European Journal of Plastic Surgery (2019) 42:597–602
https://doi.org/10.1007/s00238-019-01532-y

ORIGINAL PAPER

A randomized trial comparing octyl cyanoacrylate tissue adhesive and sutures in the management of facial lacerations

Deevish Dinakar[1] · Sunderraj Ellur[1] · Vijay Joseph[1]

Received: 1 November 2018 / Accepted: 15 April 2019 / Published online: 6 May 2019

Abstract

Background Facial laceration is one of the most common injuries encountered by plastic surgeons. The right material to be used for epidermal closure is a controversial topic with pros and cons of each. The aim of this study was to compare 2-octyl cyanoacrylate tissue adhesive and monofilament sutures for epidermal closure in facial lacerations considering closure time, wound morbidity, and cosmetic outcome.

Methods In this study, 90 patients visiting St. John's hospital, Bangalore, emergency department for facial lacerations were randomly allocated to 1 of 3 groups for the closure using octyl-2-cyanoacrylate–group 1, monofilament nylon 8/0 interrupted sutures–group 2, or monofilament nylon 5/0 subcuticular sutures–group 3 based on simple randomization by computer-generated sequence. All procedures were carried out in the operation theater under sterile precautions by plastic surgery residents. Post-operative follow-up was done on day 1, day 7, and at 3 months. Statistical analysis was done using the one-way ANOVA test and Student's *t* test.

Results Time taken for closure using 2-OCA was 4 times faster than the other 2 groups using monofilament sutures. There was no significant statistical difference among the 3 groups with respect to wound morbidity and cosmetic outcome at the end of 3 months.

Conclusions Epidermal closure with tissue adhesive for facial lacerations was faster compared to monofilament sutures with comparable cosmetic outcome at the end of 3 months.

Keywords 2-OCA · Tissue adhesive · Facial laceration · Suturing

Introduction

Facial lacerations are one of the most common reasons for people presenting to the emergency department [1]. If not closed properly, the patient is at increased risk of infection and excessive scar formation resulting in a poor cosmetic outcome [2]. As per the principles of wound closure, it is important to relieve tension on the wound edges and bring them together in an everted orientation. Suturing per se is time consuming, requires specialized training, passage of a foreign material through the skin that is usually left in place for 5 to 10 days, and may even leave cross hatch marks if sutured too tight or left for long. Additionally, suture removal in pediatric patients would either need sedation or might be cumbersome.

One of the challenges faced by a plastic surgeon in managing facial lacerations is scarring. New technology in surgical adhesives may provide the option of sutureless skin closure. A number of tissue adhesives are being developed which offer a viable alternative to traditional techniques without compromising optimal wound closure. Favorable characteristics of such an adhesive would be safe for topical application, be easy to apply, polymerize rapidly, support the approximated skin edges and maintain the skin edge eversion, and eliminate the need for suture removal. [3, 4] The introduction of tissue adhesive has been received enthusiastically since it may result in equivalent tensile strength improved cosmetic appearance of the scar and lower infection rate in comparison to sutures, staples, and adhesive tape, and many other risks and disadvantages of alternatives [5].

Key messages With minimal training in the technique of application of tissue adhesive, its use can be incorporated into practice for epidermal closure after using buried dermal sutures and produce cosmetic results similar to those of suturing in the management of facial lacerations.

✉ Sunderraj Ellur
sundernetra@gmail.com

[1] Department of Burns, Plastic and Reconstructive Surgery, St. John's Medical College, John Nagar, Bangalore 560034, India

In this article, we compare 2-octyl cyanoacrylate tissue adhesive and monofilament sutures using 2 different techniques for epidermal closure in facial lacerations considering closure time, wound morbidity, and cosmetic outcome.

Subjects and methods

All patients presenting to St. John's hospital, Bangalore, with facial lacerations between January 2016 and December 2017 and met the required criteria were included in this prospective study. Ethical committee clearance was obtained from the institution ethical committee. Patients willing for follow-up as per study criteria and presenting with facial lacerations < 6 cm in length without tissue loss were included in the study. Patients with underlying facial bone fracture, lacerations on eyebrow, lacerations extending onto lip, eye, or nose (mucosal or mucocutaneous junction, bites, puncture, infected, grossly contaminated or crush wounds, patient's with allergy to tissue glue and patient's with tendency of keloid formation) were excluded from the study.

In this study, 90 patients were randomly allocated to 1 of 3 groups for the closure of skin incisions using octyl-2-cyanoacrylate [Dermabond™]–group 1, monofilament nylon 8/0 interrupted sutures [Ethilon™]–group 2, or monofilament nylon 5/0 subcuticular sutures [Ethilon™]–group 3 based on simple randomization by computer-generated sequence. All patients had buried interrupted PDS 5/0 dermal closure of the wound prior to the epidermal closure resulting in complete approximation of the wound edges. In group 1, a dam was created using ophthalmic ointment (Neosporin™) to prevent the glue from running off to the adjacent area. All procedures were carried out in the operation theater under sterile precautions. Post-operative follow-up was done on day 1, day 7, and at 3 months. To avoid variations in cosmetic outcome due to the level of training, all the surgeries in this study were performed by plastic surgery residents with a minimum of 3 months training.

Results

The patients were randomized into one of the 3 study groups: group 1–octyl-2-cyanoacrylate (Dermabond™), group 2–8/0 monofilament intermittent, and group 3–5/0 monofilament subcuticular sutures. Out of the 90 cases, 6 cases were lost to follow-up and were excluded from the study. Each group had 28 patients at the end of the study. All 3 groups were compared with respects to age, sex, site, and length of laceration to rule out any statistically significant difference. Statistical analysis was done using the one-way ANOVA test and Student's *t* test. Observations and analysis of all the parameters studies are as follows (Tables 1, 2, 3, and 4).

Table 1 Time of epidermal closure per cm laceration

Group	Method of closure	Average time needed for epidermal closure per cm of laceration
Group 1	2-OCA	1 min 3 s
Group 2	Monofilament skin sutures–8/0 interrupted	4 min 20 s
Group 3	Monofilament skin sutures–5/0 subcuticular	3 min 36 s

Time taken for closure

The time of incision closure was calculated from the time of completion of wound preparation for epidermal closure to the time the practitioner's hands was removed from the incision site (excluding the time required to apply subcutaneous sutures). For 2-OCA, the time spent holding the incision edges in apposition until full polymerization was included. The final calculation was with respect to time taken per cm length of laceration.

There was a significant difference among the 3 groups with respect to time of closure. Time taken for closure in group 1 (2-OCA) was 4 times faster than the other 2 groups (monofilament groups).

Wound morbidity

On the 1st and 7th day after surgery, the wound was assessed for adequate healing, wound-related infections, and indicators of an acute inflammation. Adequate wound healing was assessed with respect to edge apposition, epidermal separation, and wound dehiscence. Healing was considered adequate if the wound margins were completely apposed at the end of 7 days and there was no dehiscence requiring re-treatment.

None of the cases in our study developed wound infection or dehiscence. This was mostly likely attributed to the fact that they were all operated in the major operation theater under strict aseptic conditions.

Table 2 Incidence of wound dehiscence

Group	Method of closure	Total cases	Cases with wound dehiscence
Group 1	2-OCA	28	0
Group 2	Monofilament skin sutures–8/0 interrupted	28	0
Group 3	Monofilament skin sutures –5/0 subcuticular	28	0

Table 3 Significance of variation with respect to cosmetic outcome

Group	Mean	SD	*p* value, sig
Group 1 (2-OCA)	0.42	0.79	The *p* value is .965241.
Group 2 (8/0 MF)	0.46	0.92	The result is not significant at $p < .05$.
Group 3 (5/0 MF)	0.50	0.75	

Cosmetic outcome

Cosmetic outcome was assessed after 3 months by a plastic surgeon, using the Modified Hollander Wound Evaluation Scale (HWES). A total score was given from 0 to 6. The lesser the score, the better the cosmetic outcome. A score of 0 indicates optimal scar and a score of 1–6 indicates suboptimal scar, 6 being the worst.

There was no significant statistical difference among the 3 groups with respect to cosmetic outcome. The mean HWES score in group 1 was 0.42 (least compared to other 2 groups) which indicates good cosmetic outcome. Next were group 2 at 0.46 and group 3 with a mean score of 0.50.

Discussion

Achieving a functional and cosmetically appealing scar is the ultimate goal of wound closure. Most clinical studies on facial lacerations have focused on wound infection rates despite the fact that wound infection rates are low and patients are more concerned with the ultimate cosmetic appearance of their wounds [6]. Other outcome measures must be considered before declaring tissue adhesives as an appropriate alternative to sutures.

Most of the studies done previously to evaluate the cosmetic outcome of 2-OCA were on patients in whom no dermal approximation was done after application of subcutaneous sutures. Hence, the inherent risk of wound dehiscence and scar widening was present in such cases. Our study involved meticulous approximation of dermis using PDS 5/0 sutures, which added strength to the wound and probably prevented scar widening over a period of time. Unlike suturing, cyanoacrylate adhesives have the potential to save operative time, especially with longer incisions and lacerations. A majority of studies looking at cyanoacrylate use in wound repair indicate that this technique takes only 30% to 60% of the time required for repair using suture closure [7].

The time taken for epidermal closure of wounds using octyl-2-cyanoacrylate was found to be significantly faster than by sutures. The mean closure time was around four times faster compared to suturing. Time for dermal approximation was almost the same in every case and was not included in the calculation of time of closure. In a study by Toriumi et al. [8], the mean time for epidermal skin closure using 2-OCA was 4 times faster compared to suturing. This was almost the same as the time taken in our study.

Although most of the surgeons prefer to use tissue forceps to aid in the skin edge approximation and eversion while applying the polymer, we preferred an alternative way to achieve this and to overcome the problem of glue sticking to the gloves. We created a dam using an ophthalmic ointment (Neosporin™) around the suture line leaving about 1-cm space all around which would contain the glue within that area and prevent it from flowing out (Fig. 1). We then applied additional pressure using fingers placed at 1.5 cm from the wound edge. This helped to keep the epidermal edges approximated without the glue flowing on to the forceps or surgeons glove. This also avoids wastage of glue and protects vital structures like the eyes from inadvertent flow of glue. We would also like to stress on the fact that it is important to avoid the glue from seeping into the wound until polymerization is complete (Fig. 2).

In living tissues, because the adhesive film generally sloughs off within 5 to 10 days as the epidermis regenerates, there is no need to remove the adhesive. Suture removal especially in sensitive area of the face such as nose, eyelids, and lips always accompanies a certain amount of psychological discomfort to the patient. In children, suture removal is often done under sedation to prevent the anxiety, trauma, and cross hatching. Despite all these shortcomings, suturing still retains the property of providing maximum tensile strength across the wound margins.

In all 3 groups, all patients had mild swelling noted on day 1. All patients had satisfactory wound healing as evaluated on day 7 follow-up. No dehiscence, infection, allergic reactions, or any other major wound closure complications occurred with either technique. In the study by Toriumi et al. [8], there were no instances of wound dehiscence, hematoma, or infection. This was consistent with our findings. We have not noticed any instance of infection in all the three groups in this study. However, it is a well-known fact that would infections are better managed with interrupted epidermal sutures that with subcuticular continuous sutures. It may be presumed that same may be the case with tissue adhesives also.

Cosmetic evaluation of the patients in all 3 groups was done at the end of 3 months using the Modified Hollander Scale. It has been used extensively as an outcome measure in evaluating therapy, as well as in studies involving surgical scars. None of the patients developed step off borders on evaluation at 90 days. In group 1, contour irregularity was noted in 1 patient and in group 2 it was noted in 2 patients. In group 1, scar widening (> 2 mm) was seen in 7 out 28 cases (25%). In group 2, it was seen in 6 out of 28 cases (21.4%) and in group 3, it was seen in 8 out of 28 cases (28.5%). The reason for scar widening can be attributed to either improper dermal approximation or due to their orientation with respect to the resting skin tension lines. Although buried dermal sutures were used

Table 4 Cosmetic outcome measured by Modified Hollander's Scale

Point	Group 1		Group 2		Group 3	
	0 (good)	1 (poor)	0 (good)	1 (poor)	0 (good)	1 (poor)
Step-off borders	28	0	28	0	28	0
Contour irregularities	27	1	28	2	28	0
Wound margin separation	21	7	22	6	20	8
Edge inversion	28	0	28	0	28	0
Excessive inflammation	27	1	27	1	28	0
Overall appearance	25	3	24	4	24	4

in all cases to reduce the tension and maintain margin approximation, these cases showed separation of wound margins up to 5 mm.

Edge eversion was not noted in any of the patients. One patient in group 1 and 1 patient in group 2 showed excessive inflammation which gradually settled on follow-up. Overall appearance was suboptimal in 3 out of 28 cases (10.7%) in group 1, 4 patients out of 28 cases (14.3%) in group 2, and 4 patients out of 28 cases (14.3%) in group 3. This was mainly due to hypopigmentation of the scar in dark-skinned patients despite adequate healing. Hence, there was no statistical difference in the cosmetic outcome among the 3 groups studied. Cross hatching, although noticed in group 2 (intermittent 8/0) at the end of 1 week, gradually faded over the next few weeks and was not seen at the end of 3 months in any of the patient groups.

As per the study conducted by Toriumi et al. [8], the mean wound evaluation score was 0.235 for the suture group and 0.306 for the octyl-2-cyanoacrylate group. There was no statistically significant difference between wounds treated with octyl-2-cyanoacrylate or suture as evaluated using the Modified Hollander Scale. In another comparative study of tissue adhesive and sutures in the closure of facial wounds following Moh's micrographic surgery [9], the authors found no significant differences in cosmetic outcomes at 3 months between 2-OCA and sutures. A meta-analysis of eight studies found no differences between tissue adhesives (including OCA) and sutures in rates of infection, dehiscence, cosmesis, or patient satisfaction, although the authors of this analysis reported that surgeons preferred the cosmetic appearance obtained with tissue adhesives. [10]

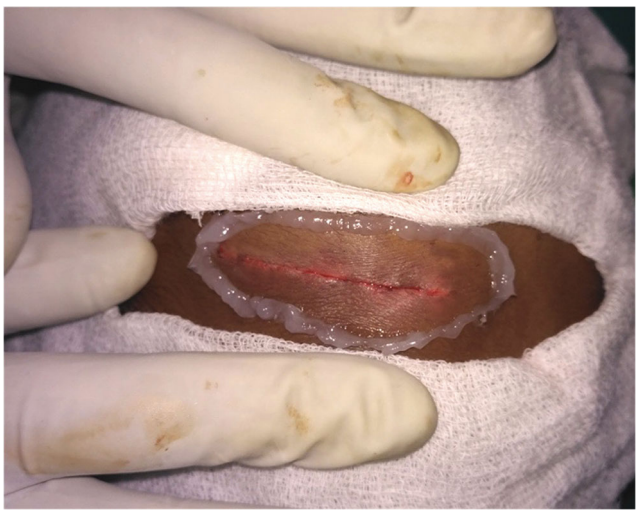

Fig. 1 Creation of dam using ointment to avoid glue flow off

All the above-mentioned parameters used in the study show octyl-2-cyanoacrylate have an advantage with respect to time needed for closure. Most importantly, for parents and apprehensive patients, octyl-2-cyanoacrylate usually persists until the underlying skin has desquamated, usually in 5 to 7 days, obviating the need for suture removal. In our study, octyl-2-cyanoacrylate has evolved as an alternate to other standard wound closure techniques with its ease of usage and predictable esthetic outcome.

For long, it was believed that the use of the cyanoacrylates should be limited to short, simple facial lacerations in children. With our study, we were able to extend its use for longer lacerations over the face, up to 6 cm, when used along with dermal sutures with acceptable results. We did not do a formal cost analysis in our study. While the direct cost of an ampoule of octyl-2-cyanoacrylate is generally higher (M.R.P of Dermabond™ mini – Rs.900) than sutures (M.R.P of 8/0 monofilament – Rs.480 and 5/0 monofilament – Rs.320), formal cost-effective analysis clearly demonstrates that adhesives are more cost effective than sutures. The marginally higher initial cost of tissue adhesive is offset by shorter time and less expense needed for follow-up especially considering children in group 2 requiring sedation for suture removal.

In our study, we noticed that 21 patients (from all 3 groups) had scar widening more than 2 mm at 3 months follow-up. This may be either due to gradual tension on the wound margins once the dermal PDS sutures start losing its tensile strength or due to improper dermal approximation. This suggests the need for better dermal approximation techniques with long-lasting, non-reactive sutures, especially when the wounds were oriented away from the RSTL. Validating this would require a separate study and was not a part of this study.

We have not compared the wound tensile strengths in the three groups, in this study; however, in each group, the means

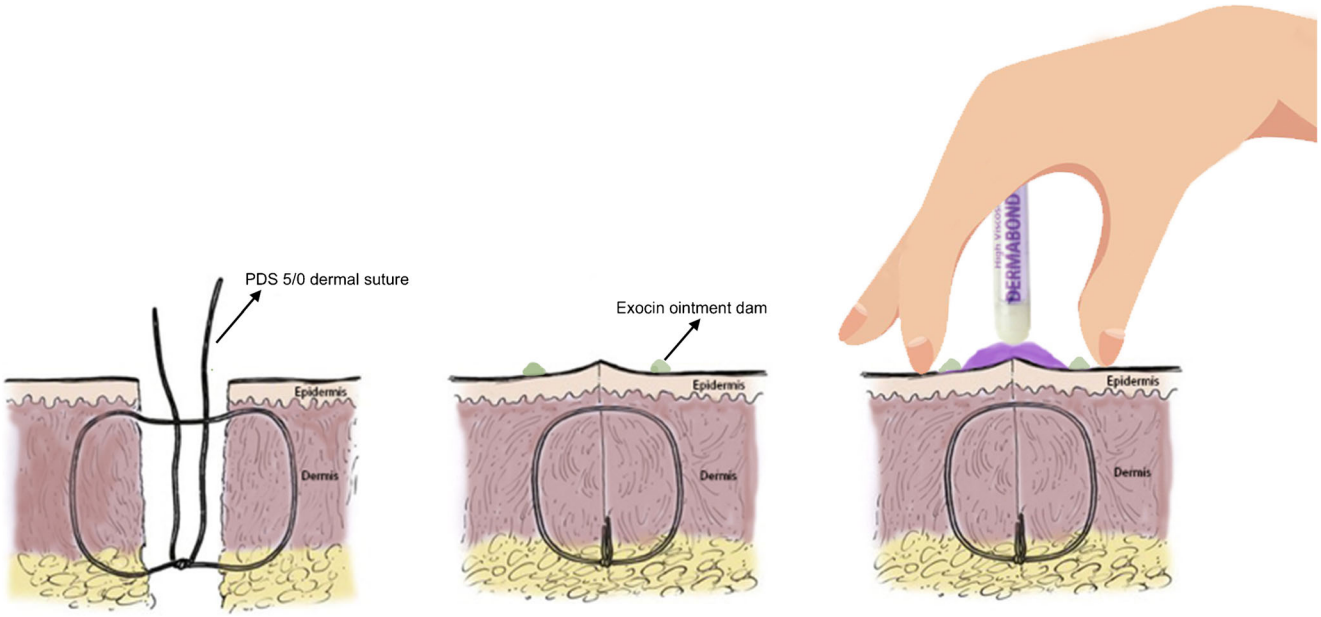

Fig. 2 Method of application of glue after dermal suturing

used to approximate the epidermis (sutures/glue) wear off by 2 weeks after which the tensile strength is borne solely by the underlying dermal suture, which remains the same in all the groups. Hence, it is safe to presume that the sound tensile strength will be comparable across the three groups.

One more phenomenon we encountered in most of the patients was the "spitting" of dermal sutures. In spite of low tissue reactivity of PDS sutures, many patients complained of bits of sutures extruding out of the suture line at various intervals. This requires further evaluation to compare various alternatives for dermal sutures to avoid this extrusion. The exact cause of this phenomenon is not yet known but most plastic surgeons believe that intradermal sutures placed too high in the dermis are the cause. Other possibilities include too many knots used or the choice of suture material. Use of barbed sutures or applying sutures deeper in the dermis with a buried knot technique may solve the problem.

Conclusion

Although interrupted sutures have been the gold standard for epidermal closure, tissue glue and 5/0 monofilament subcuticular sutures have comparable cosmetic outcomes, with the clear advantage of faster wound closure times without the need for suture removal, which is especially appreciated in the pediatric age group. This study shows that with minimal training in the technique of application of tissue adhesive, its use could be incorporated into practice for epidermal closure after using buried dermal sutures and produce cosmetic results similar to those of suturing. We would also like to introduce a new technique to avoid adhesive run away using an ointment dam.

Compliance with ethical standards

Conflict of interest Dr. Deevish Dinakar, Dr. Sunderraj Ellur, and Dr. Vijay Joseph declare that they have no conflict of interest.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Ethical approval was obtained from the institutional ethical committee.

Informed consent Informed consent was obtained from all individual participants included in the study.

References

1. Sibert JR, Maddocks GB, Brown BM (1981) Childhood accidents - an endemic of epidemic proportion. Arch Dis Child 56(3):2257
2. Hollander JE, Singer AJ (1999) Laceration management. Ann Emerg Med 34(3):356–367
3. Saleh Y, Omar M, Elsombaty M (2003) Tissue Glue (Octyl 2-Cyanoacrylate), A new tool in management of facial scar, Egypt. J Plast Reconstr Surg 27:287–293
4. Knott D, Zins JE, Banbury J et al (2007) A comparison of dermabond tissue adhesive and sutures in the primary repair of the congenital cleft lip. Ann Plast Surg 58:121–125
5. Hasan Z, Gangopadhyay AN, Gupta DK, Srivastava P, Sharma SP (2009) Sutureless skin closure with isoamyl 2-cyanoacrylate in pediatric day-care surgery. Pediatr Surg Int 25(12):1123–1125
6. Singer AJ et al (2000) Patient priorities with traumatic lacerations. Am J Emerg Med 18(6):683–686

7. Mobley SR, Hilinski J, Toriumi DM (2002) Surgical tissue adhesives. Facial Plastic Surg Clin 10(2):147–154
8. Toriumi DM, O'Grady K, Desai D, Bagal A (1998) Use of octyl-2-cyanoacrylate for skin closure in facial plastic surgery. Plast Reconstr Surg 102:2209–2219
9. Sniezek PJ, Walling HW, DeBloom JR 3rd et al (2007) A randomized controlled trial of high-viscosity 2-octyl cyanoacrylate tissue adhesive versus sutures in repairing facial wounds following Moh's micrographic surgery. Dermatol Surg 33(8):966–971
10. Coulthard P, Worthington H, Esposito M, et al. Tissue adhesives for closure of surgical incisions. Cochrane Database Syst Rev 2004; CD004287