

Comparison of Wound Closure using Octylcyanoacrylate Tissue Adhesive versus Subcuticular Suture in Inguinal Hernia Surgery

Jay Prakash Singh¹, Vikas Kumar², Shekhar Upadhyaya³, N K Chaudhry⁴

¹Consultant, Department of General Surgery, PMH, Gaya, Bihar, ²Senior Resident, Department of General Surgery, Santosh Medical College, Ghaziabad, ³Ex Professor, Department of General Surgery, CMCH, Ludhiana, Punjab, ⁴Professor, Department of General Surgery, CMCH, Ludhiana, Punjab, India

Abstract

In our study, we have compared inguinal hernia skin closure with octylcyanoacrylate tissue adhesive and subcuticular suture with 4-0 Monocryl. We found that time required for closure is significantly less with using glue. Hospital stay is less in glue group compared to subcuticular group but not significant. Incidence of infection is more in subcuticular group. Cosmetic outcome of scar is equally good in glue as compared to sutures. Post op pain is less in glue group. Inguinal hernia is a common surgical problem and the usual treatment is Lichtenstein mesh hernioplasty. Wound closure is usually done by interrupted sutures, subcuticular sutures, or staples. Tissue adhesive octylcyanoacrylate is an alternative method for skin closure, which is a new generation long chain tissue adhesive. In this study, we will be comparing the outcome of tissue adhesive octylcyanoacrylate with subcuticular suture for closure of inguinal hernia surgery in adults in terms of time efficiency, cosmesis, pain, and wound complications.

Key words: Inguinal hernia, Octylcyanoacrylate tissue adhesive, Subcuticular suture

INTRODUCTION

Hernia is defined as a protrusion of viscus or a part of a viscus through an abnormal opening in the wall of its containing cavity. It is a common disease with lifetime risk of 27% for males and 3% for females.^[1] The external abdominal hernia is the most common form, out of which inguinal hernia accounts for more than 75% of the cases.^[2,3]

There are different types of techniques for the repair of inguinal hernia. The most commonly used technique for inguinal hernia is the Lichtenstein technique. Precise approximation of the skin incision with wound closure devices is critical for a favorable cosmetic and functional surgical result. The main focus of wound closure is to minimize tension on the wound and to bring the skin edges together in an everted orientation.

The ideal incision closure should be simple, effective, safe, rapid, inexpensive, painless, cosmetic, and bactericidal.^[4-6] Sutures, staples and adhesive tapes are the traditional methods of wound closure, while tissue adhesives have entered clinical practice more recently.^[7]

Recently, few studies have been conducted which have compared these various methods of closure. Application of sutures requires passage of foreign material through the skin, which is usually left in place for 5–10 days. If sutures are tied too tight or left in too long, they may leave permanent suture scars on tracts. If sutures are removed before adequate healing, the loss of tensile strength may result in wound dehiscence or a widened scar. Although suture removal usually causes minimal discomfort, the procedure is often associated with increased patient anxiety. Surgical glue is an option for sutureless wound closure, which will overcome these difficulties. The introduction of tissue adhesives heralded the era of suture free closures, which led to better results.^[8]

MATERIALS AND METHODS

This will be an 18 months prospective study conducted in the Department of General Surgery, Christian Medical

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Corresponding Author: Dr Vikas Kumar, Senior Resident, Department of General Surgery, Santosh Medical College, Ghaziabad.
E-mail: drvikassingh@gmail.com

College and Hospital, Ludhiana. The study will include all patients above 18 years of age undergoing elective inguinal hernia repair from October 1, 2012, to March 30, 2014. The patient will be randomized into two groups in a block of 2 and 4 by block randomization.

- Group-1. Those patients who will undergo closure of skin incision by subcuticular suture
- Group-2. Those patients who will undergo closure of skin incision by octylcyanoacrylate tissue adhesive.

A detailed history of each patient will be obtained, a thorough physical examination and local examination will be done.

Statistical Analysis

All data will be collected in individual patient protocols and analyzed using t-test and Chi-square test as a test of significance.

Informed Consent

All patients will be informed about the purpose of the study before enrolment and written consent will be taken.

Technique

All patients will receive pre-operative dose of antibiotic. Skin preparation by povidone-iodine scrub will be done the previous night and on the morning of the surgery. Hair removal by clippers will be done on the table. After reconstructing the posterior wall of the inguinal canal by mesh repair, external oblique aponeurosis is sutured with continuous sutures of 1.0 prolene and the subcutaneous fat with 3.0 Vicryl interrupted sutures. The skin will be closed by glue or subcuticular sutures based on randomization.

For Group-1

The subcuticular suture is a four-step method using 4.0 Monocryl suture. With the first step, the skin is gently everted using an Adson Forceps to visualize the dermal-epidermal junction. Step two consists of introducing the needle at a 90° angle at the dermal-epidermal junction and pronating the wrist to take a deep horizontal bite parallel to the skin surface. In step three, the needle is stabilized with the Adson Forceps, being mindful of not touching the tip, and advanced through the skin. In this step, it is important to emphasize that the Adson Forceps can be used more effectively by firmly gripping the needle at more of a right angle to it, allowing more contact and thus success with grasping the needle, without dulling the needle by manipulating the tip. Finally, in step four, while continuing to stabilize the needle with the Adson Forceps, the needle is replaced in the needle holder in the appropriate position for the next throw. It should be highlighted that in this step the operator should stabilize the hand holding the needle with the Adson Forceps on the patient's body close to the

area from the last throw while releasing and reloading with the needle holder, minimize the difficulty in reloading the needle holder in the correct position for the next throw.

For Group-2

After closing the subcutaneous layer, achieving proper hemostasis of the wound achieved. The two skin edges will be approximated with the help of forceps or skin hooks. Following this, using the glue applicator glue will be applied topically over the wound edges extending 5–10 mm beyond the incision. Initial layer applies act as a barrier, which minimize any heat dissipation to the tissue. There is a delay of 10–30 s between the two applications to prevent pooling of the glue. The wound edge will be held together for 60–90 s to allow the glue to polymerize, thus taking care that glue does not enter the wound. The time required for skin closure will be recorded using a stopwatch.

For both the groups, non-occlusive dressing will be given.

Postoperatively, the patients will receive one dose of antibiotic and injectable analgesics for 1 day. On the 2nd post-operative day, the patients will be started on oral analgesics. Patients will be evaluated postoperatively on the day of discharge for evidence of inflammation, infection, and wound gaping. The total hospital stay will be noted. Patients will be re-evaluated for infection/gaping/inflammation/cosmesis during follow-up on the 15th day, 1 month, and at 3 months.

The wounds will be evaluated according to the Hollander wound evaluation scale (HWES) by a senior surgeon who will be blinded to the method of closure.

The wound score will address six clinical variables.

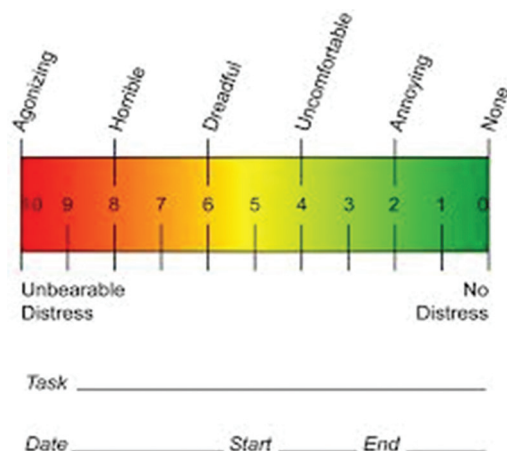
1. Step off borders (0 for yes, 1 for no)
2. Contour irregularities – puckering
3. Scar width – >2 mm
4. Inflammation – redness, discharge
5. Edge inversion – sinking, curling
6. Overall cosmetic appearance (0 = poor, 1 = acceptable).

Each of these categories is graded on 0 or 1 patient scale. A total cosmetic score is derived by the addition of scores of the six variables.

A score of six will be considered optimal, while five or less will suboptimal. The percentage of wounds from each group that attained cosmesis will be compared.

The visual analog scale (VAS) is presented as a 10-cm line, anchored by verbal descriptors, usually “no pain” and “worst imaginable pain”. The patient is asked to mark a 10-cm line to indicate pain intensity. The score is measured from the zero anchor to the patient's mark.

This score will be measured postoperatively at 0 h, 2 h, 6 h, 12 h, and 24 h. Pain from each group will be compared.



RESULTS AND ANALYSIS

A total of 30 cases satisfying the selection criteria were included in the study which was carried out at Christian Medical College and Hospital, Ludhiana, Punjab. The age of the patient above 18 years. Their relative proportion age is shown in the following table. Majority of patients were >50 years 25 patients (166.67%).

Table 1 shows the age of the patient above 18 years. Their relative proportion age is shown in the following table. Majority of patients were >50 years 25 patients (166.67%).

Table 2 shows that all samples were males.

Table 3 shows that out of 30 patients, 17 (113.33%) patients had direct hernia, 13 (73.33%) had indirect hernia, and 2 (13.33%) patients had pantaloon's hernia.

According to Table 4, 16 (53.33%) of 30 patient had right-sided hernia while 14 (46.66) had left-sided hernia.

Table 5 shows all patients (100%) underwent mesh plasty. Out of 30 patients, the glue was used for skin closure in 15 patients and subcuticular sutures for skin closure in 15 patients.

Table 6 shows that average time of 141 s was taken for closure of incision with glue. An average time of 572 s was taken for closure of incision with subcuticular suture. The difference between the groups in closure time was statistically significant ($P < 0.001$).

Table 7 at post-operative 0 h follow-up; all patients in both group had no pain.

Table 8 at post-operative 2 h follow-up, 15 patients had mild pain in glue group, but 5 and 10 patients had mild and moderate pain, respectively, in the subcuticular group, which was significant.

Table 9 at post-operative 6 h follow-up, 6 and 9 patients had no and mild pain, respectively, in glue group, but 2, 12, and 1 patients had no, mild, and moderate pain, respectively, in the subcuticular group, which was not significant ($P = 0.18$).

Table 10 at post-operative 12 h follow-up, 11 and 4 patients had no and mild pain in glue group, but in subcuticular

Table 1: Age group

Age group	Glue (%)	Suture (%)	Total (%)	P value
18–30	1 (6.67)	0 (0.00)	1 (6.67)	0.499
31–40	0 (0.00)	1 (6.67)	1 (6.67)	
41–50	2 (13.33)	1 (6.67)	3 (20.00)	
>50	12 (80.00)	13 (86.67)	25 (166.67)	
Total	15 (100.00)	15 (100.00)	30 (200.00)	

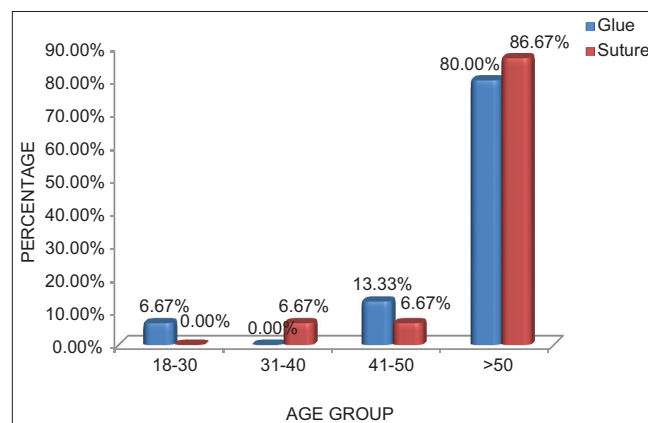


Table 2: Sex

Sex	Glue (%)	Suture (%)	Total (%)
Male	15 (100.00)	15 (100.00)	30 (200.00)
Total	15 (100.00)	15 (100.00)	30 (200.00)

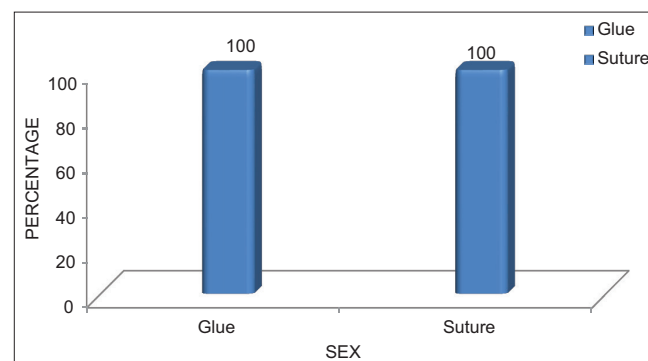
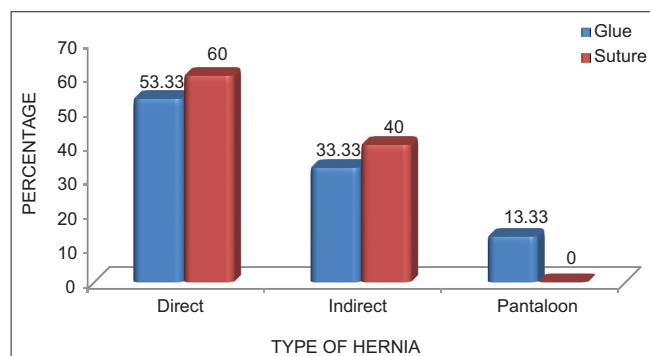
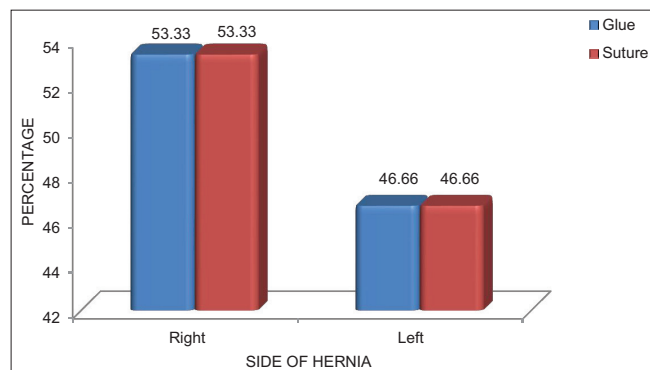


Table 3: Type of hernia

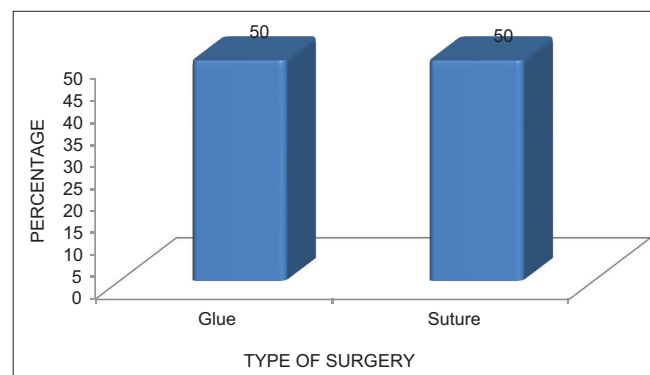
Type of hernia	Glue (%)	Suture (%)	Total (%)	P value
Direct	8 (53.33)	9 (60.00)	17 (113.33)	0.341
Indirect	5 (33.33)	6 (40.00)	11 (73.33)	
Pantaloon	2 (13.33)	0 (0.00)	2 (13.33)	
Total	15 (100.00)	15 (100.00)	30 (200.00)	

**Table 4: Side of hernia**

Side of hernia	Glue (%)	Suture (%)	Total
Right	8 (53.33)	8 (53.33)	16
Left	7 (46.66)	7 (46.66)	14
Total	15	15	30

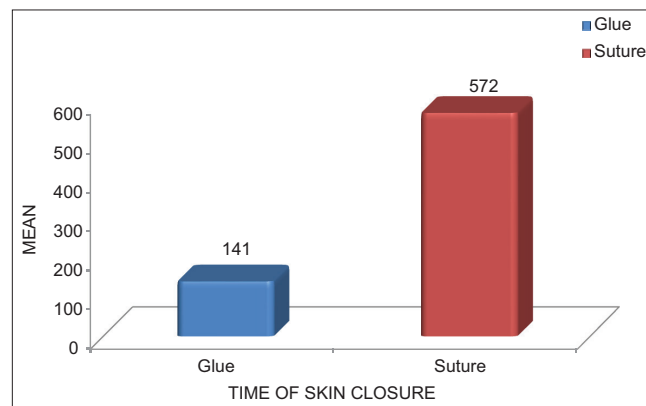
**Table 5: Surgery**

Type of surgery	Glue (%)	Suture (%)	Total
Mesh plasty	15 (50)	15 (50)	30

**Table 6: Time of skin closure**

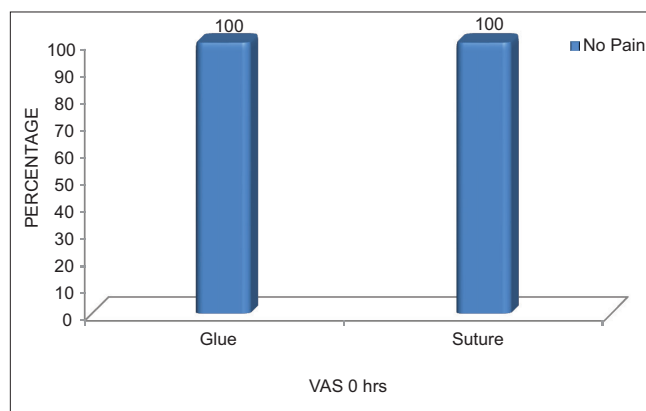
Skin closure	Mean±SD	Median	Min-Max	P value
Glue	141±9.67	140	130–165	<0.001
Suture	572±22.42	570	540–600	

SD: Standard deviation

**Table 7: VAS 0 h**

VAS	Glue (%)	Suture (%)	Total (%)
VAS 0 h No pain	15 (100.00)	15 (100.00)	30 (200.00)
Total	15 (100.00)	15 (100.00)	30 (200.00)

VAS: Visual analog scale



group, it was 2 and 13 patients, respectively, which was significant ($P = 0.003$).

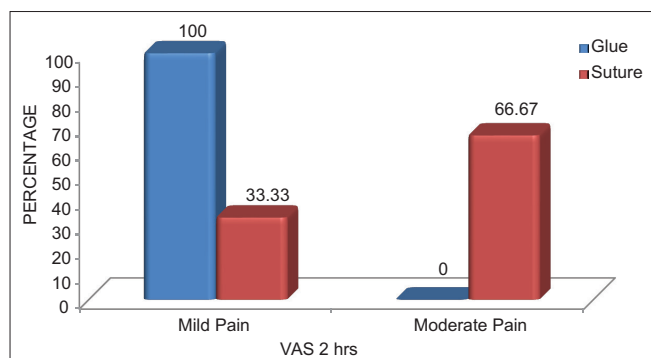
Table 11 at post-operative 24 h follow-up, 8 and 7 patients had no and mild pain in glue group, but in subcuticular group, it was 6 and 9 patients, respectively, which was not significant ($P = 0.715$).

Table 12 shows that mean VAS score at post-operative 0 h was zero in both groups. After that, all follow-up re-evaluation of mean VAS score in the glue group was less than the subcuticular group. At 2 h and 12 h follow-up, the mean VAS score of glue group was statistically significant compared to the subcuticular group.

Table 8: VAS 2 h

VAS 2 h	Glue (%)	Suture (%)	Total (%)	P value
Mild pain	15 (100.00)	5 (33.33)	20 (133.33)	<0.001
Moderate pain	0 (0.00)	10 (66.67)	10 (66.67)	
Total	15 (100.00)	15 (100.00)	30 (200.00)	

VAS: Visual analog scale

**Table 9: VAS 6 h**

VAS 6 h	Glue (%)	Suture (%)	Total (%)	P value
Mild pain	9 (60.00)	12 (80.00)	21 (140.00)	0.18
Moderate pain	0 (0.00)	1 (6.67)	1 (6.67)	
No pain	6 (40.00)	2 (13.33)	8 (53.33)	
Total	15 (100.00)	15 (100.00)	30 (200.00)	

VAS: Visual analog scale

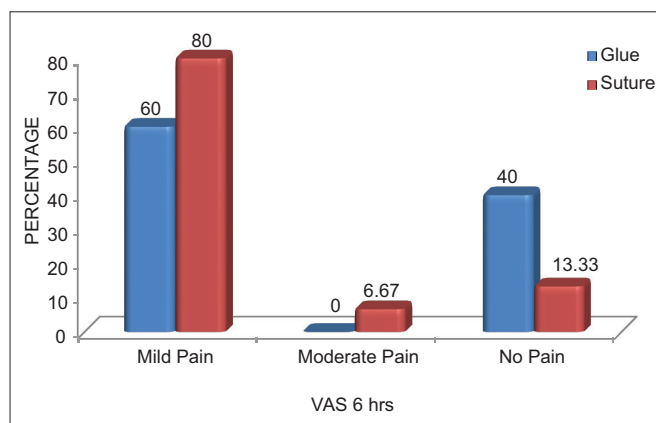


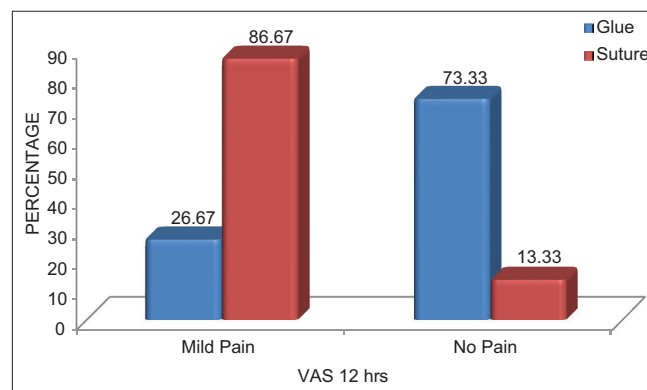
Table 13 shows that out of 30 patients, 29 (93.33%) patients had no complications and 1 (3.33%) patient developed a wound infection. In subcuticular group total, 1 (3.33%) patient developed post-operative complication, all of which had wound infection. There was no complication in the glue group. Prevalence of wound infection though more common in the subcuticular group was not statistically significant ($P = 1$).

Table 14 shows that HWES: In the glue group, 11 (73.33%) patients have an optimal score of six while 4 (26.67%) patients had ≤ 5 . In the subcuticular group, 7 (46.67%) had a score of six,

Table 10: VAS 12 h

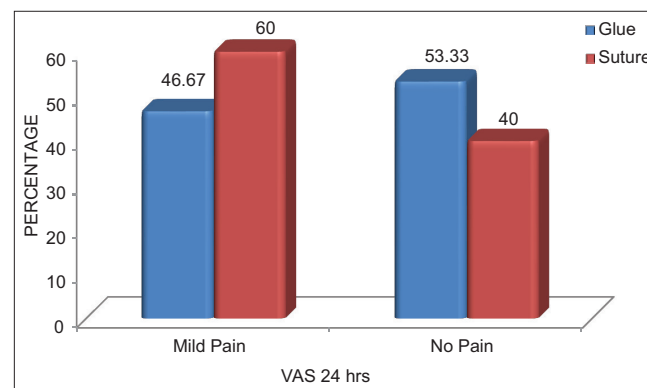
VAS 12 h	Glue (%)	Suture (%)	Total (%)	P value
Mild Pain	4 (26.67)	13 (86.67)	17 (113.33)	0.003
No Pain	11 (73.33)	2 (13.33)	13 (86.67)	
Total	15 (100.00)	15 (100.00)	30 (200.00)	

VAS: Visual analog scale

**Table 11: VAS 24 h**

VAS 24 h	Glue (%)	Suture (%)	Total (%)	P value
Mild pain	7 (46.67)	9 (60.00)	16 (106.67)	0.715
No pain	8 (53.33)	6 (40.00)	14 (93.33)	
Total	15 (100.00)	15 (100.00)	30 (200.00)	

VAS: Visual analog scale



while 8 (53.33%) had a score of ≤ 5 . Even though the difference between 2 groups is present, it is not significant ($P = 0.264$).

Table 15 shows, most of the patients of both groups were discharged on hospital day 4 after first wound evaluation. Average hospital day of patients in the glue group was 4.47 ± 2.1 .

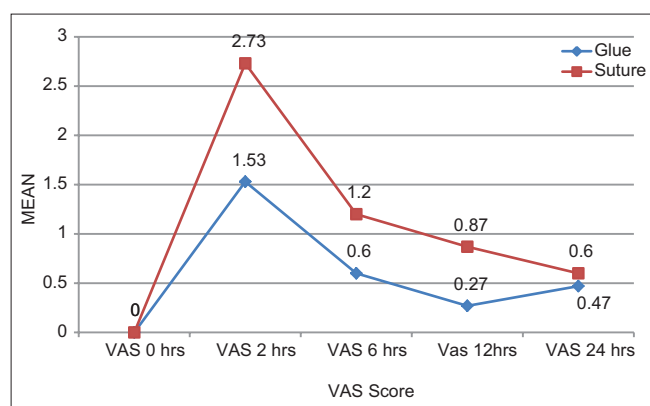
One patient in subcuticular group had wound infection and was discharged on 8th post-operative day. Average hospital day of patients in the subcuticular group was 5.13 ± 2.23 .

Difference of hospital stay between the two groups was statistically not significant ($P = 0.401$).

Table 12: VAS score

VAS SCORE (h)	Glue			Suture			P value
	Mean±SD	Median	Min-max	Mean±SD	Median	Min-Max	
VAS 0	0±0	0	0-0	0±0	0	0-0	-
VAS 2	1.53±0.52	2	1-2	2.73±0.59	3	2-4	<0.001
VAS 6	0.6±0.51	1	0-1	1.2±0.77	1	0-3	0.018
Vas 12	0.27±0.46	0	0-1	0.87±0.35	1	0-1	<0.001
VAS 24	0.47±0.52	0	0-1	0.6±0.51	1	0-1	0.481

SD: Standard deviation, VAS: Visual analog scale

**Table 13: Wound complications**

Wound complications	Glue (%)	Suture (%)	Total (%)	P value
Infection	0 (0.00)	1 (6.67)	1 (6.67)	1
No complications	15 (100.00)	14 (93.33)	29 (193.33)	
Total	15 (100.00)	15 (100.00)	30 (200.00)	

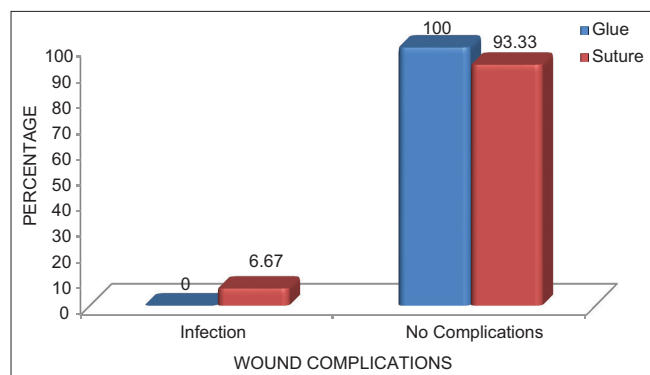


Table 16 cost factors, the cost of glue was RS 450.00 while that of suture was RS 370.00.

DISCUSSION

Proper healing of incisions/wounds so as to restore the structural integrity and strength of the wound has always been the most important factor on surgeon's mind.

With the advent of modern surgical technology and improvement in surgical skills, use of newer and higher

antibiotics, maintaining high level of surgical asepsis thus decreasing the incidence of wound complications, the onus is now on obtaining good cosmetic scar.

There are many factors, which affect the cosmetic outcome of scars.

Among the local factors, surgical skill and type of material used to close the incisions are of much importance.

Conventionally, low-tension skin incisions like groin incisions have been closed by subcuticular sutures (continuous) with absorbable (polydioxane) or non-absorbable materials (Polypropylene/nylon).

The advantage that the absorbable suture material has over the nonabsorbable material is the avoidance of suture removal, which may be slightly painful for the patient. However, the problem associated with it is that this material is not easy to insert in the subcuticular region as compared to polypropylene.

Again it lies at the discretion of the surgeon as to what material to be used.

The problem associated with suturing of the wound is as follows:

- Needlestick injuries to the surgeon
- Stitch abscess may develop
- Injury to the blood vessels in the skin resulting in hematoma.

Other alternative for skin closure is cyanoacrylate glue.

Numerous clinical reports have shown that N-butyl cyanoacrylate can be used as a successful alternative to sutures for topical skin closure of low-tension incisions.

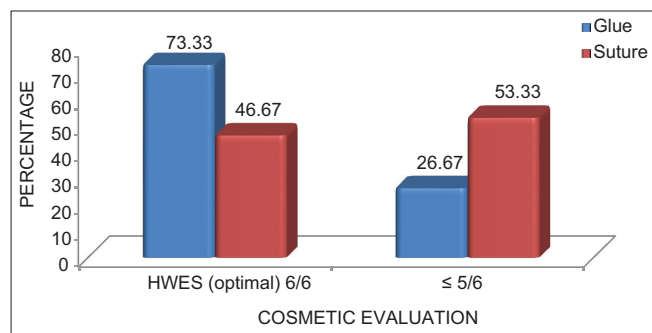
In the present study, 30 patients undergoing inguinal hernia repair were included and studied. Fifteen cases underwent skin closure in N-butyl cyanoacrylate glue while 15 cases underwent skin closure with subcuticular sutures by polypropylene (prolene 2-0)

The comparison of these two groups was done in relation to

Table 14: Cosmetic evaluation

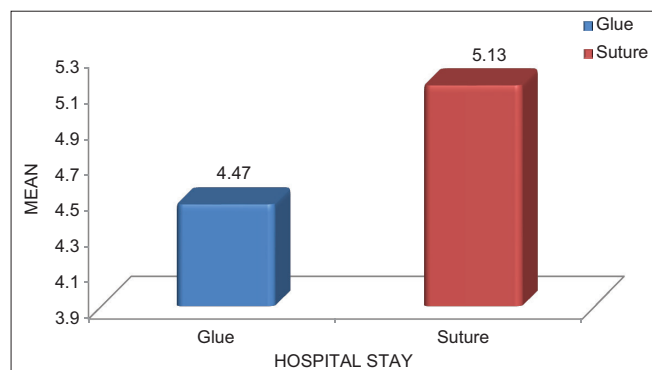
Cosmetic evaluation	Glue (%)	Suture (%)	Total	P value
HWES (optimal) 6/6	11 (73.33)	7 (46.67)	18 (120.00)	0.264
≤5/6	4 (26.67)	8 (53.33)	12 (80.00)	
Total	15 (100.00)	15 (100.00)	30 (200.00)	

HWES: Hollander wound evaluation scale

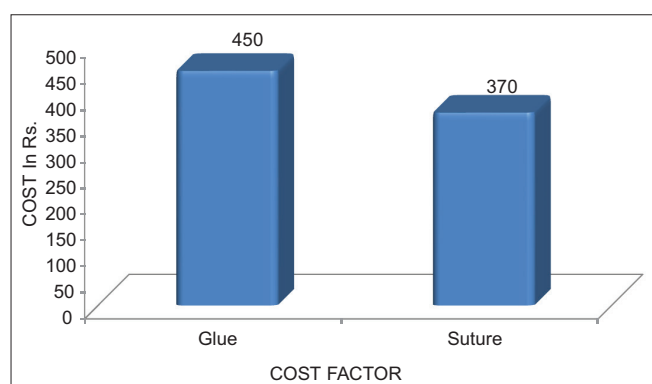
**Table 15: Hospital stay**

Skin closure	Mean±SD	Median	Min-max	P value
Glue	4.47±2.1	4	3–11	0.407
Suture	5.13±2.23	4	3–12	

SD: Standard deviation

**Table 16: Cost factor**

Price	Glue	Suture	P value
Cost	450.00	370.00	<0.001



1. Time taken for closure
2. Post-operative complications
3. Cosmetic outcome.

All the patients were males and were between the age group above 18-year direct hernia (17) was more common than indirect (11) and pantaloon hernia (2).

Time Taken

The time taken glue closure was 140 s (average) which was significantly less than the time taken for the subcuticular group, which was 570 s (average) $P = (0.001)$.

The average length of incision was 5–7 cm in the glue group, after approximating the edges with skin hooks, glue was applied topically over the edges.

Thus, according to the literature, longer the incision greater is the difference between the two groups.

Toruimi *et al.* took 55 s for closure of lacerations with glue and 235 s for sutures with the difference being significant ($P < 0.0001$)

CCP ONG *et al.* did not find any time difference between skin closure of pediatric herniotomies with glue meantime (181 s) and subcuticular sutures (161 s) $P = 0.18$. This may be because the herniotomy incision was small in length about 2–3 cm. As the incision length increases, the time difference between the two groups also increases.

Bruns conducted a trial for the closure of lacerations in children's emergency department in 1995 and concluded that there was a significant time difference between glue application and suturing with glue needing lesser time for closure.

Wound Complications

Wound complications are as follows:

1. Inflammation
2. Wound infection
3. Wound gape.

Out of 30 patients, 29 (93.33%) patients had no complications and 1 (6.67%) patient developed a wound infection.

In subcuticular group total, 1 (6.67%) patient developed post-operative complication, all of which had wound infection. There was no complication in glue group. Prevalence of wound infection though more common in the subcuticular group was not statistically significant ($P = 1$).

Infection of wound is the presence of serosanguinous discharge or frank pus from incision site, which was present in 1 (6.67%) in subcuticular group.

It is known that octylcyanoacrylate glue has antibacterial properties Quinn 1995 has shown the antibacterial property of glue in a contaminated wound model.

The exact mechanism of antibacterial property is not known, but it is likely to be a cell wall mechanism because the sensitivities are restricted to Gram-positive organisms. Gram-negative organisms are relatively less affected.

All these patients with wound infection were treated conservatively. Patients were discharged in 8–9 days. All patients were evaluated during follow-up on the 15th day, 1 month, and 3 months. No evidence of complication presents.

As octylcyanoacrylate glue causes mild histotoxicity to the vascularized tissue, this histotoxicity may be the cause of mild inflammation seen patients in glue group. This may be due to leakage of glue within the tissues. This histotoxicity may be the cause of mild inflammation seen in patients in the glue group. This may be due to leakage of glue into the tissues. However, in our study, there was no wound complication such as inflammation and wound infection.

Toruimi *et al.* did not find any evidence of gaping in both groups of glue and sutures for laceration repair. Amiel *et al.* found that post-operative complications following glue usage in pediatric herniotomies as follows: Inflammation in 5.5%, wound dehiscence in 1.1%, and wound infection 1.9%.

Hospital Stay

Most of the patients of both groups were discharge on hospital day 4 after 1st wound evaluation.

Average hospital day of patients in glue group was 4.47 ± 2.1 .

One patient in in subcuticular group had wound infection was discharge on 8th post-operative day. Average hospital day of patients in the subcuticular group was 5.13 ± 2.23 .

The difference of hospital stay between the two groups was statistically not significant ($P = 0.401$).

Cosmesis

All patients were called for follow-up after 3 months when photographs were taken of the scar for cosmetic evaluation. Photographs were evaluated by a senior surgeon who has blinded the method of closure.

Cosmetic outcome was evaluated on HWES it has been proved that 3-month follow-up evaluation provides a good measure of long-term cosmetic outcome.

HWES evaluation showed comparable results with no significant difference between the two groups ($P = 0.264$) at 3 months follow-up. Our finding is similar to other studies in literature.

CCP ONG *et al.* compared tissue glue versus subcuticular suture for pediatric herniotomies and concluded that tissue glue is easy and safe, with no complications and results equality good cosmesis.

Simon *et al.* found that cyanoacrylate is an ideal alternative to conventional suturing for the cutaneous closure of low tension lacerations in children with long-term cosmetic outcome comparable to conventional sutures.

Keng *et al.* found that glued wounds had consistently better cosmesis mean score (4.7) than sutures (4) ($P < 0.5$) at 4 weeks follow-up for groin incisions.

Toruimi *et al.* also found no significant difference between the two groups, glue and sutures in closure of skin incisions of facial plastic surgery.

Pain VAS Score

Mean VAS score at post-operative 0 h was zero in both groups. After that, all follow-up re-evaluations of mean VAS score in glue group were less than the subcuticular group. At 2 h and 12 h follow-up, the mean VAS score of glue group was statistically significant compared to the subcuticular group.

In our study, at all follow-up re-evaluation of pain was less in glue group as compared to the subcuticular group.

Toruimi *et al.* found no significant difference in VAS between the two groups, glue and subcuticular suture in closure of skin incision of facial plastic surgery.

Cost Factor

An incision of 5–6 cm requires about (0.25-ml), i.e., one ampoule of glue. Each ampoule of glue costs Rs. 450.00 while a single 4-0 Monocryl suture costs Rs. 370.00. We have used new suture material for every patient discarding the used suture. Ever though the cost of glue per patient is more than

suture, the cost of follow-up and suture removal has not been taken into consideration. Thus, we conclude that even though the cost of glue is more than suture, the overall cost of the suture group will be more or less equal to the glue group.

Limitation of Study

Our sample size was less; we have studied only 30 patients of inguinal hernia. Long-term follow-up that is 1 year for cosmetic evaluation could not be achieved.

Tissue adhesives are more convenient for patients and practitioners than sutures or staples. They fall off spontaneously in 5–10 days and do not require a return visit for their removal. However, patients should be cautioned about frequent exposure to moisture and use of any topical ointments or creams that may result in premature sloughing of the tissue adhesive.

Use of tissue adhesives avoids unnecessary needle stick injuries with sutures. In addition, tissue adhesives also have antimicrobial properties, especially against Gram-positive organisms that are responsible for most wound infections.

SUMMARY

Surgeons have become aware of the patient's need for the minimal and esthetic scar. With an increase in the control of wound infections, the onus is now on the cosmetic appearance of wound scar.

Several methods of skin closure are available to close the skin incisions in place of sutures such as staples, clips, steri-strips, and glue adhesives.

In our study, we have compared inguinal hernia skin closure with octylcyanoacrylate tissue adhesive and subcuticular suture with 4–0 Monocryl.

We found that,

1. Time required for closure is significantly less with using glue
2. Hospital stay is less in glue group compared to subcuticular group but not significant

3. Incidence of infection is more in the subcuticular group
4. Cosmetic outcome of the scar is equally good in glue as compared to sutures
5. Post-operative pain is less in glue group.

Hence, we conclude that use of glue in low tension incisions is easy, time-saving, less post-operative pain with good cosmetic outcome, low incidence of complications and equally cost effective as sutures and thus recommend its use in surgical practice.

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