Efficacy of Octyl-2-Cyanoacrylate Tissue Glue in Blepharoplasty

A Prospective Controlled Study of Wound-Healing Characteristics

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Objective: To compare the surgical efficacy and wound-healing characteristics of the tissue adhesive octyl-2-cyanoacrylate (approved by the Food and Drug Administration) with traditional suture closure in upper blepharoplasty.

Methods: Prospective, randomized, blinded study comparing cosmetic and functional outcome and time efficiency. Twenty subjects underwent upper eyelid blepharoplasty. Each patient had a control side and an experimental side determined randomly. One eyelid incision was closed with octyl-2-cyanoacrylate (DermaBond; Ethicon Inc, Somerville, NJ) tissue glue, and the other with 6.0 suture (polypropylene or fast-absorbing gut). Comparisons were performed for the time for closure by each method, wound healing, and patient satisfaction. Macrophotographs of the wounds at 1, 2, and 4 weeks after surgery were graded by 5 observers blinded to the closure method, using a 10-point scale and a modified Hollander wound evaluation scale.

Results: No statistically significant difference was found between the quality of octyl-2-cyanoacrylate closure and suture closure at 1 month. There were no differences in wound complications, duration of healing, inflammation, or final incision appearance. By 2 weeks, the sides were indistinguishable in 15 (75%) of the patients. Time for closure averaged 7 minutes with suture and 8 minutes with glue.

Conclusions: Octyl-2-cyanoacrylate glue is an excellent alternative to suture closure, producing equivalent quality of closure at all time points and no difference in appearance. This adhesive was sufficient to withstand the forces of closure in upper eyelid blepharoplasty without dehiscence in the absence of sutures.

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For more than 20 years, tissue glues have been investigated as a possible alternative to sutures. Such adhesives promise quicker application, greater comfort for the patient, and possibly faster healing in sensitive areas such as the eyelid. Since the 1970s, investigators such as Kamer and Joseph,1 Toriumi et al,2 and others have reported the use of tissue adhesives for the closure of wounds ranging from blepharoplasty incisions to lacerations. However, to date, a controlled study has not been done comparing identical tissues in the same patient (ie, the bilateral eyelid model) to definitively assess the wound-healing characteristics and surgical efficacy of this method.

Cyanoacrylate is a polymer tissue adhesive that was first discovered in 1949 and has been used in wound closure since the mid-1970s.3 Butyl-2-cyanoacrylate (Histoacryl; B. Brown Medical Inc, Sheffield, England) has low tissue reactivity and few toxic effects. It has been used in middle ear surgery with no adverse effects. Kamer and Joseph1 report a series of 100 patients with wounds closed with butyl-2-cyanoacrylate. They found no clinically significant adverse effects: no problems with wound healing, graft rejection, or infection. Similar findings with Histoacryl in human wound and animal models were reported by Keng and Bucknall,3 Ellis and Shaikh,4 Shorr et al,5 Toriumi et al,2 Howell et al,6 Shigemitsu and Mahima,7 and Veloudios et al.8 All attest to the safety and efficacy of cyanoacrylates in closure of surgical and traumatic wounds. Octyl-2-cyanoacrylate (Dermabond) is a stronger, more flexible, longer-chain cyanoacrylate than prior cyanoacrylates used. It has been found to be safe and effective by the Food and Drug Administration and has been used successfully in studies by Toriumi et al,9 Maw et al,10 and Quinn et al.11

In the past, most studies have been historical reviews containing limited information on the wound-healing properties of cyanoacrylate. More recently, prospective
PATIENTS, MATERIALS, AND METHODS

STUDY DESIGN

The null hypothesis was that the experimental (octyl-2-cyanoacrylate) closure was no different from the control closure (standard sutures). A bilateral upper blepharoplasty model was used to compare octyl-2-cyanoacrylate with suture closure. The study was constructed as a randomized, prospective, blinded study in patients undergoing bilateral blepharoplasty for functional or aesthetic indications. To remove confounding variables such as skin location on a given patient, skin variations between patients, and skin characteristics, each patient served as his or her own control. The skin of one upper eyelid was closed with octyl-2-cyanoacrylate, and the other with 6.0 suture. The results of the 2 closure methods were compared by observers masked to the type of closure used on each eyelid.

The 20 patients undergoing blepharoplasty gave their informed consent (40 upper eyelids were treated). Each patient underwent octyl-2-cyanoacrylate closure of one eyelid and suture closure of the other, 10 of which were fast-absorbing gut and 10 polypropylene (Prolene; Ethicon Inc, Somerville, NJ). Seven patients were women; 13, men. Ten cases were primarily functional. Seven were done in conjunction with a browlift. The study was approved by the Stanford Committee on Human Subjects in Medical Research. The side chosen for each closure method was determined by a coin toss.

SURGICAL TECHNIQUE

A standard upper eyelid blepharoplasty was performed on each patient by the same surgeon (D.G.). Each patient had been randomized to have either the right or left upper eyelid serve as the experimental closure with octyl-2-cyanoacrylate, and the opposite eyelid as the control with sutures. The blepharoplasties of 15 patients were closed on the octyl-2-cyanoacrylate side by using Castroviejo forceps to approximate the skin edges, dried with a cotton swab, and closed with octyl-2-cyanoacrylate. In 5 patients, 3 to 4 sutures were used as handles to facilitate apposition and eversion of the edges at the time of glue application. Glue was applied with the Dermabond applicator in 12 patients (Figure 1) and with a siliconized tuberculin syringe with a 27-gauge needle in 8 patients (Figure 2).

OUTCOME MEASUREMENTS

Closure was timed by the circulating nurse for each closure technique. The quality of each closure was assessed immediately by the surgeon (D.G.) for eversion, regularity, approximation, and any difficulties in attaining closure. Wounds were then evaluated by the patient and physician (D.G.) in the office on the first postoperative day, and at 1, 2, and 4 weeks after surgery. At each of these time points, 35-mm color slide close-up photographs were taken, with the patients' eyelids open and closed. The photographs were shown to 5 observers blinded to the technique of closure (3 facial plastic surgeons, 1 otolaryngologist, and 1 senior otolaryngology resident). The observers evaluated wound quality using a visual analog scale of 1 to 10 (10 representing the ideal blepharoplasty wound closure) and the modified Hollander scale described by Toriumi et al.9 A 2-tailed t test was used to compare the average time for closure and differences in the quality of the wounds.

controlled studies such as those by Toriumi et al4 and Maw et al9 have demonstrated better wound healing and less scarring with cyanoacrylate than with conventional suture closure. However, these studies had limitations. First, identical sites on the same patient were not used as controls to eliminate the variability between different sites on the body or even between the skin of different patients. Second, studies that include closure of incisions from head and neck oncological procedures and deep traumatic lacerations require the use of substantial deep sutures and dermal approximation. In these cases, the tissue adhesive is under little tensile load. Full-thickness wounds to the face, neck, and body produce dead space and high tension that must be closed with deep sutures, limiting the demands on the adhesive closure, and thus limiting the model's ability to test the adhesive material. Third, the wounds of patients with superficial lacerations, such as those described by Quinn et al,11 have little displacement or tensile load to begin with, and could also heal well with an adhesive strip as the closure device.

Fourth, the physician's discretion in choosing which wounds to glue and which to close with subcutaneous sutures in addition to the glue imparts a selection bias to the study. An ideal model for comparison of cyanoacrylate closure with suture techniques requires that no suture be used on the experimental side and comparisons made between identical tissues with precisely controlled wounds on the same patient. It should not require judgment by the physician as to whether the wound was "glue-able." Finally, the sites must be randomized.

Such a model has been successfully carried out in pigs by Veloudios et al8 using blepharoplasty sites to compare for glue and suture closures. The tensile strength of the closures was measured at 1, 2, 4, and 9 weeks postoperatively. The tissue adhesive closure had a statistically significant advantage in tensile strength over the suture closure at 9 weeks, but the earlier results were identical. The Veloudios et al8 study has the advantage of using eyelid skin in a standardized fashion, with choice of closure as the only variable.

The present study was undertaken to evaluate wound-healing characteristics in identical skin sites on the same patient. A blepharoplasty model served to assess the wound-healing characteristics of glue compared with traditional suture techniques, and each patient served as his or her own control.

RESULTS

No dehiscences, infections, allergic reactions, or any other major wound closure complications occurred with either technique. No inflammatory reactions occurred with
the octyl-2-cyanoacrylate adhesive. The only inflammatory reactions occurred with fast-absorbing gut suture. These were minimal and resolved on absorption or removal of the sutures. Two octyl-2-cyanoacrylate sites developed small (<4-mm) areas of minimally delayed healing where small amounts of glue infiltrated between the skin edges and acted as a barrier to healing. This only occurred early in the study to patients on whom the Dermabond applicator was used.

Glue closure time averaged 2 minutes 15 seconds, compared with 6 minutes for meticulous-running, fast-absorbing gut suture closure over 3 to 4 interrupted sutures. When sutures were not used as handles, and forceps alone were used to approximate the skin edges, the time for glue closure ranged from 6.5 minutes to 8 minutes with an average of 7 minutes. A “learning” curve was evident in this progression, with slower times earlier in the process. When performed with the chief resident as assistant, the procedure averaged 6.5 minutes, approximately the same time as the meticulous-suture closure. The Dermabond applicator was found to be useable for the eyelid closures, but the siliconized tuberculin syringe was far easier to use, more precise, and faster. No premature polymerization occurred in the siliconized syringe or needle (Wallace K. Dyer II, MD, personal communication) (Figure 3).

Ethicon Inc recommends the use of 3 coats of octyl-2-cyanoacrylate adhesive for skin closure. We found this to produce a very strong closure and a splinting effect. However, no difference in success rate occurred when 2 thin coats of octyl-2-cyanoacrylate were applied with a syringe. The amount could not be controlled as precisely with the Dermabond applicator as with the syringe; glue applied with the applicator leached into the wound in 3 cases. In 1 case, the material was completely removed. In the other 2, it resulted in small areas of delayed healing. No such problems occurred when the syringe was used as an applicator.

Immediate results demonstrated excellent skin edge approximation in all eyelids studied (N = 40), with greater eversion in the sutured eyelids but a complete lack of suture-induced “rippling” and deformation in the glued eyelids. This led to a smoother edge pattern in the glue group, which was recognizable by observers up to 1 month after surgery. Immediately after surgery, the sutured eyelids had a crease created by the sutures, and the glued eyelids displayed a “splinting” effect leading to some relative flattening. This was directly related to the amount
of glue used; more splinting occurred with the Derma-bond applicator, and less with the syringe. Less immediate eversion was attained with the glue, but this did not seem clinically significant, since both closures were performed in the supratarsal crease. Over time, all patients re-formed the supratarsal crease, which is by definition inverted.

The mean duration of glue fixation averaged 6 days (range, 5-8 days); this was similar to the longevity of the fast-absorbing gut suture. In 2 patients with extremely dry skin, the remnants of the glue had to be peeled off. In all others, it spontaneously shed.

The progression of healing is depicted in Figure 3 and Figure 4. At 1 week after surgery (Figure 3, A), minimal differences are seen between the 2 sides, with a flatter closure on the glue side (right) and minimal rippling on the suture side (left). By 2 weeks after surgery, these characteristics are no longer visible (Figure 3, B). By the fourth postoperative week, both sides are identical. The same trends are seen in the other patients.

The 5 blinded observers using the visual analog scale to rate the 40 treated eyelids did not find any statistically significant difference between the wound quality in the experimental and control groups ($P > 0.05$, t test). Likewise, the modified Hollander scale findings showed no differential score between the 2 closure techniques. However, it did pick up the rippling effect induced by suture closure as a “contour irregularity” in 4 patients and small areas of incomplete glue closure (from glue infiltrating between the skin edges) on 2 patients at week 1. These incomplete closures were 2 mm in one patient and 4 mm in another, and resolved without further treatment. One of these patients had a thickening at 2 weeks in this site, which resolved spontaneously 5 weeks after surgery. By 1 month, the 2 sides were indistinguishable in most cases. No difference in wound healing was seen in the subgroup of patients who also had a browlift.

Patient satisfaction was assessed through interviews on each follow-up visit. Thirteen of the patients preferred the glue, finding it more comfortable, without a pulling sensation when opening and closing the eyelids, and they appreciated the lack of suture removal. Uniformly, these patients reported a smoother appearance to the wound and noted a subtle rippling effect on the sutured side. These patients said they would have liked to have glue used bilaterally. Subjectively, most of the patients who liked the glue best tended to be younger women. These patients had better eyelid skin quality than the older men, greater symmetry of the eyelids, and no history of eyelid injury. Older men with good to fair skin quality also preferred the glue. Older men with deep reticulated furrows in the eyelids and very dry skin experienced more stiffness and less comfort with the glue. They also required removal of glue remnants, which they found as uncomfortable as the suture removal. Patients treated with 3 coats of octyl-2-cyanoacrylate were less comfortable than those treated with lesser amounts.

The present study, using an upper eyelid blepharoplasty model, confirms that wound-healing results with octyl-2-cyanoacrylate are equivalent to those obtained with sutures, thus supporting the null hypothesis that no healing differences exist between the 2 closure methods. Wound-healing analysis by observers blinded to the material used for skin closure shows no statistical difference between the 2 methods of closure. Since excellent healing is typical for blepharoplasty incisions, we focused on early healing (1 day to 1 month) to find differences between the 2 closure modalities. Photographs at 1 month showed little difference in wound quality between the 2 sides. Earlier photographs, at 1 and 2 weeks, showed different characteristics of the wounds, e.g., a subtle rippling from the running polypropylene or fast-absorbing gut suture vs a flattening of the eyelid from the splinting effect of the glue, as well as residual glue in place. The observed minimal inflammation at the suture line in the first week may correlate with the findings of Howell et al of higher wound bacterial counts in suture-closed wounds than in those closed with octyl-2-cyanoacrylate adhesive. However, none of these differing characteristics led to differences in wound-healing quality overall between the glue and sutures. Once the early healing process was completed, and these telltale signs were resolved, the techniques were indistinguishable from each other.

Two techniques of using the octyl-2-cyanoacrylate closure were assessed. Using 3 to 4 sutures as handles to hold the edges together and evert the skin was slower (7-8 minutes), highly dependent on the skills of the assistant, and involved a learning curve.

The use of cyanoacrylate glues in the closure of upper eyelids is inherently more challenging than in lower eyelids. Upper eyelids are far more mobile and are closed under more tension. The skin edges must be actively held together during glue closure. By contrast, lower eyelid subciliary incisions can be placed in apposition and glued without the use of forceps. Thus, there is a higher risk of glue leaching between the flaps in upper blepharoplasty than in lower blepharoplasty, and the glue must
resist the higher forces of eyelid opening, closure, and brow elevation.

Two techniques of glue application were assessed: the Dermabond applicator and the siliconized insulin syringe. The Dermabond applicator is approximately 5 mm in diameter, too wide for easy use in blepharoplasty, although it was successfully used in 16 of our cases. Our preferred method is a siliconized tuberculin syringe with a ½-in, 27-gauge needle for pinpoint application of adhesive. This method was faster, more precise, and never led to leaching of adhesive that then needed to be removed with a swab.

CONCLUSIONS

- Octyl-2-cyanoacrylate glue is an easily applied, excellent alternative to suture closure, producing equivalent quality of closure at all time points and no distinguishable difference in appearance 4 weeks after surgery.
- Wound healing characteristics of blepharoplasty incisions closed with octyl-2-cyanoacrylate were excellent, without any inflammatory complications or delay of healing. Octyl-2-cyanoacrylate produced less inflammation than fast-absorbing gut sutures.
- Octyl-2-cyanoacrylate withstood the forces of closure in blepharoplasty without dehiscence and in the absence of sutures, even with the added forces imparted by concurrent browlift.
- In selected cases, octyl-2-cyanoacrylate can produce greater comfort and a smoother initial closure, free from the deformation produced by a running suture.
- Our recommended technique for the use of glue in upper eyelid blepharoplasty involves the placement of 3 absorbable sutures as handles, followed by edge apposition and octyl-2-cyanoacrylate application with a siliconized tuberculin syringe. This technique is rapid, fairly easy, and produces excellent aesthetic results.

REFERENCES