

The Choice of Topical Tissue Adhesives for Wound Closure and Microbial Barrier Protection Spans Surgical Specialties and Procedures

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Although suturing remains the most common method of closing wounds, topical skin adhesives are increasingly being used in place of non-absorbable sutures, staples and adhesive strips. They offer a fast and less traumatic closure for appropriately selected wounds. Tissue adhesives are indicated for the closure of topical skin incisions and trauma-induced lacerations in areas of low skin tension. Topical adhesives may be applied over wounds initially under tension, as long as the tension is first alleviated by applying either subcutaneous or subcuticular sutures according to standard practice. Topical adhesives are not to be applied over joints, such as knees or elbows.

Topical adhesives are made from medical grade cyanoacrylates (medical grade crazy glue), which polymerise into a thin protective film over the wound edges when they come into contact with moisture in the skin. The polymerised cyanoacrylate adheres to the skin and itself, forming a clean strong adherent bond that holds the edges of skin wounds together so that wounds can heal normally underneath the film. When intact, the polymerised film also acts as a microbial barrier to protect the wound from the potential colonisation of infection-causing micro-organisms originating outside the wound. Topical tissue adhesives slough from the skin in seven to 10 days as the skin heals underneath and it is no longer required, thus eliminating the need for non-absorbable suture or staple removal.

This article explores the use of a particular topical tissue adhesive, across different surgical specialties and procedures. The tissue adhesive is applied sparingly in one continuous application and sets within 30 seconds. The combination of a single application and a non-clogging applicator tip helps maximise the length of the wound that can be closed per vial. Surgeons were asked to consider the following questions when drafting their submission for this article:

- What is your patient selection and exclusion criterion?
- What do you perceive to be the advantages/benefits of the product over conventional wound closure or other topical tissue adhesives?
- What was your learning curve with the tissue adhesive, including application tips or precautions that you would recommend?
- Were your patients pleased with their closed wounds?

Laparoscopic General Surgery

Dr William H Chapman, an Associate Professor of Surgery at the Brody School of Medicine in Greenville, North Carolina, writes, "As a General and laparoscopic surgeon, I perform at least 40 to 50 major operations per month. As an advanced laparoscopic surgeon, most of the surgeries I conduct are through small holes that range in size from 3mm to 15 mm. The types of operations I perform are: laparoscopic gastric bypass, laparoscopic colectomies, laparoscopic Nissen funduplications, laparoscopic adrenalectomies, laparoscopic inguinal and incisional hernias, laparoscopic splenectomies and laparoscopic biliary surgery. As a minimally invasive surgeon, I take pride in the cosmetic benefits of laparoscopic surgery. In the past, wounds were closed with deep dermal sutures followed by benzoin and adhesive strips and finally gauze and an OpSite® dressing. The final result was good except for those who developed tape blisters from the strips, had a reaction to the benzoin or split some of their subcuticular sutures. It was a cosmetic, reasonably quick, inexpensive way to close the wounds.

A few years ago I was asked to trial an octyl-cyanoacrylate tissue glue on trocar site closures. It was a short trial. The tissue glue took too long to dry. The applicator tip constantly became clogged and we were often using multiple vials to close five to six trocar sites. I stopped using the tissue glue and went back to adhesive strips. When a butyl-



cyanoacrylate was FDA [US Food and Drug Administration]-approved and released for use, I was sceptical. However, since the first time I used it, I have never looked back. I have used the glue in over 750 cases. The butyl-cyanoacrylate glue dries much more quickly in approximately 30 seconds. There really is no learning curve to use this glue. The applicator tip has never clogged up and to date I have never had to use more than one vial on any of my laparoscopic cases. I still use deep dermal sutures in the larger trocar sites (10mm, 12mm and 15mm) prior to applying the glue. I have not had any skin dehiscences since using the glue and I have used it on people weighing in excess of 500lbs.

I also use a butyl-cyanoacrylate on all of my thyroidectomy incisions and open hernia incisions, which range in size from 8cm to 15cm. Again, I usually place some interrupted deep dermal sutures prior to using the glue. The wound should be haemostatic or the glue and blood will form a coagulum over the wound and will not really approximate the skin as well. I usually keep the wounds covered with gauze and an OpSite® dressing for 24 hours. Patients have commented on how nicely their wounds have healed. It takes no longer to use the butyl-cyanoacrylate glue than it did to place adhesive strips and the patients do not have to worry about the strips falling off or taking them off. Trocar sites very infrequently become infected, so I cannot say that I have seen a benefit from an infection standpoint. Overall, this is a superior product compared to others on the market and I encourage my associates and residents in my training program to use it on every case."

Laparoscopic Gynaecological Surgery

Dr Camran Nezhat, Clinical Professor of gynaecology and obstetrics at Stanford University Medical School and Director for the Centre for Special Minimally Invasive Surgery, writes, "Laparoscopic surgery is used to give the patient, among many other advantages, very good incisional cosmetic results. Laparotomy is the more conventional method for performing surgery, leaving large vertical or horizontal incisions. With the advent of laparoscopy, more complex surgeries can be performed using small incisions, usually two to five incisions measuring between 5mm to 12mm. Subsequently, it becomes of the utmost importance to close these incisions with great care to achieve great cosmetic results. Another important factor in surgery is speed, because the least amount of time a patient is under anaesthesia the better. Combining all of these factors together results in the necessity of utilising a method that will help close an incision. One which is fast and at the same time has good results in wound healing

while maintaining a sterile field. The FDA-approved butyl-cyanoacrylate tissue adhesive is a product which offers all of these attributes.

We use the butyl-cyanoacrylate for closure of almost 99% of the incisions in our patients. Almost all of our gynaecological procedures are performed laparoscopically, such as laparoscopic hysterectomy, myomectomy, cystectomy and treatment of endometriosis. The exclusion criteria includes prior allergic reaction to cyanoacrylates. The advantages of the butyl-cyanoacrylate glue are that it is easy to use, easy to apply, fast-acting and serves as a microbial barrier. In our experience, applying the butyl-cyanoacrylate is at least twice as fast as suturing and only requires one vial per procedure. We close fascia in port sites over 10mm but do not use subcutaneous or subcuticular stitches on our butyl-cyanoacrylate closed sites. Wound edges are carefully approximated by hand.

One should be cautious and only use this product when the incision is haemostatic and dry, as contamination with blood prevents obtaining maximum benefits with cyanoacrylate topical adhesives. Overall, our patients are very happy with the closure of their incisions. There are no sutures to be removed, thus the patients do not need to go through the anxiety of suture removal."

General Surgery

Dr Tom Fullerton, a general surgeon from Sioux Falls, South Dakota, writes, "I have been using the FDA-approved butyl-cyanoacrylate for approximately one year. I think that there are significant advantages for both the patient and surgeon with this product. Probably the most significant advantage for the patient is the 'no-fuss/no-mess' wound care that the butyl-cyanoacrylate skin closure provides.

After early success with skin closure during hernia procedures, I have used it on virtually every wound with the exception of clean-contaminated and grossly contaminated wounds. I find it exceptionally suitable for skin closure after 'Port-a-Cath' insertion, breast biopsy and mastectomy. For mastectomy closure, I have found that one vial of the butyl-cyanoacrylate glue is sufficient to treat most incisions. All of my patients have responded favourably to its use and particularly appreciate not having to have multiple sutures or staples removed.

It is imperative to have good dermal apposition and tension relieved by interrupted sub-dermal sutures before applying the cyanoacrylate glue. This product is a topical adhesive that needs to be applied on top of the wound edges and in fact, if it gets between tissues,

it will impair healing. It is designed to hold the tissue in epidermal proximity so that healing can occur.”

Cardiovascular Surgery

Dr Bradley Taylor, Chief of cardiovascular surgery, University of Pittsburgh Medical Centre Passavant Hospital, writes “I use the FDA-approved butyl-cyanoacrylate in the closing of skin for my medium sternotomies, for my saphenous vein harvest sites and whenever I put in a pacemaker. I use it as a way of essentially sealing my incisions. Concerning the risk of post-operative superficial skin incision infection, my biggest concern is at the beginning and end of the incision line and in the middle where the knots are, because often the suture knots are not completely buried and there will be little breaks or separations at these points where bacteria can get in and adhere to the suture. It is usually at these suture knots that one can see a breakdown for wound infection. In my opinion, the butyl-cyanoacrylate is an excellent tissue adhesive that ensures epithelial-to-epithelial wound approximation that is particularly beneficial over the sites of my suture line knots. Since I began using the butyl-cyanoacrylate, I have noticed a decrease in suture line disturbance and infection and I am very pleased with the outcome.

The butyl-cyanoacrylate is applied meticulously and sparingly in a single application just along the edges of the incision where I have approximated the skin. It is applied in a continuous and controlled film that just glistens over the wound edges and freezes them in place. The butyl-cyanoacrylate glue is ideal for my patients’ saphenous and radial harvesting sites as well as their sternal incisions for coronary artery bypass grafts (CABG). I do not, however, use it on the chest when I feel that the patient may be coagulopathic immediately post-operatively, due to the re-operative risk and the inconvenience of removing or cutting through the tissue adhesive. My patients and I have been very pleased with the results when using the butyl-cyanoacrylate. There is virtually no learning period and the product is provided in an applicator that makes it very easy to apply.”

Plastic Surgery – Body Contouring following Bariatric Obesity Surgery

Dr Peter Rubin, Assistant Professor of surgery, University of Pittsburgh, writes, “The FDA-approved butyl-cyanoacrylate provides an ideal microbial barrier for major plastic surgery body contouring procedures. We use this adhesive for clean cases and exclude patients in whom there is evidence of active infection or compromised tissue viability. In contrast to adhesive strips, the butyl-cyanoacrylate glue is faster to apply, provides superior protection of the wound and minimises

seepage of fluid from the incision. There is a minimal learning curve for use of the butyl-cyanoacrylate glue and it is ‘off-the-shelf’, ready to use.

Body contouring procedures often involve position changes during the operation. In the past, it has been difficult to place a definitive dressing on separate wounds between stages of the operation because adhesive strips become saturated and fall off. The butyl-cyanoacrylate tissue adhesive allows for definitive dressing of each wound in a multi-stage operation without having to change each dressing at the end of the case.”

Plastic, Reconstructive and Hand Surgery

Dr Stanley Librach, plastic, reconstructive and hand surgeon, writes, “The clinical results using the FDA-approved butyl-cyanoacrylate on breast reduction procedures, lipectomies, trunk, extremity and hand surgeries have been extremely successful. My patient selection criteria are based on the wound. Clean wounds and low-tension wounds are preferable. The patient exclusion criteria includes dynamic joint areas such as elbows or knuckles.

The advantages of using the butyl-cyanoacrylate glue verses traditional percutaneous skin closure techniques (sutures, staples and adhesive strips) are that it holds and seals the wound, preventing bacterial penetration. The butyl-cyanoacrylate tissue adhesive also allows better cosmesis for my patients.

The learning curve with the butyl-cyanoacrylate glue is very simple as it is an operating room-friendly product. I approximate the wound edges and squeeze the vial of butyl-cyanoacrylate, applying a single layer over the wound edges. My patients are very pleased with their results when I use this tissue adhesive because there are no post-operative stitch marks.”

Plastic Surgery – Oculoplastic Surgery

Dr Brian Haas, a private practice oculoplastic surgeon in Orlando, Florida, writes, “The FDA-approved butyl-cyanoacrylate is well-suited for use in oculoplastic surgery. It forms a strong bond quickly with only one easy application — significantly reducing wound closure time without compromising results.

It is particularly useful for closing upper lid blepharoplasty incisions. I pre-place a few interrupted 6-0 nylon sutures to eliminate wound tension (if necessary) and then ‘spot-weld’ the opposed skin

edges together with small droplets of the butyl-cyanoacrylate glue placed 4mm apart. When used correctly, the butyl-cyanoacrylate provides a safe, fast closure with excellent post-operative cosmesis. In addition, less time is spent later in the office removing sutures, adding to the efficiency.

Octyl-cyanoacrylate glue, on the other hand, is difficult to use in oculoplastic surgery because it cannot be applied easily in droplets small enough to control. After breaking the glass capsule, octyl-cyanoacrylate glue polymerises quickly, making for a ‘race against the clock’ in terms of proper delivery to the skin edges because it must first be transferred to a small gauge needle and syringe to reduce the size of the drops. Re-application is also recommended by the manufacturer to improve tensile strength in the closure, further slowing down the procedure.

Fortunately, it is easy to create fine droplets of the butyl-cyanoacrylate glue by attaching a small blunt-tip cannula to the ampule in which it is packaged. Cannulas such as the Kendall Monoject™ Blunt Tip Cannula are readily available in most surgical centres or are otherwise inexpensive to obtain from suppliers. It is very important to keep the drop size small so that placement in these small areas near the eye can be precisely controlled. Cyanoacrylates generate an exothermic reaction as they polymerise on the skin and fine droplets spaced apart prevent any thermal injury from occurring on the delicate eyelid. For all cyanoacrylates, it is important to avoid contact with the ocular surface during drop application to prevent unwanted lash adhesions or concretions, which may abrade the eye. Applying small drops of the butyl-cyanoacrylate glue with an easy, controlled method of application helps avoid these potential complications. Patient acceptance of tissue glue is high among our patients and cosmetic results are comparable to those seen using more standard closure techniques.”

Burns and Skin Grafting

Dr Lynn Solem and his staff at the Regents Hospital Burn Centre in St. Paul, Minnesota, writes, “We utilise the FDA-approved butyl-cyanoacrylate for skin closure in two different applications.

The first is to appose sheet grafts. We use butyl-cyanoacrylate glue both with graft-to-graft closure and with graft to normal skin closure. We initially hold the grafts in place with staples placed around the margins followed by applying butyl-cyanoacrylate glue at the margins. We then remove the vast majority, but usually not all, of the staples. We use the butyl-cyanoacrylate glue only with sheet grafts and not with meshed grafts.

The other area where we use the butyl-cyanoacrylate glue is the closure of groin incisions for full-thickness grafts. We use a fair number of full-thickness grafts from the groin for palmar burns in children. We also use full-thickness grafts harvested from abdominal folds for elderly patients (since elderly patients tend not to heal at split-thickness skin graft donor sites).

The advantage of the butyl-cyanoacrylate glue over conventional wound closure is in minimising the number of staples, hopefully minimising any cross-hatching from the staples and cutting down the pain associated with staple removal. The advantage of closure of the groin donor sites in children is that many of the children with full-thickness palmar burns are still in nappies and the cyanoacrylate glue works as a sealant for the wound.

The learning curve in the use of the butyl-cyanoacrylate glue is relatively brief and the product applicator is convenient. The surgeon needs to be cautious to avoid sticking the surgical instruments to the butyl-cyanoacrylate glue and to the skin grafts, but again this is a relatively short learning curve.

I think that our patients are pleased with the butyl-cyanoacrylate glue closure of their wounds. However, since those wounds closed with butyl-cyanoacrylate glue tend not to have a comparison, they are not aware of the discomfort associated with the numerous staples which would require removal in a normal skin graft.”

Urology

Dr Ramakumar, Assistant Professor of surgery and urology at the University of Arizona Health Sciences Centre, writes, “I have recently evaluated the use of the FDA-approved butyl-cyanoacrylate glue for skin closure after my laparoscopic procedures. For larger incisions, I prefer a subcuticular absorbable suture and use the butyl-cyanoacrylate glue as a barrier; however, laparoscopic port sites are ideal wounds for this product. Exclusion criteria include infected wounds, those that are under high tension, or patients with allergic reactions to cyanoacrylates. The advantages of the butyl-cyanoacrylate glue are ease of application, cost benefit by decreasing operating room time and reduced tissue trauma resulting in better cosmesis. My experience with the octyl-cyanoacrylate glue was less satisfactory because:

- multiple applications are required for closure;
- the cotton applicator tip resulted in wasted product; and
- several pens may be needed for a single patient (cost increase).

With proper instruction, there is a minimal learning curve for applying the butyl-cyanoacrylate glue, perhaps two to three cases. I caution new users of skin adhesives that the wound must be meticulously haemostatic because unlike sutures, there is no compression of the underlying tissues. My patients appear to be pleased with the butyl-cyanoacrylate glue as no bandages are required, they avoid the skin irritation of adhesive strips or tape and the cosmetics seem to be better.”

Conclusion

In conclusion, topical tissues adhesives offer a fast and less traumatic skin closure for appropriately selected wounds with distinct advantages over non-absorbable sutures, staples and adhesive strips. For all the reasons stated above, they are being used with increased frequency across different surgical specialities and procedures as both a tissue adhesive and microbial barrier to protect the wound. ■