup>th</sup> Post-operative day and at the end of 1<sup>st</sup> and 3<sup>rd</sup> month using Modified Hollander cosmesis scale<sup>12,9,13</sup> which has six clinical variables as step off borders, edge inversion, contour irregularities, excess inflammation, wound margin separation and good overall appearance. Wound will be assigned 0 or 1 point each for the presence or absence of the following-

- Step off the borders, (0 for yes, 1 for no)
- Contour irregularities – puckering, (0 for yes, 1 for no)
- Wound margin separation, (0 for yes, 1 for no)
- Wound edge inversion, (0 for yes, 1 for no)
- Excessive wound distortion, (0 for yes, 1 for no)
- Good overall appearance (0 for poor, 1 for acceptable)

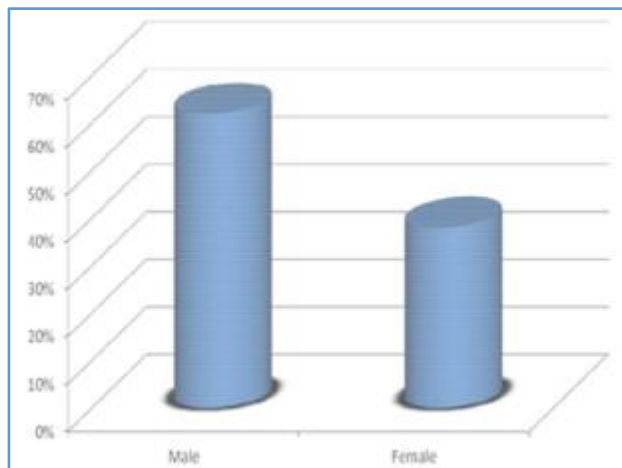
Wounds with a score of 6 are considered to have an optimal cosmetic appearance and others suboptimal appearance.

**RESULTS**

In adhesive group none of the patients had local irritation of the skin or any hypersensitivity reaction. No toxicity was observed in any case belonging to adhesive group.

Sex	Frequency	Percent
Male	31	62
Female	19	38

**Table 1. Shows the Sex Distribution in the Present Study**

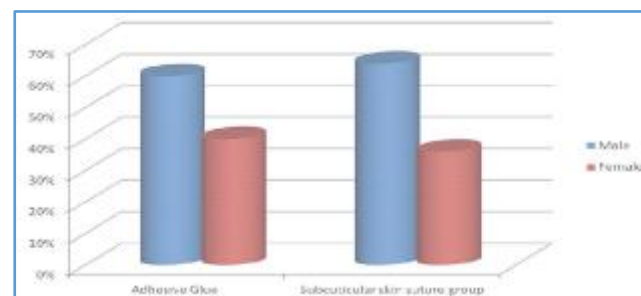


**Graph 1. Gender Distribution of Study Population**

Table -2 shows sex distribution in each group. Out of the 25 patients in the adhesive glue group, there were 15 males constituting 60% of the group and 10 females constituting 40% of the group. There were 16 males comprising 64% and 09 females comprising 36% in the sub cuticular suture group.

Type of Material Used	Sex		Total
	Male	Female	
Adhesive Glue	15 (60%)	10 (40%)	25
Subcuticular Skin Suturing	16 (64%)	09 (36%)	25
<b>Total</b>	<b>31</b>	<b>19</b>	<b>50</b>

**Table 2. Gender Distribution among the Two Study Groups**

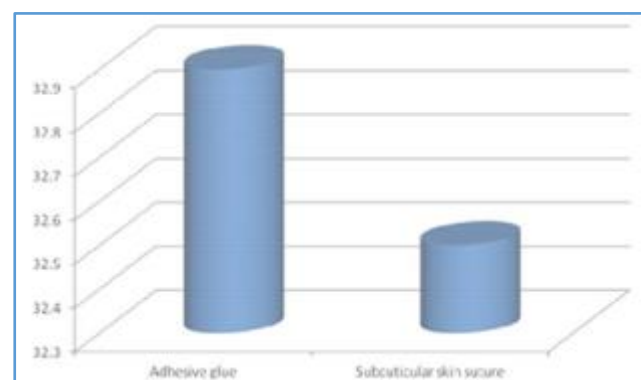


**Graph 2. Gender Distribution among the Two Study Groups**

Group	No. of Patients	Mean Age	Standard Deviation	Min. Age	Max. Age
Adhesive Glue	25	32.92 Yrs.	19.38	4	70
Subcuticular Skin Suturing	25	32.56 Yrs.	16.4	27	65

**Table 3. Mean Age Distribution among Study Groups**

The mean age in the adhesive glue group was 32.92 yrs. ± 19.3. The mean age in the subcuticular suture group was 32.56 yrs. ± 16.4. The above data can be graphically represented as follows.



**Graph 3. Mean Age Distribution among Study Groups**

**Nature of Surgical Procedures**

In the present study different surgical procedures were performed in each study group. The split up of the surgical procedures in each group is indicated in the following table. All cases were clean and elective.

Surgical Procedures	Type of Material Used		Total
	Adhesive Glue	Subcuticular Skin Suturing	
Excision of Fibroadenoma	5	4	9
Excision of Lipoma	6	3	9
Excision of Sebaceous Cyst	2	-	2
Orchidectomy in a case of undescended testis	1	-	1
Lichensteins Tension free hernioplasty	5	11	16
Subtotal thyroidectomy	1	1	2
Excision of Lymph node	1	1	2
Herniotomy	3	4	7
Mesh repair of Incisional hernia	1	1	2
<b>Total</b>	<b>25</b>	<b>25</b>	<b>50</b>

**Table 4. Distribution of SURGICAL Procedures According to Type of Material Used**

**Wound Asepsis Score**

The outcome of wound is assessed on 3<sup>rd</sup>, 5<sup>th</sup> and 7<sup>th</sup> post-operative days using asepsis score. Wound is scored from 0 to 10 according to the proportion of wound involved and presence of- i) serous collection ii) Erythematous changes iii) Purulent exudates and iv) separation of deep tissues. Table-5 shows the incidence of each of the four parameters of ASEPSIS score.



**Figure 2. Subcuticular Skin Closure on 7<sup>th</sup> Post-Operative Day**



**Figure 3. Adhesive Glue Skin Closure on 7<sup>th</sup> Post-Operative Day**

Interval (days)	Type of material	No Complication	Seroma	Erythema	Purulent Exudates	Wound Separation	Total
3rd day	Adhesive Glue	21	2	1	0	0	25
	Subcuticular Skin Suturing	19	3	2	0	0	25
	<b>Total</b>	<b>40</b>	<b>5</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>50</b>
5th day	Adhesive Glue	23	1	0	1*	1*	25
	Subcuticular Skin Suturing	22	2	0	1+	1+	25
	<b>Total</b>	<b>45</b>	<b>3</b>	<b>0</b>	<b>2</b>	<b>2</b>	<b>50</b>
7th day	Adhesive Glue	24	0	0	0	1*	25
	Subcuticular Skin Suturing	24	0	0	0	1+	25
	<b>Total</b>	<b>48</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>50</b>

**Table 5. Incidence of ASEPSIS Score Parameters at Different Intervals in the Two Study Groups**

\*and + same patient in glue group and subcuticular suture group had purulent discharge and wound separation.

Time Interval (days)	Type of Material	Seroma	Erythema	Purulent Discharge	Wound Separation	Total Score/mean	t Value	p Value
3rd day	Adhesive Glue group	4	3	0	0	7(0.28)	0.4103	0.7
	Subcuticular Skin Suturing group	5	4	0	0	9(0.36)		
5th day	Adhesive Glue group	1	0	2	0	3(0.12)	0.8055	0.4
	Subcuticular Skin Suturing group	3	0	4	0	7(0.28)		
7th day	Adhesive Glue group	0	0	0	2	2(0.08)	0	0
	Subcuticular Skin Suturing group	0	0	0	2	2(0.08)		

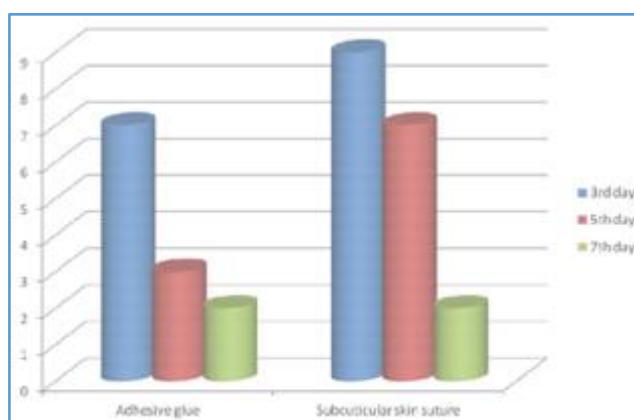
**Table 6. ASEPSIS Scores of the Study Groups on 3<sup>rd</sup>, 5<sup>th</sup> and 7<sup>th</sup> Days**

The above score is calculated on the basis of the proportion of wound involved and presence of serous collection, erythematous changes, purulent exudates and separation of deep tissues. The wound is scored from 0 to 10 as per the following.

Wound characteristic	Proportion of wound affected %					
	0	< 20	20-39	40-59	60-79	> 80
Serous exudates	0	1	2	3	4	5
Erythema	0	1	2	3	4	5
Purulent exudates	0	2	4	6	8	10
Separation of deep tissues	0	2	4	6	8	10

**Table 7. ASEPSIS Score Based on the Proportion of Wound Involved**

It is observed from table-7, that on day 3 mean ASEPSIS score for adhesive glue group is 0.28 and for the skin suturing group is 0.36(P=0.7). Though there is a numerical difference in favour of the adhesive glue group, this difference is found to be statistically insignificant.



**Graph 4. Comparison of ASEPSIS Scores on 3<sup>rd</sup>, 5<sup>th</sup> and 7<sup>th</sup> Day**

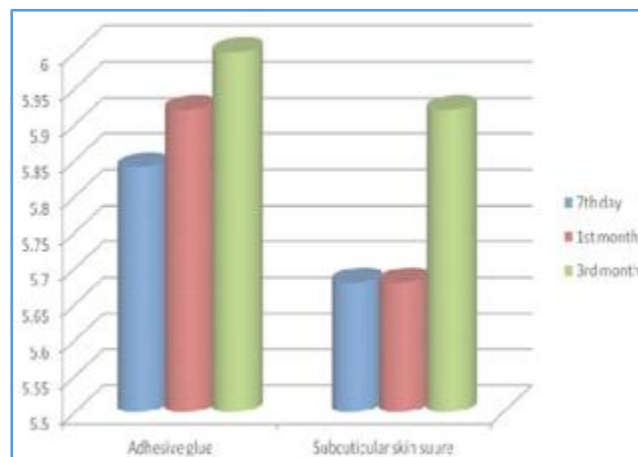
Time Days/Months	Type of Material Used	No.	Mean	Std. Deviation	Min. Score	Max. Score	t Value	p Value
7th Day	Adhesive Glue	25	5.84	0.4725	4	6	1.0955	0.3
	Subcuticular Skin Suturing group	25	5.68	0.5567	4	6		
1 Month	Adhesive Glue	25	5.92	0.27676	5	6	1.6134	0.1
	Subcuticular Skin Suturing group	25	5.68	0.6903	4	6		
3rd Month	Adhesive Glue	25	6	0	6	6	1	0.36
	Subcuticular Skin Suturing group	25	5.92	0.27676	5	6		

**Table 8. Comparison of Post-Operative Wound Cosmesis Score**

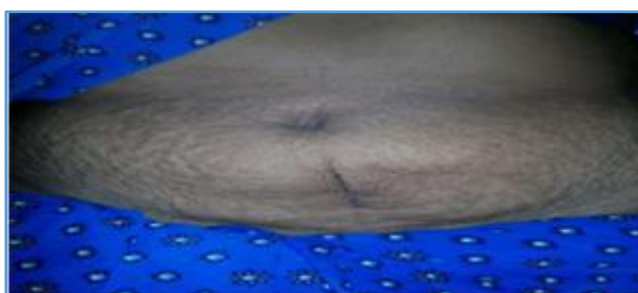
It is observed from table –8, that the cosmesis score on 7<sup>th</sup> day in both the groups is spread between a minimum of 4 and a maximum of 6. The Mean score for Adhesive glue group was 5.84 and the same for skin suturing group was 5.68 which is marginally less than the adhesive glue group. It is found that the values are statistically insignificant with a p value of 0.3.

**Wound Cosmesis Score**

Wounds of patients in both the groups were assessed for cosmesis on 7<sup>th</sup> day, 1<sup>st</sup> month and 3<sup>rd</sup> month 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 the variables. A score of 1 is given to each variable if not present in the wound. So a score of 6 was considered as optimal while 5 or less as suboptimal. Any complications if present were observed in both the groups. Table – 8 shows the comparison of wound cosmesis between adhesive glue group and subcuticular skin suturing group.



**Graph 5. Comparison of Cosmesis Scores for the Study Groups at Different Intervals**



**Figure 4. Incisional Hernia Repair with Adhesive Glue Skin Closure on 3<sup>rd</sup> Month of Postoperative Follow up-**

**Wound Complications**

Complications	3 <sup>rd</sup> Day		7 <sup>th</sup> Day	
	Type of Material Used		Type of Material Used	
	Adhesive Glue	Subcuticular Skin Suturing	Adhesive Glue	Subcuticular Skin Suturing
	(N=25)	(N=25)	(N=25)	(N=25)
Seroma	2	3	0	0
Erythema	1	2	0	0
Purulent	0	0	1*	1*
Wound separation	0	0	1*	1*
<b>Total</b>	<b>3 (12%)</b>	<b>5 (20%)</b>	<b>1 (4%)</b>	<b>1 (4%)</b>

**Table 9. Total Complications Observed in Each Group**

\* same patient in glue group and subcuticular suture group had purulent discharge and wound separation.



**Figure 5. Subtotal Thyroidectomy Glue Closure Immediate Post-Operative Period**



**Figure 6. Subtotal Thyroidectomy Glue Closure at the End of 3 Months**



**Figure 7. Subtotal Thyroidectomy Subcuticular Skin Closure at the end of 3 Months**

## DISCUSSION

Traditionally, needle skin suturing with suture material is the commonest method of surgical wound closure that is being practiced by surgeons because of its cost effectiveness. No doubt the cost consumed by suture material to close one unit of surgical incision is cheaper than the one consumed by adhesive glue.

But if we consider the other aspects like, frequency of postoperative wound care, the length of postoperative hospitalization and the number of postoperative consultations with the doctor which build up the cost of the procedure, it can be concluded that adhesives bring down the total cost of the surgical procedure.

In addition, nowadays surgeons are looking for faster, comfortable and cosmetically best technique for skin closure and this obviously has thrown attention on the adhesive glues like 2-octyl cyanoacrylate. 2-octyl cyanoacrylate provides a flexible, water resistant, sealed skin closure and also a needle free method of wound closure. This being a needle free method, guards against blood borne viral infections like HIV, HBV etc.

Further Cyanoacrylates have some antimicrobial properties and hence bandaging can be avoided which contributes to reduction of total cost of the procedure. Cyanoacrylates provide a water-resistant closure and hence patients can have the comfort of having showers in the postoperative period which is not available with skin suturing method of wound closure. Patients with glue closure do not need to come back for suture removal which is not the case with skin suturing method. Though suture removal is rarely painful, patients will have a high degree of anxiety for these procedures.

### Sex Ratio

In the present study the sex ratio M: F of the entire study population was 1.63:1. The sex ratios M:F for adhesive glue group was 1.5:1 and the same for the skin suturing group was 1.76:1. The sex ratio in Martin. S.F.'s<sup>14</sup> study was very close to the ratio of the present study. Anyway, the sex ratio is not thought to have any effect on the results as all the patients were randomly selected healthy adults.

### Wound Asepsis Score

The outcome of wound was assessed on 3rd, 5th and 7th Post-operative days using ASEPSIS score. Mean ASEPSIS score on 3rd day for Adhesive glue group was 0.28 whereas the same for Skin suturing group was 0.36 (P=0.7).

Mean ASEPSIS score on 5<sup>th</sup> day for Adhesive glue group was 0.12 and the same for skin suturing was 0.28(P=0.4) indicating a larger separation of the two means than on the 3<sup>rd</sup> day but statistically insignificant.

This difference in the mean ASEPSIS score can be attributed to:

- Suture materials facilitate microbial colonization and
- Adhesives glues have some antibacterial properties.

This finding is specially highlighted in comparative studies on contaminated lacerations. One such study by John M Howellet. al<sup>15</sup> concluded that contaminated wounds closed with Cyanoacrylate alone have significantly lower staphylococcal counts than lacerations containing suture material.

On day 7 there was one case of wound separation in each group and the mean ASEPSIS score for both the groups was the same 0.08. This finding of the present study is supported by earlier published studies by Singer A.J.<sup>9</sup> et al., which concluded that the infection rates at the end of one week after surgery were similar and fewer cases of Adhesive glue were erythematous.

They also concluded that there were no differences in wound dehiscence rates (Adhesive glue – 1.6% vs. suturing group 0.9% p = 0.35) and there was no difference in the percent of wounds with optimal appearance (Adhesive glue – 82% vs. suturing group 83% p = 0.67)

### Wound Cosmesis Score

Patients in both the groups were assessed for the cosmetic outcome of the wound on the 7th post-operative day, at the end of 1st month and at the end of 3rd month using Modified Hollander Cosmesis scale. Modified Hollander cosmesis scale has six variables and the absence of each variable in the wound gets 1 score. A score of 6 is considered optimal and a score of 5 and below is considered sub optimal.

On the 7<sup>th</sup> post-operative day the mean cosmesis score for the adhesive glue group was 5.84 and the same for the suturing group was 5.68(P=0.3). This numerical difference is in favour of Adhesive glue, but this difference was statistically not significant. At the end of one month the mean cosmesis score for the Adhesive glue group was 5.92 and the same for the suturing group was 5.68(P=0.1).

As compared to the 7<sup>th</sup> day mean values there is further numerical widening of the 1<sup>st</sup> month mean cosmesis scores. At the end of 3 months the mean cosmesis scores for the two groups were very close, as close as 6 for the Adhesive glue group and 5.96(P=0.36) for the skin suturing group. At this stage, even the numerical difference between the mean scores is not pleasing and can be ignored and concluded as similar outcome. In a study conducted by Jallali N. et al<sup>16,12</sup> showed no significant difference in cosmesis. Adam J. Singer et al. also concluded that there was no statistically significant difference in the cosmetic outcome between the two groups.

### Wound Complications

At the end of 7 days both adhesive glue group and skin suturing group ended up with one wound separation each.

On day 3 there were 2 seromas and 1 erythema in adhesive glue group and there were 3 seromas and 2 erythemas in subcuticular skin suturing group. Day 5 in the postoperative period, there were 1 seroma and 1 purulent exudates with wound separation in adhesive glue group and there were 2 seromas and 1 purulent exudates with wound separation in subcuticular skin suturing group.

At the end of the discussion it seems that Adhesive glue group had fewer complications, a smooth sailing towards a good cosmetic outcome. These findings when summed up with other advantages of adhesive glues like (i) they form a water-resistant barrier allowing the patients to have shower (ii) No need to apply bandage (iii)NO need for suture removal and (iv) Shorter hospital stay, make the adhesive glues a good alternative to skin suturing skin closure.



**Figure 8. Adhesive Glue Closure with Wound Separation on 7<sup>th</sup> Post-Operative Day**



**Figure 9. Subcuticular Skin Closure after 3 Months**



**Figure 10. Adhesive Glue Closure after 3 Months**

## CONCLUSION

Octyl cyanoacrylate provides an effective and reliable means of skin closure and yields similar cosmetic results as with subcuticular skin sutures. The incidence of infection and wound complications are comparable in both the groups. In addition, octyl cyanoacrylate provides certain practical

advantages to the patients. The advice as to which method is used for closure of wound may come down to economics and operator preference.

In conclusion the concept of using surgical tissue adhesives for superficial skin closure looks an attractive and a fast-emerging alternative to the use of sutures for both surgeons and patients. Octyl cyanoacrylate gives faster, comfortable and easier skin closure. So, octyl cyanoacrylate is effective and reliable skin closure in clean elective surgeries.

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