Expanded applications for octyl-2-cyanoacrylate as a tissue adhesive.

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Expanded Applications for Octyl-2-cyanoacrylate as a Tissue Adhesive

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The commercial introduction of octyl-2-cyanoacrylate as a medical-grade tissue adhesive was intended to be a rapid, painless, suture-free method for closure of simple lacerations and surgical wounds. The efficiency and therefore potential economic advantage of this material has led to further investigations of other possible indications. This glue has now been used in more than 100 different occasions for "off-label" applications including nailbed repair, skin graft fixation, temporary otoplasty, wound sealant, and other forms of wound closure. Complications are virtually nonexistent, and there has been no evidence of histotoxicity. The role of this material as an important reconstructive tool has not yet been delineated completely, but it appears to have no contraindications if used sensibly.

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Cyanoacrylates have been used clinically for more than 40 years as a synthetic tissue adhesive.[1,2] They polymerize rapidly to adhere tightly to proteinaceous surfaces, form a strong and flexible bond, and are resorbable.[1] Biocompatibility is related directly to histotoxicity resulting from formation of formaldehyde and cyanoacetate compounds on degradation,[1,3,4] which can be manifested adversely by acute or chronic inflammation.[2]

The longer chain cyanoacrylates are less reactive than the original shorter chain alkyls, because the former are degraded less rapidly.[1,3] Octyl-2-cyanoacrylate is the latest and even longer chain form. It has a breaking strength three times that of the n-butyl-cyanoacrylates still commercially available, which is approximately equivalent to that of a 5-0 nylon suture.[2,5] A plasticizer has also been included that permits formation of a more flexible bond.[4]

Octyl-2-cyanoacrylate has heretofore been used primarily for repair of lacerations[6,7] and incisions.[3,5] Rate of wound dehiscence, hematoma formation, and infection are no different than sutured repairs.[3] "Spin-off" applications deserve further investigation, possibly to tap the speed, efficiency, and economic advantage of this material.

Methods

The tissue adhesive octyl-2-cyanoacrylate is available in convenient single-use vials (Dermabond; Ethicon, Inc., Summerville, NJ). As a general recommendation, all tissue surfaces should be as clean and dry as possible so that contact is made directly on the involved structures. After the vial is broken, the liquid can be wiped or dripped onto the wound as necessary. Multiple, minimal coatings are superior to placing a large quantity that could run off onto unintended sites. After approximately 30 seconds of immobilization, the exothermic reaction of the polymerization is complete.

A prospective review of the past 18 months of this use of octyl-2-cyanoacrylate for situations other than simple lacerations or excisions was undertaken. This involved 102 different encounters in 92 patients (Table). Specific methodologies varied according to the desired application, as detailed in the following paragraphs.

Otoplasty

Cyanoacrylates were reported previously in this journal for achieving a "30-second" otoplasty.[8] A drop of glue placed on the mastoid area allows the protruding ear to be pushed back to recreate the anthelical fold (Fig 1.). The adhesive sloughs with the epidermis in 7 to 14 days, so this is a safe but temporary nonsurgical method that could avoid cumbersome splints for the neonate.[9]

Applications Using Octyl-2-cyanoacrylate

Characteristic	n	N
Graft fixation		14
Nailbed graft	1	
Split-thickness skin graft	9	
Full-thickness skin graft	4	
Nailplate adhesive		71
Stent of nailbed repair		
Laceration only	38	
Partial amputation	4	
Scar revision	3	
As fixation point for cross-finger flap	1	
Consolidation of split nailplate	11	
Silastic nail implant	1	
Recovered nailbed		
Avulsed nailplate	1	
Split toe graft donor site	3	
Foreign body retrieval	4	
Lesion removal	5	
Transient otoplasty		2
Wound closure		14
Dehiscence	1	
Subcuticular closure	6	
Groin skin graft donor site	6	
Direct repair of nailbed	1	
Wound sealant		1
Total		102[a]

[a]Of 92 patients.

Nail Plate

After nailbed violation, replacing the nail plate under the proximal nailfold provides a stent for any repair, biological cover to prevent desiccation, and rigid splint of any fracture.[10] A light drip of the adhesive along the perionychium after the nail plate is returned in situ avoids the use of sutures or Steri-Strips for such fixation (Fig 2).[10,11] No glue is needed on the nail undersurface,[12] because good contact can be maintained by external pressure with a forceps on the nail until it is "set." The split or torn nail plate pieced together properly on the nailbed can also be glued easily to its appropriate position—a task otherwise near impossible. If the nail plate is unavailable, other materials such as a Silastic sheet "cut to fit" can be glued similarly into position.

Grafts

In lieu of suture or staples, a skin graft can be held in place by octyl-2-cyanoacrylate dripped at strategic points around its perimeter (Fig 3). Wiping or rubbing the glue onto the graft must be avoided because this could move the graft. If this maneuver bunches up the graft, flattening and reinsetting become impossible because "set" occurs so rapidly. The glue must not be placed in the interstices of meshed grafts because a foreign body reaction has been identified even 6 months after grafting, at least with the n-butyl-cyanoacrylates.[13]

Wound Closure

Most prior reports using octyl-2-cyanoacrylate concentrated on facial wounds,[3,4,6] but similar results can be expected throughout the body. Flexion surfaces and closures under tension are avoided. This adhesive has been helpful in reinforcing subcuticular closures,[14] and as the only method for skin closure after harvest of full-thickness groin skin grafts. Nevertheless, in both situations, subcutaneous sutures remain essential.

Sealant

In a single case, octyl-2-cyanoacrylate was applied to attempt leakage of a seroma through a surgical incision. The area involved was first carefully dried, and the adhesive was wiped over the skin orifice with the intent that it would dry as a patch.

Results

After these expanded uses of octyl-2-cyanoacrylate, failure occurred in only a single instance. The exception was the attempted sealing of the seroma. Although waterproof, it is acknowledged that repeated water exposure will prematurely weaken any cyanoacrylate bond, which invariably occurred.[2] Otherwise, in no patient was there evidence of any acute or chronic inflammation over the length of this study, implying an absence of any histotoxicity.

All meshed skin grafts were used to regraft the donor site in elderly patients to ensure healing, which was then uneventful. All full-thickness skin grafts retained recipient site viability. A major benefit was pain avoidance, which is always unpleasant when staples are used.

The nail plate, when returned as a stent, typically remained adherent over the nailbed for a few weeks, but sometimes stayed in place for a

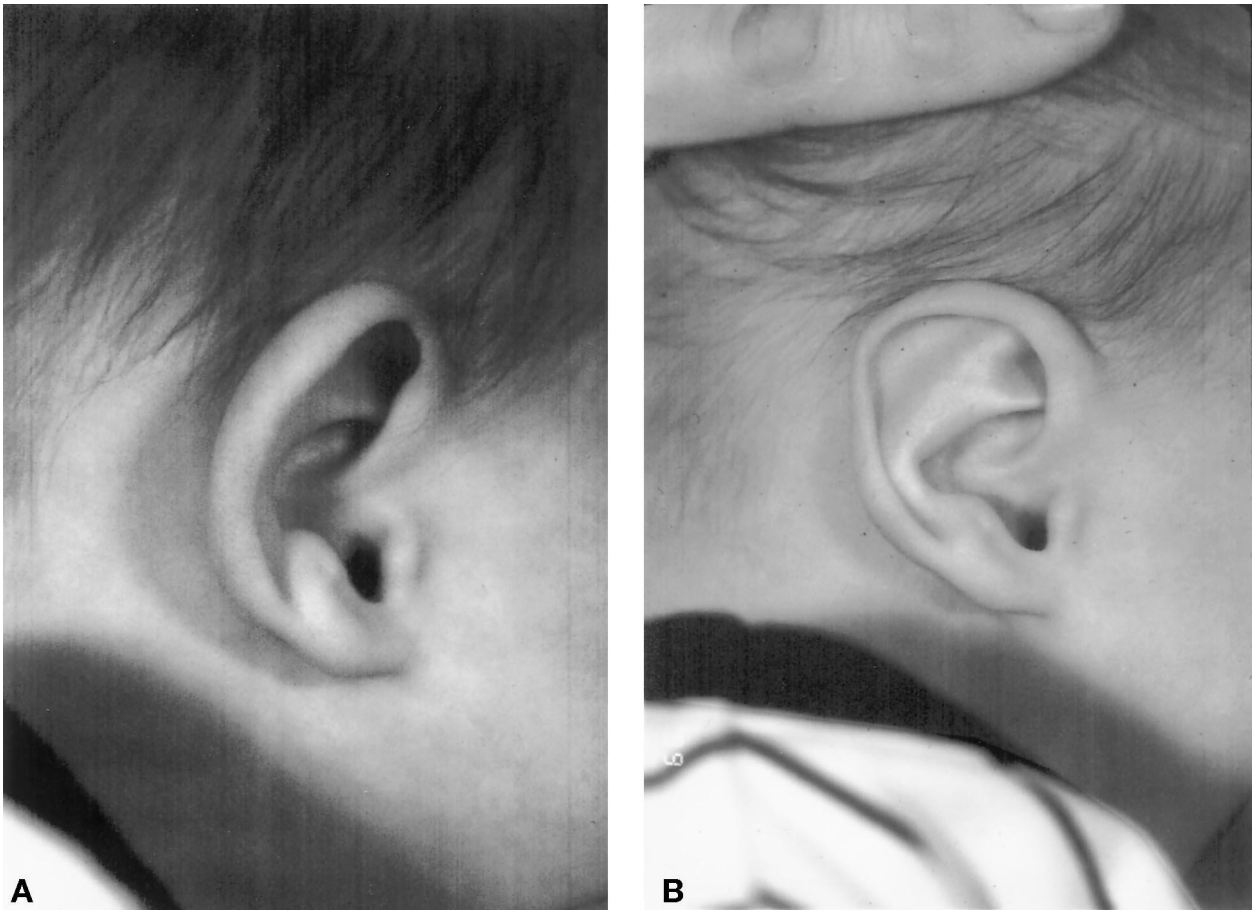

Fig 1. (A) Neonate with protruding ear. (B) After placing a drop of octyl-2-cyanacrylate onto the mastoid area and pressing the ear medially, a nonsurgical and reversible otoplasty was rapidly completed.

month or more until pushed off by the new nail. There was no noticeable change in the incidence of lack of nail plate adherence or abnormal regeneration.

Discussion

Ethyl-cyanoacrylates can be purchased "over the counter" in this country as a "brush on" nail glue for the repair of split, cracked, or torn nails. Medical-grade n-butyl-cyanoacrylates have been used similarly to reaffix nailplates,[12] in addition to indications other than the closure of facial wounds or simple lacerations. This precedent has included grafts of skin, bone, cartilage, and corneas.[1,2,13] The delicate tips of flaps have been inset without the trauma of suturing.[13] Internal fixation after craniofacial osteotomies in lieu of conventional fixation devices has been accomplished at least experimentally.[15] Sealing leaks from esophageal varices or cerebrospinal fluid has also been attempted.[2,3]

The introduction of this even longer chain homologue—octyl-2-cyanoacrylate—appears to have the potential to supersede the role of the n-butyl-cyanoacrylates because it is less brittle, more flexible, and more biocompatible.[2,3,6,16] This experience seems to indicate the truth of this prediction, as demonstrated by our success with multiple indications (see the Table). Its low histotoxicity has even allowed patent microanastomoses[17]! At least to date, there have been no contraindications to suggest even more widespread applications.

Debra A. Lutz, RN, The Lehigh Valley Hospital, Allentown, PA, provided insight and assistance with many of these patients.

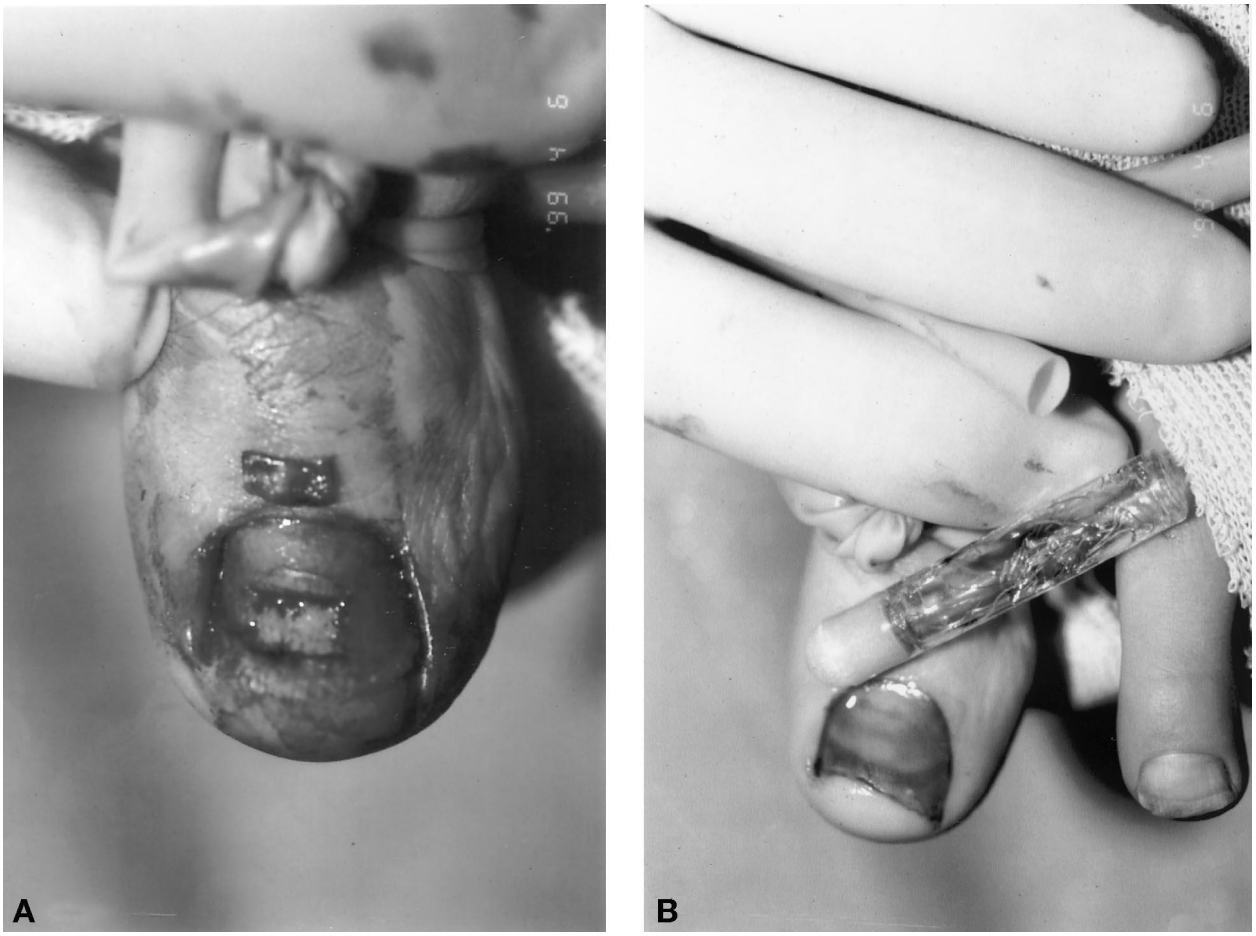

Fig 2. (A) Harvest of split nailbed graft (seen above the proximal nailfold) from the great toe. (B) The nail plate is returned to the great toe as a conforming stent, and is held in position with octyl-2-cyanoacrylate adhesive placed around its perimeter.

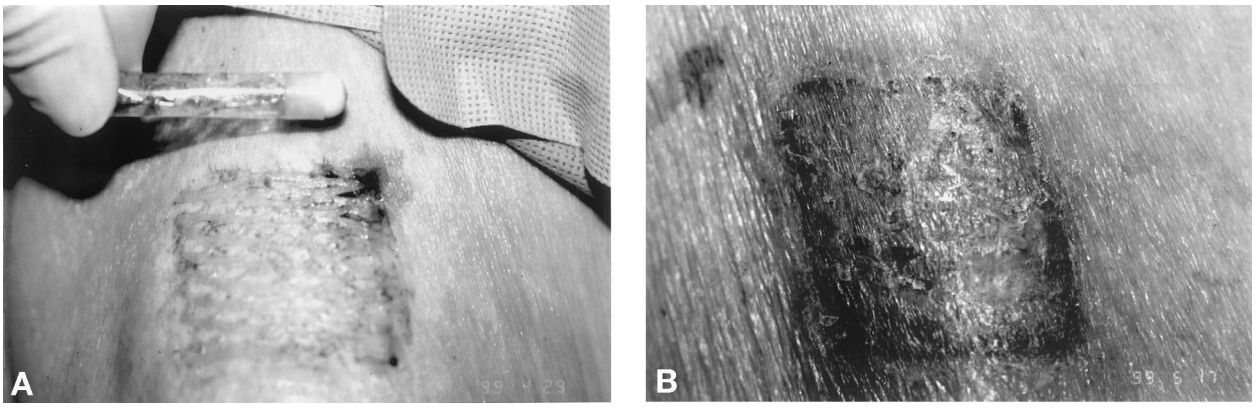

Fig 3. (A) Meshed, split-thickness skin graft returned to hasten thigh donor site healing, affixed in place at its corners by drops of octyl-2-cyanoacrylate. (B) Reepithelialized donor site 3 weeks later.

References

1 Ousterhout DK, Steinicki EJ. Plastic surgery's plastics. Clin Plast Surg 1996;23:183–190

2 Penoff J. Plastic Surgery Educational Foundation DATA Committee. Skin closure using cyanoacrylate tissue adhesives. Plast Reconstr Surg 1999;103: 730–731

3 Toriumi DM, O'Grady K, Desai D, Bagal A. Use of octyl-2-cyanoacrylate for skin closure in facial plastic surgery. Plast Reconstr Surg 1998;102:2209–2219

4 Eppley BL. Alloplastic implantation. Plast Reconstr Surg 1999;104:1761–1783
5 Maw JL, Quinn JV, Wells GA, et al. A prospective comparison of octylcyanoacrylate tissue adhesive, suture for the closure of head neck incisions. J Otolaryngol 1997;26:26–30
6 Quinn J, Wells G, Sutcliffe T, et al. A randomized trial comparing octylcyanoacrylate tissue adhesive, sutures in the management of lacerations. JAMA 1997;277:1527–1530
7 Singer AJ. Evaluation, management of traumatic lacerations. N Engl J Med 1997;337:1142–1148
8 Scrimshaw G. The 30-second otoplasty. Ann Plast Surg 1983;10:86–87
9 Matsuo K, Hirose T. A splint for nonsurgical correction of cryptotia. Eur J Plast Surg 1989;12:186–187
10 Shepard GH. Management of acute nail bed avulsions. Hand Clin 1990;6:39–56
11 Zook EG. Discussion. Management of acute nail bed avulsions. Hand Clin 1990;6:57–58
12 Richards AM, Crick A, Cole RP. A novel method of securing the nail following nail bed repair. Plast Reconstr Surg 1999;103:1983–1985
13 Wilkinson TS, Rybka FJ. Experimental study of prevention of tip necrosis in ischemic Z-plasties. Plast Reconstr Surg 1977;47:37–38
14 Solmer R. What's wrong with Dermabond? Plast Reconstr Surg 2000;105:2276 [Letter]
15 Armante MTJ, Constantinescu MA, O'Connor D, Yaremchuk MJ. Cyanoacrylate fixation of the craniofacial skeleton: an experimental study. Plast Reconstr Surg 1995;95:639–646
16 Saltz R. Update. Tissue sealants in plastic surgery. Aesthetic Surg J 1999;19:168–169
17 Hall WW, Wrye SW, Banducci DR, Ehrlich P. Microvascular anastomosis using 2-octyl cyanoacrylate in the rat femoral artery. Ann Plast Surg 2000;44:508–511