

# Use of skin glue versus traditional wound closure in shunt surgery in young children, incidence of local wound complication: a prospective study

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## Abstract

Ever since shunt surgeries are done for management of hydrocephalus, local wound complications has been the its part and parcel. Many efforts had been done to reduce the complication rate.

**Keywords:** CSF, VP shunt, cyanoacrylate glue.

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## INTRODUCTION

As far as shunt surgeries for hydrocephalus are concerned shunt infections are still one of the most important complications. On closer inspection they have to be separated into primary and secondary infections. The later are caused due to wound dehiscence and/or CSF leakage from subcutaneous CSF accumulation along fibers of sutures (wick-effect). Additionally sutures may introduce bacteria from skin into the wound via punctures of the skin that generate migration path through the skin. Shunt catheters and sutures which are eventually in direct contact with each other in subcutaneous tissue, exponentially increase the risk of shunt infection. Here glue found to have upper hand over conventional sutures. Application of glue involves no suture removal, less time required for application, less surgical instrumentation necessary and no foreign body such as sutures and staples within the wound which can increase the risk of infection.

Moreover cyanoacrylate glue seems to exhibit bactericidal activity against gram positive organisms. Postoperative wound infection is well recognized complication in surgical procedures. Recent studies suggest that the use of octyl cyanoacrylate tissue adhesive for incisional surgical wounds results in cosmetic outcome comparable to that achieved by conventional sutures. Cyanoacrylate discovered by Dr. Harry Coover<sup>2-4</sup> and Fred Joyner in Kodak Laboratory described its adhesive properties and suggested its possible use as surgical adhesive in 1960. Since the introduction of this adhesive in surgery, short chained cyanoacrylate has been used for decades for skin closure with good asthetic results but reactions were often induced by the glues in the bodies. The new long chained octyl-2-cyanoacrylate (Dermabond) further improved 3 dimensional breaking strength to 3 times higher than that of butyl-2-cyanoacrylate. These adhesives are solvent free, liquid monomers and work by polymerization (require 45 – 90 seconds) in an exothermic reaction when contacting a fluid or basic medium thereby forming a strong, flexible and impermeable bond when applied to moist skin. It was approved by FDA both for its closure of superficial skin lacerations and also as a barrier to microbes causing infections<sup>1-9-11</sup>. Also cosmesis of the wound sealed with glue was better.<sup>12,13</sup> We plan to do prospective study and compare the incidence of local wound complications in VP shunt surgery in two groups. In one group closure of skin with glue and in other group with traditional skin sutures.

## CASE REPORT

We studied and compared the incidence of local wound complications in ventriculoperitoneal shunt surgery in two groups. In one group with skin glue closure and in other group with traditional skin closure for the period from August 2012 to August 2014. We made two groups of patients (30 patients each) consisting of young children, age below 5 years, who are undergoing shunt surgery.

**GROUP I:** We used skin glue for skin closure i.e. subcutaneous layer with 3-0 polyglycolic acid suture and skin

closure with skin glue.

**GROUP II:** We used traditional skin closure technique i.e. subcutaneous layer with 3-0 polyglycolic acid suture and skin closure with 3-0 monofilament polyamide suture. We inspected the wound on day 4, day 7, day 10 and at the end of one month postoperatively for any wound complication like infection, dehiscence or CSF leak. We inspected shunt tract everyday for erythema and signs of skin infection. We compared the incidence of local wound complications in these two groups. We excluded patients who had systemic infections, local skin infection and Immuno compromised host.



**Figure 1:** Skin incision closure with skin glue



**Figure 2:** Scalp incision on pod 4 in glue group



**Figure 3:** Scalp incision on pod 7 in glue group



**Figure 4:** Scalp incision on pod 10 in glue group



**Figure 5:** Scalp incision after 1 month post-op in glue group



**Figure 6:** Wound dehiscence in glue group



**Figure 7:** Wound dehiscence in suture group



**Figure 8:** CSF leak on pod 1 in glue group



**Figure 9:** Cosmesis after 1 month in glue group



**Figure 10:** Cosmesis after 1 month in suture group

### AIMS AND OBJECTIVES

To study and compare the incidence of the local wound complication in VP shunt surgery by using either skin glue or traditional wound closure in young children.

### OBSERVATION AND RESULTS

**Table 1:** Sex Distribution

Patients	Skin Closure With Skin Glue	Skin Closure With Sutures
Male	14	15
Female	16	15
<b>Total</b>	<b>30</b>	<b>30</b>

**Table 2:** Age distribution

	No. Of Patient of Age < 3months	No. Of Patient Between Age 3 months – 5 yrs
GLUE GROUP	18	12
SUTURE GROUP	19	11

**Table 3:** Local complications

Complications	Group I (skin closure with skin glue)	Group II (skin closure with skin sutures)
Local infection	2	3
Skin necrosis	0	1
Dehiscence of wound	2	3
Neurological worsening	0	0
CSF leak	1	2
Local infection leading to septicemia	0	0
Erythema along shunt track	1	1

We studied the incidence of complications in both the groups. In Group I patients, two patients had local skin infection on POD 3 ; wound dehiscence on POD 5 and POD 4 in two patients ; no patient had local skin necrosis and one had CSF leak through scalp incision on POD 1 and one patient had erythema along shunt track. Similarly in Group II patients, three patients had local skin infection on POD 3 of which three proceeded to wound dehiscence on POD 6; one patient had local skin necrosis, two patients had CSF leak through scalp incision on POD1 and one patient had erythema along shunt track No patients were encountered with local infection leading to septicemia or Neurological worsening. Here ‘z test for difference between two proportions’ was applied individually for every complication. For local skin infection in both groups z value came out to be 0.46; and p value came out to be >0.05 implying that the difference

of local complications in both the groups was not statistically significant. Similarly for wound dehiscence z value came out to be 0.46 and p value >0.05. Also for skin necrosis z value was found to be 1 and p value=>0.05. For CSF leak z value came out to be 0.59 and p value = > 0.05. For erythema along shunt track z value was zero. Inferring from all this statistical calculation, difference was not

### STATISTICALLY SIGNIFICANT

Skin glue used for the study cost Rs.800 and the polyamide suture material used cost Rs. 400. Patients were kept hospitalised for 5 days till the doses of i.v. antibiotics was completed and were later discharged as per their convenience. Some patients who suffered local wound complications were kept until they recovered from the complication and later were discharged. Local

wound culture sent from the infected wound of Group I patients was reported to be “no growth” and that from Group II patients was found to have *Staphylococcus aureus*. Cosmesis was better in patients which had skin closure with skin glue.

## DISCUSSION

This adhesive has been shown to save time during wound repair, to provide a flexible water-resistant protective coating and to eliminate the need for suture removal. The long-term cosmetic outcome with cyanoacrylate is comparable to that of traditional methods of repair. Best suited for small, superficial lacerations, it may also be used with confidence on larger wounds where subcutaneous sutures are needed. This adhesive is relatively easy to use following appropriate wound preparation. Patients, especially children, readily accept the idea of being “glued” over traditional methods of repair. Randomized controlled clinical trials by Thomas B. Bruns et. al.<sup>4-9-15</sup> have shown that infection rates are not significantly different between wounds that have been sutured and wounds that have been closed with cyanoacrylate. However, if adequate wound cleansing and preparation are compromised because of the ease of use of a tissue adhesive, an increase in infection rates could occur. We followed proper technique of glue application like; giving saline wash, closing subcutaneous layer first, approximating wound edges thoroughly that too without any tension, applying almost 3 layers of glue and waiting for a minute or two for glue to dry with dry sterile dressing to follow. In our study sex distribution was comparable and similar in both the groups. Glue group had 14 male and 16 female patients which underwent skin closure with skin glue. Suture group had 15 male and 15 female patients which had their skin closure with skin sutures. (Observation table no. 1) It was found that, age wise, 18 patients were less than 3 months age and 12 patients were between age group from 3 months to 5 yrs in Glue group. Similarly 19 patients were below 3 months age and 11 patients were between 3 months to 5 yrs age in Suture group. Average age of the patients for Glue group was found to be 6.4 months and that for Suture group patients was 5.7 months. (Observation table no. 2) We observed the patients in both the study groups for local wound complications like local skin infection, wound dehiscence, CSF leak, local skin necrosis, erythema along shunt track, septicemia and neurological worsening. We found out that:

### In Glue Group patients

Two patients had local skin infection on POD 3; one patient was 60 days and other was of 10 days old. Two wound dehiscence on POD 5 in patient of age 51 days and on POD 4 in other patient of age 90 days; No patient

had local skin necrosis A 1 day old patient had CSF leak through scalp incision on POD 1 and A 60 days old patient had erythema along shunt track.

### In Suture Group patients

Three patients had local skin infection on POD 3. Three patients had wound dehiscence on POD 6; One patient had local skin necrosis, Two patients had CSF leak through scalp incision on POD1. One patient had erythema along shunt track. No patients were encountered with local infection leading to septicemia or neurological worsening. Local skin infection and erythema along shunt track was treated with intravenous antibiotics and local wound care. Wound dehiscence was treated with regular cleaning and dressing and resuturing. We found difference in the rate of local wound complications. (Observation table no. 3) Wound dehiscence in Glue group was seen in 2 patients whereas in Suture group 3 patients suffered wound dehiscence. (z value = 0.46, p value > 0.05). Local wound infection was found in 2 patients in Glue group and in 3 patients in Suture group (z value = 0.46, p value > 0.05). Skin necrosis was seen only in Suture group. One patient suffered from skin necrosis in Suture group and none of the patients from Glue group suffered this complication. (z value = 1, p value =>0.05). CSF leak was seen in only one patient from Glue group, on the other hand 2 patients from Suture group had CSF leak (z value = 0.59, p value = >0.05) Erythema along the shunt track was noted in single patient in both Glue group and Suture group (z value = 0). This showed that relatively less number of patients of Glue Group had local wound complications as compared to Suture Group, though this difference was not statistically significant as p value was > 0.05 in all the observed complications. In sutured wounds the fibers act as a wick. Serous fluid of the subcutaneous tissue and CSF that gathers around the catheter is transported to the top of the skin along the skin sutures and needle prick site. Moving in the opposite direction, bacteria of the normal skin can negotiate through the whole layer of the skin into the subcutaneous tissue. They may migrate on the surface of the shunt catheter through the epithelizing stitches within days. Also wound healing of the skin provides especially challenging circumstances, due to foreign body (shunt catheter) beneath the cutis that is eventually surrounded by small film of fibrinolytic CSF. It is particularly advantageous in these cases to close the upper layer of the skin with tissue adhesive<sup>94</sup>. Thus application of tissue adhesive eliminates the need for the deep skin sutures. Notably the local wound complications that occurred in the Glue Group patients belong to age group below 3 months as compared to the patients of Suture Group in which these complications was found to be distributed over a wide range of age.

**Cost**

Cyanoacrylate tissue adhesive costs approximately Rs.800-900 a ampule (0.5 ml per ampule), with a shelf-life of two years. Sutures commonly used in the ambulatory care setting generally cost about Rs. 300-400 per package. Tissue adhesive requires no suture removal or follow-up visit. Unless a complication develops, wounds closed with tissue adhesive need not be seen again. A study done by Regina Eymann and Michael Kiefer<sup>7</sup> in 90 pediatric age group patients having hydrocephalus and who underwent VP shunt; 44 children in whom final skin closure was performed by skin glue and remaining 46 children had skin closure with suturing. In this study they found a significant difference in the rate wound dehiscence as well as consecutive local skin infection rate, which were both worse in the suturing group. In the glue group there was one dehiscence (2%) of the wound and local wound infection rate was not found. In contrast to the low rate of wound healing complications in the glue group, 24% of the children in the suturing group showed CSF or serous fluid flow

through the stitches to the surface of the skin and the secondary wound dehiscence. This study done by Regina and Michael inferred that the wound dehiscence rate was reduced from 24% to 2 % and the local infection rate was reduced from 17% to 0% when glue was used to close the skin instead of sutures. They reasoned that it was due to extermination of the “wick-effect” along filament used to close the skin. Our study seems to follow similar trend as that of the study done by Regina and Michael but it failed to show statistical significance. Our study have greater local complication rate than that of study by Regina and Michael with respect to glue closure of the skin. This might be due to the fact that in our study average age group of the patients was 6.4 months less than that of the study done by Regina and Michael, whose average age of study group was 7.5 months; also all of the complications that occurred in our Glue group were found to be in the age below 3 months making us to rethink, if it was because of very delicate skin or young age of the patients. which did not offer adequate support for the glue to help normal healing of the skin incision.

Local wound complications	Our Study(%of patients)		Regina Eymann and Michael Kiefer Study (%of patients)	
	Glue Group	Suture Group	Glue Group	Suture Group
Wound dehiscence	6.67	10	2	24
Local infection	6.67	10	0	17
CSF leak	3.33	6.67	0	24

Whenever any of our patient had local wound infection or any local wound complication, we collected culture samples using sterile technique. We cultured wound of all the patients who had local wound infection. It showed that local wound culture did not have any growth of organism in Group of patients who undergone skin closure with glue. On the contrary Group of patients who had skin closure with sutures had their wound cultures positive for Staphylococcus aureus ; implying that glue might be having bactericidal effect. In the study done by Regina Eymann and Michael Kiefer, a few of the patients of the suture group who suffered local wound complications progressed to systemic infection or ventriculitis or nephritis or development of seizures and intra-peritoneal cyst.<sup>14</sup> We were fortunate that none of our Glue group and Suture Group patients which suffered local wound complication proceeded to systemic infection or ventriculitis or nephritis or development of seizures and intra-peritoneal cyst. Complications were relatively less in patients in which skin glue was used for skin closure than that patients which underwent skin closure with traditional skin suturing, but the difference was not statistically significant. Also there was pooling of complications in the age group less than 3 months in Glue group . For this reason we feel that a study with bigger sample size is required to affirm the findings.

**SUMMARY**

In our comparative study, we had compared local wound complication in 60 patients having diagnosed hydrocephalus and requiring VP shunt surgery in the age group below 5 years. We divided the patients in two groups. Glue Group in whom skin closure was done with application of skin glue and Suture Group in whom skin closure was done with traditional skin suturing. Each of the group had 30 patients. A few of our patient suffered local wound complications.

- a. **Local wound infection:** seen in 2 patients in Glue group and 3 patients in Suture group.
- b. **CSF leak :** seen in one patient in Glue group and 2 patients in Suture group
- c. **Wound dehiscence :** seen in 2 patients in Glue group and 3 patients in Suture group
- d. **Local skin necrosis :** seen in one patient in Suture group but none in Glue group
- e. **Erythema along shunt track:** seen in one patient each in both the study groups.

But none of them progressed to septicemia or had succumbed. All the local complications got corrected by appropriate treatment. Patients who undergone skin closure with the glue suffered less local wound complications as compared to the patients who had skin

closure with sutures. However the difference was not found to be statistically significant. Moreover, all the complications which Glue Group had, was found to be distributed in the age less than 3 months as compared to Suture Group patients which had their complications distributed over a wide range of age; necessitating the need to rethink, if it was because of very delicate skin or relatively young age of the patient that glue did not supported the skin to heal normally. Local wound culture was reported to be 'no growth' in the Glue Group patients, whereas patients of Suture Group had their local wound cultures positive for *Staphylococcus aureus*; depicting bactericidal activity of the tissue glue. Cost of the skin glue was more than that of the skin sutures used to close the skin incision in VP shunt surgery. The hospital stay was similar in both the groups. Parents seemed to be more worried about suture removal postoperatively in Suture Group patients showing that emotional burden continued till the day of suture removal. Patients of Glue group had better cosmesis of surgical scar. Though local wound complications were less in the Glue Group but difference was not found to be statistically significant, a bigger study is required to validate the findings.

## CONCLUSION

Our comparative study of using skin glue versus traditional skin suturing for skin closure in VP shunt surgery of children below 5 yrs age revealed following :

- Patients of Glue Group had relatively less wound dehiscence, local infections and CSF leak through the scalp incision as compared to Suture Group patients, though the difference was not statistically significant.
- Patients and their relatives of group who underwent glue closure had less emotional burden with fact that no sutures were to be removed post-operatively.
- Cost of the glue is higher than suture material used for skin closure. But the increase of the cost can be countered with the fact that it leads to less local wound complications thus avoiding further expenses on treatment of the complications.
- Tissue adhesive used might have bactericidal activity.
- Hospital stay was similar in both the groups of patients.
- In the patients who had skin closure with skin glue cosmesis of the surgical scar was better.

Though skin closure with tissue adhesive seems to have lowered local wound complication in paediatric patients

who underwent VP shunt as compared to the patients who had skin closure with traditional sutures, but difference was not found to be statistically significant. Hence bigger sample size would be needed to validate these findings and prove cost effectiveness of the tissue adhesive over traditional suturing.

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