Journal of Coastal Life Medicine
www.jclmm.com
ISSN: 2309-5288(Print)/2309-6152(Online)
Volume 10 No.1 (2022), Page No. 372 – 379
Article History: Received: 02 January 2022, Revised: 10 February 2022, Accepted: 21 February 2022, Publication: 31 March 2022

Cyanoacrylate Adhesives: A boon To Dentistry -A Literature Review

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ABSTRACT:

Introduction : Cyanoacrylate adhesives have been used in medicine and dentistry with some controversy. There are many diverse treatment approaches and options available in the field of wound care as there are practitioners treating wounds.Tissue adhesives have been studied in recent years as an excellent alternative to conventional sutures in recent years, but they are required to have the following properties, among others: suitable adhesive strength, proper polymerization in a wet environments, biocompatibility, stability, and working duration.

Aim: With a focus on the uses, indications, benefits, and drawbacks of using cyanoacrylate adhesives for oral wounds in dentistry and surgical procedures, the goal of this study was to summarise the pertinent literature in this area.

Conclusion: In conclusion, in vivo and clinical research have produced compelling evidence supporting the feasibility, safety, and efficacy of all cyanoacrylate adhesive types utilised in intra- and extraoral operations.

KEY WORDS: Tissue Adhesives; Cyanoacrylate; Sutures; octyl cyanoacrylate.

INTRODUCTION

There are many diverse treatment approaches and options available in the field of wound care as there are practitioners treating wounds. There is a steady stream of new products and technology to add to the wound care arsenal, even though many physicians rely on and achieve good outcomes with older "tried and true" therapies. While some of these medications are enhanced and updated versions of earlier therapies, others are the outcome of completely new research areas. Like with any new product, there is frequently a rush to get it into clinical use before a sufficient controlled trial is done, and the efficacy is then determined by actual clinical experience.

Suturing is the most common approach used to close intraoral wounds today; However, documented disadvantages have fueled the search for novel procedures and materials. In general, wounds have a high risk of reinfection during the healing process, which is common in the oral cavity due to biofilm formation and food accumulation, compounded by the presence of sutures [1–3]. Suturing requires the use of anaesthetics and needles, as well as increased procedure time and a second visit for suture removal [1,3], resulting in increased patient discomfort [4] and risk of puncture accidents for clinicians and auxiliary employees [1,5].

Tissue adhesives have been studied in recent years as an excellent alternative to conventional sutures in recent years, but they are required to have the following properties, among others: suitable adhesive strength, proper polymerization in a wet environments, biocompatibility, stability, and working duration.[2,6] The cyanoacrylates were first synthesised in 1949

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by a German chemist then used by Coover for wound closure in 1959.[7] The United States Food and Drug Administration (FDA) approved cyanoacrylate adhesive for surgical and trauma wounds in August 1998. [8]

The chemical formula is CH2=C(CN)-COOR, where R can be replaced with any alkyl group, resulting in a variety of cyanoacrylate adhesives. Changing the type of alkyl chains in the compound to one with a longer molecular chain can reduce tissue toxicity.[1] This glue is kept in a liquid state by an acidic stabiliser, consists of partially ionised water molecules and has the effect of neutralising the inhibitor. In the presence of hydroxyl ions in wet tissue, these adhesives polymerize, resulting in a slightly exothermic polymerization.[9] Cyanoacrylates [10]have been commercially available in various forms depending on the length and complexity of their chains: methyl, ethyl, n-butyl, isoamyl, isohexyl, and octyl cyanoacrylates.[10]

Our research and knowledge have resulted in high-quality publications from our team [11–21] . Octyl cyanoacrylate adhesive tissue has become the most popular and widely used adhesive tissue, with advantages such as instantaneous hemostasis, bacteriostatic properties, and fast adhesion to soft and hard tissues. It also has a hemostatic effect with a long half-life and good tissue tolerance, as well as gradual absorption without foreign body reaction.[22] In medicine, cyanoacrylate (CA) glue is used to seal traumatic and surgical injuries. For example, CA has been used on abdominal organs, to heal penetrating wounds on abdominal viscera, and to treat liver disease. Due to their fast-adhering and hemostatic properties, they are also used in vascular surgery and laparoscopic surgery for repairing partial hernias and for mesh fixation. In addition, the use of CA in procedures in various medical specialties such as gynaecology, neurology, orthopaedics, plastic surgery, dermatology, and urology has been documented in the literature.[23] Since the use of cyanoacrylates has previously been less documented due to oral applications, various problems that have been suggested but cyanoacrylates have also evolved over time.

1. APPLICATIONS

The literature reports the widespread use of cyanoacrylate adhesives during procedures performed in various fields of medicine [24] such as skin [25,26], breast [27,28], cardiac [29], gastrointestinal [30], head and neck [31], hepatic [32], neurological [33], orthopaedic [34], paediatric [35], thoracic [35], bone [36], dental [31,37,38], and vascular surgery [39].

1.1 THE USE IN PERIODONTAL SURGERY

One of the primary goals of every surgical treatment is wound closure; this requires the repair of the incision by bringing the edges of the wound together so that it can heal. As a result of this concern, the use of suture materials has improved over time [40]. Mustafa Ozcan in 2017 stated that the patient compliance, time and healing were better with cyanoacrylates and the results were statistically non-significant when compared with sutures for a Free Gingival Graft [41]. Tavelli et al.[42] in 2018 in a Randomised Control Trial stated that palatal coverage appears to result in better outcomes when compared to suture alone. In particular, a double-layered protection of the palatal wound with a gelatin sponge combined with cyanoacrylate appeared to be the best option in reducing pain and postoperative discomfort [42].AlJasser et al. stated that the use of CAA in FGG stability and healing is comparable to conventional suturing for soft tissue grafts in terms of success outcomes [43]. With its cost effectiveness, lesser time consumption, post-operative pain and comparable graft stability and dimensions, the use of CAA may be a promising alternative for conventional and microsurgical techniques for the stabilisation of FGG in the oral cavity [43]. Saquib et al in a study showed that the use of cyanoacrylate for the closure of periodontal flaps results in better initial post-operative healing as compared to closure with silk suture and that this method of closure can be advocated in a routine surgical periodontal practice [44].

1.2 FIXATION OF AUTOLOGOUS BONE GRAFTS

The most commonly employed materials for hard tissue repair are autografts. The ability of an allograft to be osteogenic, osteoconductive, or osteoinductive is dependent on the graft's intimate contact with the bone bed [1]. Titanium screws are employed in the current graft fixation procedure. This method provides for the position and dimensional stability of the bone grafts, but the use of screws has some drawbacks, such as difficult access to places and screw loosening, which may

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necessitate a second surgical treatment to remove the screws in some circumstances. However, using an adhesive would provide benefits such as ease of application and graft stability [45,46].

1.3 MEMBRANE FIXATION IN GUIDED TISSUE REGENERATION

Rezende evaluated a 47-year-old lady with a vertical bone defect who was treated with directed tissue regeneration utilising a particulate autogenous bone graft attached to a collagen membrane, which was cemented to the bone surrounding the defect and the tooth surface with CA in 2015. They discovered that the membrane attached with CA is technically and biologically viable and safe, and that it may be used for clinical purposes [47].

1.4 IN THE FIELD OF ORAL AND MAXILLOFACIAL SURGERY

Choi et al. used histological research to assess the effectiveness of a cyanoacrylate glue for the closure of maxillary sinus membrane holes in rabbits. The authors discovered that the Schneiderian membrane had completely healed without any symptoms of inflammation [48]. Bozkurt and Saydam[49] used cyanoacrylate adhesives for wound closure after head and neck surgeries in 80 patients, reporting no complications and high patient satisfaction with scarring when this adhesive was used, whereas Sagar et al. [9] used them for intraoral wounds such as mucosal incision, biopsies, fractures, adenoma excision, and apical surgery. In high-risk extraction situations, such as those involving third-molar removal, these adhesives have also been employed as hemostatic agents [50–52].

1.5 IN THE FIELD OF ESTHETIC SURGERY

Cyanoacrylate adhesives have been utilised for wound closure, skin grafting treatments, blepharoplasty, face and brow lifts, and other cosmetic surgeries in the field of aesthetic surgery [53]. Furthermore, they have been utilised to treat lacerations in youngsters without the need for anaesthetic operations. In general, cyanoacrylate can be applied to any part of the body that is not under tension [5].[2,47]

Multidrug resistance will become a reality in the not-too-distant future, in the era of antibiotic abuse this study aims to test a product (antimicrobial incorporated cyanoacrylate) which is not available in the market, as this will not only bring down the systemic antibiotic abuse down but will also create an environment of satisfactory wound healing by itself.

ADVANTAGES

There are several advantages of cyanoacrylates to advocate their intra oral use for various surgical procedures, In the presence of fluids such as blood or saliva, cyanoacrylate adhesives harden, and they have good biodegradability, as well as hemostatic and bacteriostatic qualities [2,47]. The easy and quick application of cyanoacrylate adhesives, together with their excellent hemostatic qualities, enables effective closure of oral mucosal lesions. Al-Belasy and Amer[54] validated the hemostatic effects of cyanoacrylate in patients undergoing oral operations while taking warfarin, reporting acceptable healing with no problems.

Furthermore, cyanoacrylate adhesives create a mechanical barrier that prevents detritus from collecting, shortening healing time and speeding up epithelium keratinization [53,54]. Patients have also expressed high levels of pleasure with this substance [9]. Cyanoacrylate adhesives simplify membrane fixing and save time and discomfort for the doctor in cases of guided bone regeneration. When using a cyanoacrylate glue, Gum us and Buduneli found less shrinkage of free gingival grafts, as well as less dimensional changes, clinical time, and pain at the recipient site, compared to microsurgical (suture: 7.0, magnifying) and conventional (suture: 5.0) procedures.Cyanoacrylate adhesives do not require the use of needles, they reduce the risk of puncture injuries among doctors and auxiliary employees [55,56]

DISADVANTAGES

Although the high cost of octyl and isoamyl compounds and lower tensile of butyl cyanoacrylate have been documented, there are few downsides of cyanoacrylate adhesives described in the literature[9].

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CONTRAINDICATIONS

There are few contraindications to using cyanoacrylate adhesives. They can't be utilised in locations where there's a lot of stress, including joints, areas where there's a lot of friction, and areas where there's an infection or exudate contamination [57,58]. Furthermore, they are not suitable for conjunctival procedures or patients with cyanoacrylate allergies [5953,5459] .

CARCINOGENICITY AND TOXICITY

As of now there is no sufficient data to state if cyanoacrylates are toxic or carcinogenic to humans. This topic is controversial ,Except for methyl cyanoacrylate, all cyanoacrylates encourage the development of connective tissue and allow for adequate healing without necrosis.Ethyl cyanoacrylate [59,60] has been linked to skin toxicity, necrosis, and allergic dermatitis, according to certain writers. According to these scientists, increasing the amount of lateral chains in the cyanoacrylate molecule reduces cytotoxicity, extends healing time, and decreases adhesiveness. According to some studies, ethyl cyanoacrylate is a safe and inexpensive adhesive that aids in the joining of wound edges, produces an acceptable inflammatory response with decreased polymorphonuclear infiltration and an aesthetically acceptable scar, and does not cause necrosis or allergic reactions [61,62].

CONCLUSION

In conclusion, in vivo and clinical research have produced compelling evidence supporting the feasibility, safety, and efficacy of all cyanoacrylate adhesive types utilised in intra- and extraoral operations.

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