Evaluation of a cyanoacrylate liquid skin protectant for the treatment of type 1 and 2 skin tears at a long-term care facility


Authors:
Kimberly LeBlanc and Dawn Christensen

The prevention and treatment of skin tears provide a unique challenge, especially in older individuals. This case study evaluated a cyanoacrylate liquid skin protectant for the treatment of skin tears in 20 patients who were residents of a long-term care facility in Ontario, Canada. Individuals were eligible for the study if they presented within 4 hours with a type 1 (no flap loss) or type 2 skin tear (minimal flap loss). After wound cleansing, cyanoacrylate liquid skin protectant was applied to the wound edges. The skin tears were evaluated at 0, 3 and 10 days. Complete closure of all 20 skin tears was observed within 10 days after a single application of cyanoacrylate. No associated problems were reported and patients reported minimal or no pain. In conclusion, one application of a no-sting cyanoacrylate liquid skin protectant is a viable option for type 1 and 2 skin tears, and can provide patients with increased comfort, minimal to no pain, and no signs or symptoms of infection.

***Kimberly LeBlanc** is Chair of the WOC-Institute, Nurses Specialized in Wound Ostomy and Continence Canada (NSWOCC); **Dawn Christensen** has retired from KDS Professional Consulting*

Wound care is a major concern for patients with acute or chronic skin injuries. Cyanoacrylate adhesives were first produced in 1949, and in 1959 it was suggested they could have a surgical use (Eaglstein and Sullivan, 2005). These glues undergo an exothermic polymerisation reaction when they come into contact with skin, providing a protective seal with microbial properties. Because the adhesive is applied as a liquid, there is no need for removal of bandages once the wound has closed. Cyanoacrylate adhesives are designed to polymerise quickly and slough off within 5–10 days.

Originally, the quick-setting cyanoacrylate adhesive known as "super glue" was developed for household use. However, the notion that similar substances may have medical uses did not take hold until the longer chain cyanoacrylates 2-octyl cyanoacrylate (2-OCA) and n-butyl cyanoacrylate (BCA) were developed and approved as tissue sealants for the treatment of skin wounds and injuries. These longer chain adhesives have been used to treat skin tears, minor cuts, abrasions and burns. Tissue sealants containing 2-OCA last longer, are more flexible and are four times stronger than BCA (Singer et al, 2002; Chow et al, 2010).

TisssueSeal, containing BCA, was one of the first commercially available cyanoacrylates in the late 1960s and is used as a tissue adhesive for skin closure. The goal was to produce a tissue adhesive that could close small wounds without suturing or stapling. Dermabond was the first 2-OCA product and was approved by the Food and Drug Administration in 1998 for over-the-counter use as a topical skin adhesive for the treatment of minor cuts and abrasions. The 2-OCA demonstrated a low rate of dehiscence and low infection rate, and provided excellent cosmetic results for skin closure caused by traumatic lacerations and surgical incisions (Singer et al, 2002). The currently commercially available skin and tissue sealants include 2-OCA, high-viscosity 2-OCA, BCA, 2-OCA/BCA blends, and non-cyanoacrylates.

The use of cyanoacrylate skin adhesives to close minimal surgical wounds, lacerations, and skin lesions has become common practice. Several studies have compared standard wound closure (SWC) methods, such as suturing, skin clips, skin staples, adhesive strips, and adhesive

tape, to cyanoacrylate skin adhesives either alone or in conjunction with SWC (Mattick et al, 2002; Singer et al, 2002; Chow et al, 2010; Vlahovic et al, 2011).

A multicentre randomised controlled trial (n=814) evaluated 924 wounds: 383 lacerations, 235 skin lesions, and 316 minimal and general surgeries (Singer et al, 2002). The study was designed to evaluate wound closure using 2-OCA tissue adhesive compared to SWC methods. Wounds and lacerations were evaluated at three months for wound infection, dehiscence rates, and cosmetic outcome. Overall, wound closure was significantly faster using 2-OCA (2.9 minutes versus 5.2 minutes, p<0.001). At 1 week, the infections and dehiscence rates were similar to SWC and the overall appearance and cosmetic outcome was similar at 3 months. These results indicated that 2-OCA provides comparable low dehiscence, low infection rates, and excellent cosmetic results for the closure of lacerations and surgical incisions.

During a meta-analysis of randomised controlled trials, 2-OCA was compared to SWC (Chow et al, 2010). Data from 26 studies of 2,105 patients with 2,637 wounds compared the use of 2-OCA to SWC methods typically used for elective surgeries. Skin sutures were directly compared with tissue glue in 16 studies, and 14 studies showed that time for skin closure using tissue glue was considerably faster compared with skin sutures. However, unlike the findings from Singer et al (2002), wound dehiscence rates were significantly higher in the 2-OCA group compared with the SWC group (5.0% and 1.2%, respectively).

Blends of BCA and 2-OCA have been developed in order to incorporate the advantages of faster drying with greater flexibility. BCA dries faster but potentially is more brittle, while 2-OCA dries more slowly but is more flexible. Some products contain a blend of 90% BCA and 10% 2-OCA (Jan et al, 2013).

In a study of individuals with topical laparoscopy wounds (n=114), an BCA/2-OCA blend skin adhesive was compared to suture alone (Jan et al, 2013). The time to close wounds was significantly faster (P<0.001) by a mean of 2 minutes compared to sutures. In addition, 100% of surgeons were satisfied with the skin adhesive in terms of cosmesis and closure of the wound site.

Cyanoacrylates have also been used successfully for the treatment of pedal skin fissures (Milne et al, 2011; Vlahovic et al, 2011), and protection against moisture-associated skin damage (Woo et al, 2017).

In a randomised controlled trial of paediatric laceration repair, individuals (n=44; median age 4 years old) were treated with 2-OCA with or without adhesive strips (Mattick et al, 2002). Wounds considered for closure were non-infected lacerations that were <5 cm in length. Parents were asked their opinion of the cosmetic outcome (scarring) of the wound closure at 3–12 months post-treatment. Using a linear visual analogue score, the scores from both participants and surgeons showed no significant difference between the groups (Mattick et al, 2002). Cyanoacrylate topical skin adhesives alone are unsuitable for high-tension wounds (Singer et al, 2008; Spotnitz and Burks, 2010). Most studies of cyanoacrylate adhesives have been limited to short lacerations and incisions, suggesting that tissue adhesives should be limited to low-tension lacerations. The use of cyanoacrylates should be avoided in higher tension wounds unless used in conjunction with deep tension-relieving sutures, surgical tapes and immobilisation (Singer et al, 2008).

Recently, high-viscosity 2-OCAs have been developed in order to increase bursting strength, improve flexibility and decrease wound site migration (Singer and Perry, 2012). More recent clinical evidence suggests that high-viscosity 2-OCA may be more suitable for use on high-tension wounds. However, in terms of wound closure, deep dermal suturing and prevention of infections, high-viscosity 2-OCAs have been shown to be equivalent to low-viscosity 2-OCAs (Blondeel et al, 2004; Miller and Swank, 2010).

In a study of a 35 emergency room patients (aged 7–78 years), a high-viscosity 2-OCA was evaluated for the treatment of 36 lacerations (Wolfe et al, 2017). Skin lacerations were located on fingers, toes, hands, feet, arms, legs and faces, with lengths of 9–90 mm and a mean length of 22.8 mm. Prior to emergency room discharge, adequate haemostasis and wound closure occurred in 97% of patients. At 5–10 day follow-up, 94% of patients reported haemostasis and 84% of patients reported wound closure. The first 2 days post treatment showed the highest occurrence of wound dehiscence (4 out of 36 wounds), mostly occurring in patients with finger wounds at the joints. Finger splinting following tissue glue was recommended to avoid dehiscence.

The cyanoacrylates have shown limited capacity for haemostasis (Singer et al, 2008). In one study, 162 patients with minor cuts and abrasions were randomised to receive either a 2-OCA liquid adhesive bandage or a traditional

sheer adhesive bordered pad bandage. The results at day 12 in the 2-OCA treated group showed a significant difference ($P<0.05$) in terms of haemostasis and pain relief. However, no difference was observed in complete healing by day 12 (Eaglstein et al, 2002). Other types of tissue adhesives, including albumin–gluteraldehyde and fibrin sealants, have been explored for use, mainly as haemostatic agents for surgical applications and skin grafts for burns (Reece et al, 2001; Spotnitz, 2014; Boccara et al, 2014).

Skin tears may be particularly amenable to closure by cyanoacrylates. Skin tears are defined as "traumatic wounds caused by mechanical forces, including removal of adhesives" (LeBlanc et al, 2018).

The International Skin Tear Advisory Panel (ISTAP) developed and validated the ISTAP Skin Tear (ST) Classification System (LeBlanc et al, 2014). The purpose of the ISTAP ST Classification was to establish a simple and common language for describing and documenting skin tears. The ISTAP classification groups skin tears into three types. A type 1 tear has no skin loss, with a linear flap tear that can be repositioned to cover the wound bed. A type 2 tear is characterised by partial flap loss that cannot be repositioned to cover the wound bed. Finally, a type 3 tear entails total flap loss, exposing the entire wound bed.

A study of emergency room patients (n=40) with 50 wounds, including 11 skin tears and 39 abrasions, were assessed to evaluate the efficacy of a no-sting cyanoacrylate liquid skin protectant (Singer at al, 2015). Participants were aged 20–90 years, with wounds on the face (n=16), hands (n=14), legs (n=11) and arms (n=9). All participants were monitored every 1–2 days until complete wound healing was obtained. The median time to complete closure and sloughing of the overlying scab was 10 days (range 7.4–14.0 days) with mean healing time at 12.4 days (range 10.8–14.1 days). Complete wound closure occurred in 90% of patients and 92% of wounds treated. One participant with a type 2 skin tear required the application of surgical tape to the edges of the tear following application of the cyanoacrylate and the wound closed in 17 days.

While prevention of skin tears needs to be the primary focus, healthcare professionals working with the older population must be able to identify and manage these types of wounds. There has been an increase in the attention given to skin tears in the literature; however, there is still no gold standard for their identification, treatment and management.

Aim

The purpose of this case report was to explore the use of a no-sting cyanoacrylate liquid skin protectant to treat skin tears in older residents (n=20) at a long-term care facility presenting with type 1 and 2 wounds based on the criteria described by the ISTAP ST Classification System (LeBlanc et al, 2014).

Materials and methods

During a 1-month study period, 20 patients (14 women and 6 men) were enrolled, ranging in age from 79 to 94 years. They resided in a long-term care facility and presented with type 1 or 2 skin tears according to the ISTAP classification to the wound care specialist in the LTC facility. Trained registered nurses applied the topical treatment. No patients with type 3 tears were evaluated. There was one skin tear per study participant.

Ethical approval was obtained from the long-term care facility's ethical review panel. Written consent for participation and photography was obtained from either the participants or their power of attorney.

The skin tears were treated with a cyanoacrylate liquid skin protectant (OCA). Prior to treatment, each participant's skin tear was cleansed and controlled for bleeding within 4 hours of the initial trauma. The wound edges were approximated immediately preceding cyanoacrylate application. The cyanoacrylate liquid skin protectant was applied according to the manufacturer's instructions and allowed to dry. The wound was protected from additional trauma during the healing process; skin tear prevention protocol was initiated, individuals wore long sleeves and pants, as well as shin guards when required.

Photos of each individual's skin tears were taken at 0, 3 and 10 days. Skin tears were evaluated at 3 and 10 days for closure. There were no additional applications of the cyanoacrylate during the healing process.

Results

Following application, complete closure occurred within 10 days folowing application in all 20 subjects, with no signs or symptoms of infection. In addition, all individuals reported experiencing no pain associated with application of the cyanoacrylate liquid skin protectant.

The long-term care facility registered staff nurses reported no problems associated with the cyanoacrylate application. In addition, participants reported a degree of comfort and

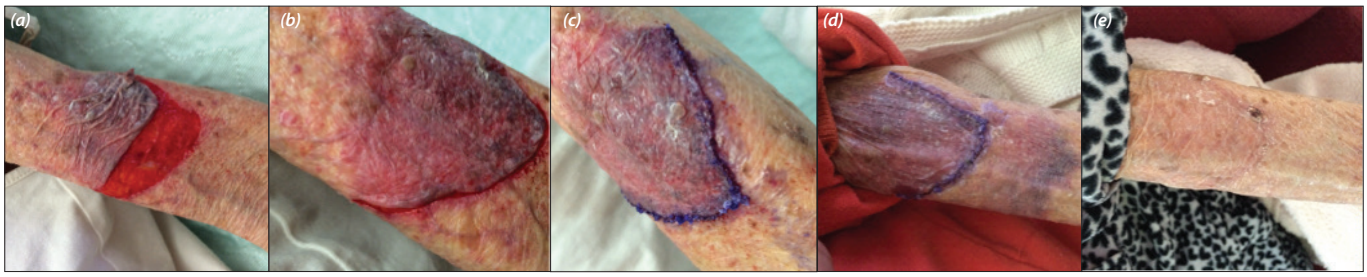

Figure 1. Type 1 skin tear on the upper arm. (a) Pre-treatment. (b) Alignment of wound edges. (c) After application of cyanoacrylate liquid skin protectant. (d) Day 3. (e) Day 10.

Figure 2. Type 2 skin tear of the right cheek. (a) Pre-treatment. (b) Day 3. (c) Day 10.

Figure 3. Type 1 skin tear of the lower leg. (a) Post-treatment. (b) Day 3. (c) Day 10.

minimal or no pain associated with application. As an additional benefit, staff nurses speculated that the patients would be less likely to scratch and pick at the wound site after application of the cyanoacrylate liquid skin protectant and during the healing process.

These results confirm that the cyanoacrylate liquid skin protectant was equally as effective in the treatment of both type 1 and type 2 skin tears in older patients.

In this report, we provide specific details on three cases that are representative of the broader group of 20 participants.

Case 1

An 84-year-old woman with a type 1 skin tear on the upper forearm was evaluated at day 0 post-alignment of wound edges and after application of the cyanoacrylate liquid skin protectant *[Figure 1]*. The partial skin flap was approximated and re-aligned prior to the cyanoacrylate application. Follow-up at day 3 showed that the edge of the wound was completely closed with continued wound healing evident at 10 days post-treatment.

Case 2

A 79-year-old woman with a type 2 right side facial skin tear was evaluated at days 0, 3 and 10 after application of the cyanoacrylate liquid skin protectant *[Figure 2]*. On day 0, the partial skin flap was re-positioned prior to application. Day 3 showed healing of the wound edges, with slight inflammation occurring. Complete wound closure and healing was observed, with minimal facial scarring at day 10 post-treatment.

Case 3

A 93-year-old man with a type 1 skin tear on the left lower leg was evaluated on days 0, 3 and 10 after application of the cyanoacrylate liquid skin protectant *[Figure 3]*. Initial closure of the wound was observed by day 3, with complete resolution occurring by day 10 post-treatment.

Discussion

Ageing individuals are commonly affected by skin tears, especially those individuals who have compromised nutrition, have had previous skin tears, or are challenged with wheelchair or bed confinement. Age-related skin changes are a major contributing factor to skin tear development (Milne et al, 2011). More than 1.5 million skin tears occur each year in skilled nursing home facilities (Milne et al, 2011).

In one study, it was found that 22% (25 out of 113) residents in a long-term care facility had skin tears (LeBlanc et al, 2013a). Of those reported, 51% were rated as a skin tear with no skin loss (ISTAP type 1 equivalent), 16% as having partial flap loss (ISTAP type 2), and 33% as total flap loss (ISTAP type 3). The most common skin tear locations were arms (48%), lower legs (40%) and hands (12%).

Given the presumed high prevalence of skin tears and the associated cost for treatment, it is important that cost-effective methods are implemented to manage skin tears (Woo, 2014; LeBlanc et al, 2018).

The results of this case series support the use of a no-sting cyanoacrylate liquid skin protectant to treat ISTAP type 1 and 2 skin tears in older individuals. Our results show

that 100% of skin tears treated with a single application of cyanoacrylate had complete closure at 3–10 days post treatment. Moreover, treatment was associated with minimal or no pain and patient comfort, as well as decreasing the nursing time required for wound care. In addition, staff nurses reported that there were no problems associated with the cyanoacrylate application. The cost was estimated to be C$5.00 per application, based on the unit price of the cyanoacrylate, which is consistent with previously reported costs for the management of skin tears (Woo, 2014).

The results of this case study support an earlier study in which older residents (mean 82.5 ± 11.2 years of age) from three long-term care facilities presenting with types 2 and 3 skin tears were treated with a 2-OCA topical bandage. All participants had commonly occurring type 2 and 3 skin tears that were less than 8 hours old. When evaluated at 1 week post-treatment, 90% (18/20) had complete healing with only one application of a 2-OCA topical bandage. Only one patient reported experiencing pain during treatment. These results suggest that a 2-OCA topical bandage may be appropriate for the treatment of skin tear wounds with a more extensive skin flap epidermal loss of 25–100% (Milne and Corbett, 2005).

The case series also provides supporting evidence for the ISTAP Skin Tear Product Selection Guide (LeBlanc et al, 2016). ISTAP conducted a Delphi study to establish consensus on appropriate management options for skin tears. Consensus was set at 80%. A convenience sample of 121 wound care experts with experience in managing skin tears participated in the study. ISTAP and the international review panel agreed or somewhat agreed (85.7%) that 2-OCA products are appropriate for the treatment of type 1 and 2 skin tears according to the ISTAP classification (LeBlanc et al, 2016).

From the review of the literature, several commercially available skin glues or liquid skin protectants that can be used for the treatment of skin tears were identified. The selection of different forms of skin glue is beyond the scope of this case series. However, it is suggested that treatment should be based on the type of skin tear, ease of use and comfort to the individual.

Conclusion

The presented case series supports the effectiveness of a no-sting cyanoacrylate liquid skin protectant as a viable treatment for ISTAP type 1 and 2 skin tears. The authors conclude that one application of a cyanoacrylate liquid skin protectant can be used effectively to treat patients with ISTAP type 1 and 2 skin tears and will provide increased patient comfort, minimal to no pain, reduced infections with minimal wound intervention and reduced costs. WINT

References

Blondeel PN, Murphy JW, Debrosse D et al (2004) Closure of long surgical incisions with a new formulation of 2-octylcyanoacrylate tissue adhesive versus commercially available methods. *Am J Surg* 188(3): 307–13

Boccara D, De Runz A, Bekara F et al (2017) Artiss Sealant®: an alternative to stapling skin grafts on the dorsal side of the hand and fingers. *J Burn Care Res* 38(5): 283–9

Chow A, Marshall H, Zacharakis E et al (2010) Use of tissue glue for surgical incision closure: a systematic review and meta-analysis of randomized controlled trials. *J Am Coll Surg* 211(1): 114–25

Eaglstein WH, Sullivan TP, Giordano PA, Miskin BM (2002) A liquid adhesive bandage for the treatment of minor cuts and abrasions. *Dermatol Surg* 28(3): 263–7

Eaglstein WH, Sullivan T (2005) Cyanoacrylates for skin closure. *Dermatol Clin* 23(2): 193–8

Jan H, Waters N, Haines P, Kent A (2013) LiquiBand® Surgical S topical adhesive versus sutures for the closure of laparoscopic wounds. A randomized controlled trial. *Gynecol Surg* 10: 247–52

LeBlanc K, Christensen D, Cook J et al (2013a) Prevalence of skin tears in a long-term care facility. *J Wound Ostomy Continence Nurs* 40(6): 580–4

LeBlanc K, Baranoski S (2014) Skin tears: best practices for care and prevention. *Nursing* 44(5): 36–46

LeBlanc K, Baranoski S, Christensen D et al (2016) The art of dressing selection: a consensus statement on skin tears and best practice. *Adv Skin Wound Care* 29(1): 32–46

LeBlanc K, Campbell K, Beeckman D et al (2018). Best practice recommendations for the prevention and management of skin tears in aged skin. *Wounds International*

Mattick A, Clegg G, Beattie T, Ahmad T (2002) A randomised, controlled trial comparing a tissue adhesive (2-octylcyanoacrylate) with adhesive strips (Steristrips) for paediatric laceration repair. *Emerg Med J* 19(5): 405–7

Miller AG, Swank ML (2010) Dermabond efficacy in total joint arthroplasty wounds. *Am J Orthop (Belle Mead NJ)* 39(10): 476–8

Milne CT, Corbett LQ (2005) A new option in the treatment of skin tears for the institutionalized resident: formulated 2-octylcyanoacrylate topical bandage. *Geriatr Nurs* 26(5): 321–5

Milne CT, Saucier D, Trevellini C, Smith J (2011) Evaluation of a cyanoacrylate dressing to manage peristomal skin alterations under ostomy skin barrier wafers. *J Wound Ostomy Continence Nurs* 38(6): 676–9

Reece TB, Maxey TS, Kron IL (2001) A prospectus on tissue adhesives. *Am J Surg* 182(2 Suppl): 40S–4S

Singer AJ, Chale S, Taylor M et al (2015) Evaluation of a liquid dressing for minor nonbleeding abrasions and class I and II skin tears in the emergency department. *J Emerg Med* 48(2): 178–85

Singer AJ, Perry L (2012) A comparative study of the

surgically relevant mechanical characteristics of the topical skin adhesives. *Acad Emerg Med* 19(11): 1281–6

Singer AJ, Quinn JV, Clark RE, Hollander JE (2002) Closure of lacerations and incisions with octylcyanoacrylate: a multicenter randomized controlled trial. *Surgery* 131(3): 270–6

Singer AJ, Quinn JV, Hollander JE (2008) The cyanoacrylate topical skin adhesives. *Am J Emerg Med* 26(4): 490–6

Spotnitz WD (2014) Fibrin sealant: the only approved hemostat, sealant, and adhesive – a laboratory and clinical perspective. *SRN Surg* 203943

Spotnitz WD, Burks S (2010) State-of-the-art review: Hemostats, sealants, and adhesives II: update as well as how and when to use the components of the surgical toolbox. *Clin Appl Thromb Hemost* 16(5): 497–514

Vlahovic TC, Hinton EA, Chakravarthy D, Fleck CA (2011) A review of cyanoacrylate liquid skin protectant and its efficacy on pedal fissures. *J Am Col Certif Wound Spec* 2(4): 79–85

Wolfe A, Aten A, Schrock JW (2017) The use of 2-octyl cyanoacrylate skin adhesive for laceration repair in the emergency department. *Clin Dermatol Res J* 2: 1

Woo KY (2014) Health economic benefits of cyanoacrylate skin protectants in the management of superficial skin lesions. *Int Wound J* 11(4): 431–7

Woo KY, Beeckman D, Chakravarthy D (2017) Management of moisture-associated skin damage: a scoping review. *Adv Skin Wound Care* 30(11): 494–501