Original Article

Comparison of octyl-2-cyanoacrylate and conventional sutures in facial skin closure

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ABSTRACT

Introduction: Closure of wounds to achieve an esthetically pleasing result has always been a challenge. Since time immemorial, surgeons have strived to produce "invisible scars". This, however, has always been elusive. The introduction of tissue adhesives heralded the era of suture free closures which led to better results. **Aims and Objectives:** The aim of this study is to compare the efficacy of octyl- 2-cyanoacrylate with that of the conventional sutures, in facial skin closure. **Results and Conclusion:** The use of octyl-2-cyanoacrylate offers many advantages such as rapidity and ease of application and superior results.

Key words: Cyanoacrylates, sutures, wound closure

Introduction

Wound closure techniques have evolved from the earliest development of suturing materials to resources that include synthetic absorbable sutures, staples, tapes, and adhesive compounds. The creation of natural glues, surgical staples and tapes to substitute sutures has supplemented the armamentarium of wound closure techniques. The use of tissue adhesives has long appealed to surgeons and they have been extensively studied for nearly four decades for diverse applications including tissue adhesion, wound closure, hemostasis, closure of cerebrospinal fluid (CSF) leaks, vascular embolization and application of skin grafts.

The ideal method of laceration and incision closure should be simple, safe, rapid, inexpensive, painless, bactericidal, and result in optimal cosmetic appearance of the scar. The cyanoacrylate tissue adhesives offer many of these characteristics. Developed in 1949, the cyanoacrylate adhesives are applied topically to the outermost skin layer. The cyanoacrylates are supplied as monomers in a liquid form. On contact with tissue anions, they polymerize forming a strong bond that holds the apposed wound edges together. The cyanoacrylate adhesives usually slough off with wound re-epithelialization within 5–10 days and do not require removal.

The aim of this study is to compare the efficacy of octyl-2-cyanoacrylate with that of the conventional sutures, in closure of facial skin.

Materials and Methods

Twenty patients were enrolled in the study and they were randomly divided into two groups. In group I, octyl-2-cyanoacrylate (Dermabond, Ethicon Inc, Johnson and Johnson, Somerville,New Jersey, USA.) [Figure 1], was used for skin closure [Figure 2]. In group II, conventional silk sutures were used [Figure 3]. Patients were eligible for inclusion in the protocol if they were of generally good health without significant systemic abnormalities, agreed to return for 10th-day and second month follow-up assessment, and provided written informed consent.

Specific exclusion criteria were patients with multiple trauma, peripheral vascular disease, insulin-dependent diabetes mellitus, known bleeding diathesis, known personal or family history of keloid formation or scar hypertrophy, or a known allergy to cyanoacrylate compounds or formaldehyde.

In addition to inclusion and exclusion criteria for patients, the study also had specific criteria based on

Figure 1: 2-Octyl cyanoacrylate (Dermabond, Ethicon, Inc.)

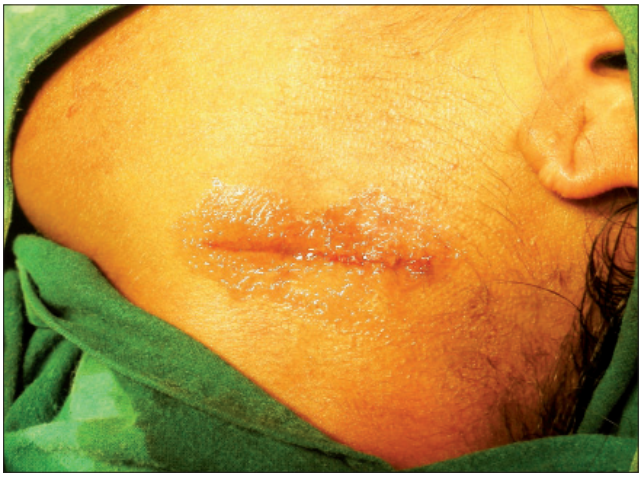


Figure 2: Closure with Dermabond

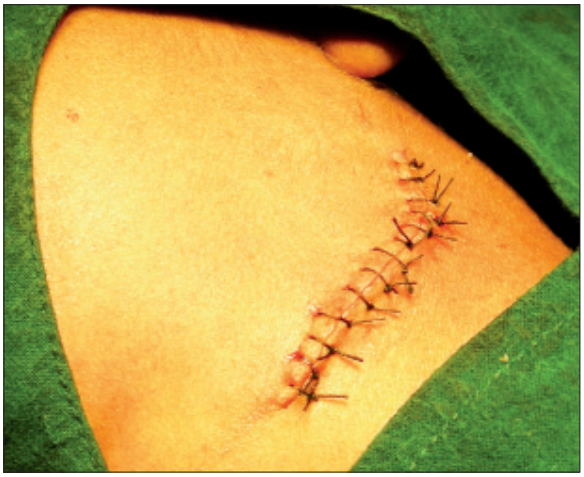


Figure 3: Closure with sutures

laceration etiology, degree of wound contamination, and location. Eligible wounds were those that required 3-0 or smaller sutures for skin closure. Although the functional tensile strength of 2-octylcyanoacrylate is comparable to that of 5-0 sutures, as we commonly use 3-0 braided black silk sutures for skin closure, we designed the study with the same. Wounds as a result of animal or human bites, punctures, ulcers, or crush injuries were excluded. Wounds with visual evidence of active local or systemic infection, gangrene, contaminated or devitalized tissue, or within active rashes were also excluded. In addition, wounds located at the vermilion border of the lip, the mucosa, or in areas covered by natural hair (precluding an assessment of cosmetic outcome at 2 months) were excluded.

Dermabond is supplied in a single use sterile plastic vial containing 0.5 ml of octyl-2-cyanoacrylate adhesive within an inner glass ampoule. Just before application, the outer plastic vial is gently crushed between index finger and thumb to break the inner glass ampoule and the adhesive is expressed through the tip of applicator. As the adhesive moves through the applicator tip, it mixes with an initiator and begins the chemical change from monomer to polymer. Moisture on the surface of the skin adds the final catalyst to create the strong polymer bond that bridges the wound edges. The wound edges are meticulously approximated by the operator or assistant.

Care is taken to avoid introducing the adhesive between the wound edges since it would impede healing. The adhesive is then carefully expressed through the tip of the applicator and gently brushed over the wound surface in a steady continuous motion. It is made sure that the adhesive covers the entire wound and an area covering 5–10 mm on either side of the wound edges. Initial layer was allowed to polymerize for approximately 15–30 seconds, two additional layers of adhesive are similarly brushed onto the surface of the wound, with a waiting period of 5–10 seconds between successive layers. Excessive adhesive is quickly wiped away with dry gauze.

Results

A total of 20 patients were randomly divided into two groups. Group I consisted of patients where wounds were closed using Dermabond. Sutures were used for closure in Group II patients. First postoperative patient evaluation was done immediately. Second postoperative evaluation was done on 10th postoperative day for complications. Third postoperative evaluation was done at the end of second month for cosmesis.

Out of the 20 patients 14 were males and 6 were females. On 10th day, 19 patients reported for follow up in which, 9 belonged to group I and 10 belonged to the group II. Wounds were evaluated for complications, i.e., wound dehiscence and presence of infection. The percentage

of each group was calculated. Statistical analysis was performed using chi-square test for parametric variables and the *P* (probability) and *Z* values were calculated.

One patient in group I had immediate postoperative bleeding after application of adhesive, which had resolved itself within 2–3 minutes. The incidence of bleeding may be attributed to incomplete hemostasis prior to closure.

On the 10th day follow up, one patient in group I had wound dehiscence in the chin region. The wound finally healed uneventfully. Although it was in 10% of the total cases, the difference was statistically insignificant. One case in each group had the presence of infection for which the patients were treated by standard protocol.

Statistically, the overall difference between results in both the groups on 10th postoperative day was insignificant. Similar studies by Jim Quinn *et al*,[4] Toriumi,[5] and Singer *et al*,[12] have reported results in compliance with the present study.

Next postoperative evaluation was done at the end of second month [Figures 4 and 5] for cosmesis. Scar was evaluated for patient's and surgeon's satisfaction on a 1–10 point visual analog scale (VAS), where 1 denotes worst possible outcome and 10 is the best possible outcome. Earlier study by Quinn[3] has demonstrated VAS as a valid scale to measure the cosmetic outcome. The mean of the total patient satisfaction score and the surgeon's satisfaction score was calculated with standard deviation. Patient satisfaction score in group I was higher as compared to group II, but this difference was statistically insignificant ($Z = 1.405$, $P = 0.500$).

The surgeon's satisfaction score was also higher in group I [Graph 1] as compared to group II [Graph 2], although this difference was statistically insignificant ($Z = 1.50$, $P = 0.773$). Overall difference in cosmetic result between both the groups was statistically insignificant. Similar result was found in several other prior studies by Quinn,[4] Toriumi,[5] and Singer *et al*.[10] However, a study by Bernard Laurie *et al*,[9] showed a statistically significant difference on VAS scale in favor of sutures.

The cost effectiveness in both the groups were also measured and it was found that although cost of the

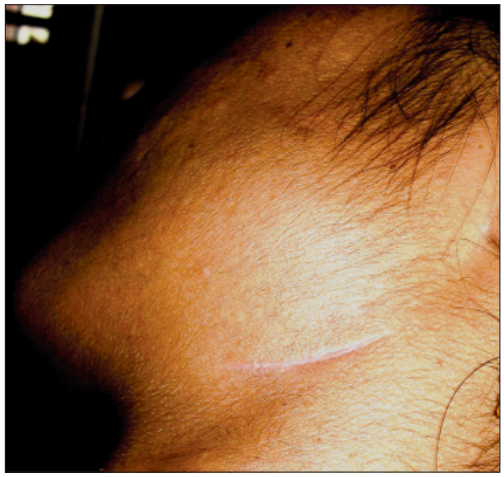


Figure 4: Postoperative view at the end of 2 months (Dermabond)

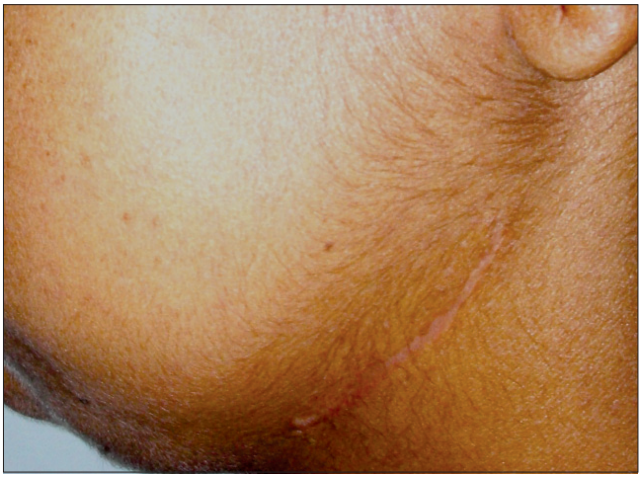
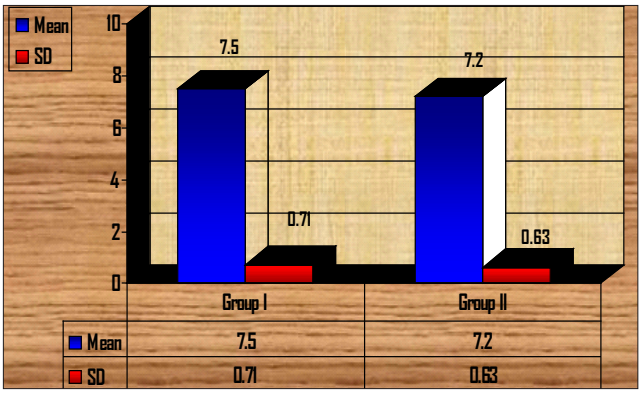
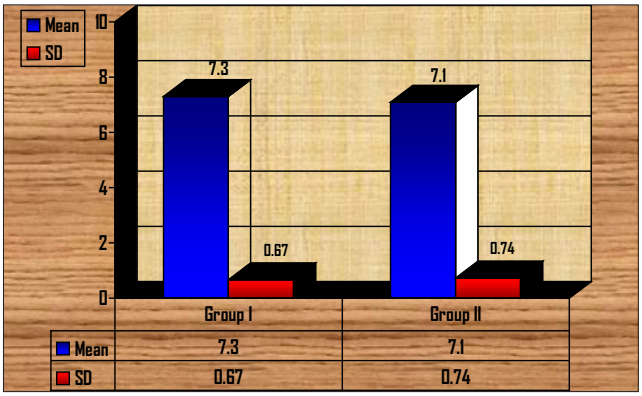


Figure 5: Postoperative view at the end of 2 months (sutures)



Graph 1: Surgeon's satisfaction score



Graph 2: Patient's satisfaction score

material in the case of group I was higher, total effective cost including transportation cost for follow up, loss of wages, cost of dressing and local antibacterial medicaments was higher in group II. Thus, overall effective cost was almost equal in both groups. Martin *et al*,[1] did an economic comparison between adhesives and sutures and found tissue adhesives to be more efficient economically.

The time required for closure with Dermabond was one-third of the time required for suture closure. Quinn *et al*,[4] and Toriumi *et al*,[5] found similar results in their studies.

Discussion

Early, uncomplicated wound healing has been a subject of intensive research over the ages. The complexities involved in wound healing, such as involvement of more than one type of tissue, various degrees of wound strength during the process of healing, exposure of the biomaterials to body fluids and a variety of wounds, each with its own healing problems, call for different types of wound closure materials.[2,15,6]

In general, wound closure biomaterials are divided into three major categories: suture materials, staples and tissue adhesives. Suturing has been the most widely used method for wound closure because of high reliability of suture materials. However, alternative techniques have long been sought, since suturing technique requires skill and experience, a relatively longer time and the need for its removal. Due to these reasons, surgeons are increasingly using tissue adhesives over sutures for wound closure.(7,8) Several studies regarding the use of the tissue adhesives in closure of facial wounds have been conducted to compare their efficacy against the conventional sutures.[10-14]

Although most facial wounds heal without complications, owing to the abundant blood supply of the region, mismanagement may result in infection, wound dehiscence, and unsightly and dysfunctional scar.[1,5] Historically, the autologous and homologous fibrin tissue adhesives have been extensively used due to their safety and reliability. However, fibrin tissue adhesives carry the risk of viral transmission.[16] Epoxy resins (polyurethanes) also have been considered for surgical applications. The polyurethanes have high bond strengths as compared to adhesive systems, but apparently form bonds at a rate too low for practical applications. Also, it has been seen that they exhibit adverse bonding behavior in the presence of moisture, making them unreliable.[16] Cyanoacrylate-based adhesive systems are most recent tissue adhesives. The rapid setting time and desirable effect of moisture on polymerization have made them most investigated system.

The most widely used tissue adhesives nowadays comes from homologues of alkyl cyanoacrylates. Early attempts at developing a cyanoacrylate-based tissue adhesive have been fraught with handling problems and associated histotoxicity. Further studies demonstrated that the histotoxicity of cyanoacrylate tissue adhesives can be attributed to the by-products of cyanoacrylate polymer degradation, i.e., cyanoacetate and formaldehyde.[15] This rate of degradation is affected by the length of the alkyl group of the cyanoacrylate derivative. Shorter chain derivatives such as methyl and ethyl cyanoacrylates degrade quickly and therefore have more toxicity than longer chain derivatives.

Octyl-2-cyanoacrylate (Dermabond, Ethicon, Inc.) is a recent cyanoacrylate derivative with eight alkyl constituents off the carboxyl group, which slows down the degradation and by-product release into the surrounding tissues. Additionally, plasticizers have been added which make the adhesive bond stronger and more durable but allow flexion of the skin.[17] Its usage as a skin adhesive was first described by Quinn[4] and Toriumi.[5]

Cyanoacrylates have a number of advantages over conventional sutures like their fast and painless application, rapid setting which reduces the total operating time, their antibacterial properties. Cyanoacrylate itself acts as a water proof dressing and helps in reduction in the number of follow-up visits. As they do not require any needles, accidental needle stick injuries are prevented. However, there are certain disadvantages of cyanoacrylates like their less tensile strength and chances of adhesive seepage if edges are not properly approximated.

Multiple studies have shown equivalence of octyl cyanoacrylate to 5-0 skin sutures in esthetic facial surgery and repair of traumatic facial wounds.[5,13] However, it is important to remember that dermal suture support is still needed (in wounds that traverse the full thickness) and skin must be held together as the adhesive is applied to prevent the deposition of the cyanoacrylate polymer into the wound, potentially delaying or preventing the healing.

The popularity of Dermabond for closure of elective surgical incisions, repair of traumatic facial lacerations and in esthetic facial surgery is limited in India, primarily due to cost considerations and a dearth of studies conducted on Indian population. Although the cost of Dermabond tissue adhesive is more compared

to conventional sutures, the total cost effectiveness of using the material is equivalent or even better compared to conventional sutures.[1]

Conclusion

We may conclude that the use of octyl-2-cyanoacrylate is better than sutures in the closure of facial wounds. However, further studies with a larger sample size are necessary on Indian population for octyl cyanoacrylate to replace sutures as a primary method for repair of facial wounds.

Acknowledgement

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