Octylcyanoacrylate Tissue Adhesive in the Repair of Pediatric Extremity Lacerations

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Lacerations comprise a significant number of emergency department referrals for pediatric patients. Management of lacerations with sutures involves the use of needles and the injection of local anesthetic and represents a unique challenge in the wound management of an already distressed and frightened child. Octylcyanoacrylate, a new-generation, medical-grade tissue adhesive, has been found to be an effective alternative to replace skin sutures on virtually all facial lacerations and has been employed in low-skin tension wound management. Its use, however, has generally been avoided in the management of high-skin tension lacerations. Over the last 10 months, 32 children with high-skin tension (hand, feet, and over joints) lacerations were managed at our center by octylcyanoacrylate tissue adhesives. Skin closures and splints were applied to restrict movement of the affected area to overcome the limitation of adhesive application. Octylcyanoacrylate adhesive applied with optimal immobilization was found to be an effective method of skin closure in high-skin tension lacerations. Advantages of tissue adhesives for incision and laceration include quick application, excellent cosmetic results, patient preference, and cost effectiveness.

THE CYANOACRYLATE GROUP of adhesives were first described in 1949, but it was not before 1959 that their potential as clinical adhesives for surgical procedures was reported.[1] On contact with a fluid or basic substance, these adhesives polymerize in an exothermic reaction forming a strong bond. Investigations performed in the 1960s and 1970s to assess their application as tissue adhesives concluded that the shorter-chain cyanoacrylate monomers were tissue toxic, and therefore their clinical use was limited. However, the longer-chain *N*-2-butylcyanoacrylates caused no toxic effects or carcinogenicity and were found to be a better alternative for topical skin closure.[2]

Although butylcyanoacrylates are effective at closing superficial lacerations under low tension, they do have several limitations. Studies have shown wound-breaking strength of butylcyanoacrylates to be equal to that of suture-repaired wounds at 5 to 7 days, but with the day 1 breaking strength being only about 10 to 15 per cent of that of a wound closed with 5-0 monofilament sutures.[3,4] Also, despite forming a strong bond after polymerizing, the butyl derivatives become brittle and are subject to fracture when used on long lacerations, over skin creases and joints, or on areas of movement (*high skin tension*).[5]

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Octylcyanoacrylate (Dermabond®, Ethicon, Norderstedt, Germany), a new-generation, medical-grade longer-chain-formulated cyanoacrylate addresses the limitations of the butyl-cyanoacrylates. This longer-chain-formulated cyanoacrylate is a combination of monomer and plasticizers that forms a flexible bond. It has a 3-dimensional breaking strength four times that of *N*-2-butylcyanoacrylate.[6] However, the application of octylcyanoacrylate has also been traditionally restricted to facial lacerations and lacerations in areas away from joint proximity (*low skin tension*).

Patients and Methods

Over a 10-month period from July 1997 through April 1998, 145 children with lacerations in the 2 to 16-year-old age group were managed at the Emergency Service of the Pediatric Surgical University Clinic, Münster. Sixty-four children presented with high skin tension lacerations (26 knee, 20 elbow, 10 hand, and 8 feet) and fulfilled the exclusion criteria (Table 1). After randomly dividing cases into two groups, these lacerations were managed using octylcyanoacrylate tissue adhesives or sutures. The mean length of the lacerations was 2.4 ± 1.2 cm. Wounds were prepared in the standard manner after cleansing with chlorhexidine solution and achieving hemostasis with pressure. After the wound edges were manually approximated by fingers, octylcyanoacrylate was painted on the apposed edges with the applicator tip. Care was taken not to apply adhesive between the wound edges. The wound was held for 30 seconds to

TABLE 1. *Exclusion Criteria for Tissue Adhesive Laceration Repair*

Contraindications to Laceration Repair Using Tissue Adhesives
Soiled or heavily contaminated wounds
Wounds requiring debridement
Animal or human bite wounds
Animal scratch wounds
Puncture wounds
Stellate crush wounds
Mucocutaneous junction wounds
Scalp lacerations
History of skin allergy
History of keloid formation
Ear lacerations
History of diabetes or corticosteroid use

allow complete polymerization. Skin closures (Steri Strip™, 3M Health Care, Borken, Germany) 25 × 125 or 12 × 100 mm were used to secure the approximated wound edges and decrease tension at the point of adhesive application. Splints were used in all children to immobilize the extremity or joint for 7 to 10 days. Sutured wounds were anesthetized and cleaned, and the skin was closed with a 5-0 monofilament suture by standard sterile techniques.

Results

Sixty-four children with high-skin tension lacerations were managed after being randomly divided into two groups (32 in suture group and 32 in octylcyanoacrylate group). All of the patients were evaluated on days 7 to 10 for wound assessment after skin closure and splint removal or suture removal. There was one infection that required antibiotic therapy in the suture group. Two wound dehiscences occurred in the adhesive group, and each closed spontaneously without any adverse outcome.

Patients were seen at 12 weeks postmanagement for wound evaluation and to have a photograph of their healing wound. Photographs were taken with the use of a 1:3 macro setting with a ring flash and slide film (100 Kodak Ektachrome).[7] These photographs were rated for cosmesis on a validated standard 100-mm visual analog scale (VAS).[8] The cosmesis VAS is a 100-mm line with the "worst scar" at the right end of the line and the "best scar" at the left end. The mean VAS cosmesis score was 70 mm in the tissue adhesive group (*vs* 68 mm in the suture group). The incisions were further rated using the Holander Wound Evaluation Scale.[9] The score addresses six clinical variables: step-off borders, contour irregularities, scar width, edge inversion, excessive inflammation, and overall cosmetic appearance. Each of these categories is graded on a 0- or 1-point scale, and a score of 6 is considered optimal, whereas a score of 5 or less is suboptimal. Eighty-three per cent of patients attained optimal late wound scores in the adhesive group (*vs* 84% in the suture group).

Discussion

The application of tissue adhesives as an alternative to sutures has gained high acceptance in the management of lacerations in the pediatric age group. The fear of medical intervention using needles and sutures frightens the already traumatized child and often renders a child more uncooperative because of this fear rather than because of the actual pain experienced in the injury. This fear of painful medical intervention further presents the traditional suture management of lacerations as a duel between the patient and the attending physician.

At our center, children over the age of 5 years with lacerations, when informed that their wounds would be managed without sutures, although skeptical, were more cooperative when tissue adhesives were applied. This not only allows the physician to attend to the wound optimally, but also permits thorough inspection of the wound bed to rule out any foreign body that may be embedded inside. Tissue adhesives until now have been generally avoided on the hands, feet, or high-skin tension joints. High-skin tension lacerations were successfully managed in our patients using skin closures and splints to permit optimal tension at the wound edges similar to those of low-skin tension lacerations for adequate wound healing and scar formation. Evaluation of our patients showed no significant difference in scar formation between the suture and adhesive group as assessed by the Holander Wound Evaluation Scale and cosmesis VAS scores. Furthermore, histological studies have also reported no difference in wound healing characteristics between sutured and tissue adhesive repaired wounds.[10]

Tissue adhesive wound repair is a topical closure and has been found to be as effective as 5-0 monofilament suture for low-tension lacerations.[11] Care should be taken to ensure that the wound edges are well apposed so that no adhesive gets in between the wound edges. Tissue adhesive between the wound edges impairs healing (epithelialization is prevented) and could elicit foreign body reactions.[12, 13] When used properly for topical wound closure, tissue adhesives can decrease infection rates in contaminated wounds caused by antimicrobial properties against Gram-positive organisms.[14, 15] Also, because this is a needleless method of wound repair, the probability of needlestick injury is eliminated. These factors, along with their relatively low cost, make tissue adhesives an economical method of wound repair, with strong patient and physician preference.[16] Octylcyanoacrylate tissue adhesive can replace skin sutures on virtually all facial, extremity, and torso lacerations, and this painless wound closure may change the course of future wound management in children to that of a less distressing experience.

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