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Cyanoacrylate in Intraoral Wound Closure

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ABSTRACT

Aim: To study the effect of long chain cyanoacrylate as an adhesive for intraoral wound closure and to explore its haemostatic and effects.

Materials and methods: 32 patients from saveetha dental college and hospitals of mean age 35 were selected randomly and split mouth study is done where one side given cyanoacrylate for wound closure and other side conventional sutures for wound closure.

Results: Marginal seal/wound seal was acceptable as the incised margins were in close apposition with each other. Inflammation and edema were not present in the maximum number of cases on the 15th postoperative day.

Conclusion: Cyanoacrylates can be used as an alternative to sutures for gluing the mucoperiosteum to bone, for example, after impaction removal, periapical surgeries, cleft closure, or biopsy. It can be used as an adjuvant to sutures in many situations to offer wound protection and reduce dehiscence and infection rates, for example, at bone graft sites, for skin grafts or collagen retention, and for mucosal closure at fracture sites. its haemostatic, antimicrobial, and analgesic properties require further evaluation.

Key words: Cyanoacrylate, Wound healing, Wound closure, Sutures

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INTRODUCTION

In the last few years, tissue adhesives have been studied as a good alternative to conventional sutures, although the following properties, among others, are imperative: adequate adhesive strength, appropriate polymerization in a moist environment, biocompatibility, stability, and good working time [1,2]. In this regard, cyanoacrylate adhesives seem to be a good option for use in medicine as well as dentistry [3]. In August 1998, the U.S. Food and Drug Administration approved the use of a cyanoacrylate adhesive for surgical and trauma wounds [4]. These adhesives polymerize in the presence of hydroxyl ions present in moist tissue, achieving slightly exothermic polymerization [5].

Cyanoacrylates are available in several different forms based on the length and complexity of their chains; these include methyl, ethyl, n-butyl, isoamyl, isohexyl, and octyl cyanoacrylates [6].

Herod et al, developed the first review of the use of cyanoacrylate adhesives in dentistry; however, an update is necessary with in vitro, in vivo, and clinical research that include new tests in combination with the use of commercial cyanoacrylate adhesives, which have achieved continuous improvements in the last few years. Ten, in the present review, we attempt to summarize the relevant literature regarding the use of cyanoacrylate adhesives for oral wounds created during dental and surgical procedures, with focus on the applications, indications, advantages, and disadvantages.

The previous literatures report the widespread use of cyanoacrylate adhesives during procedures performed in various fields of medicine, including gynaecology, gastroenterology, neurosurgery, orthopaedics, plastic surgery, dermatology, urology, and vascular and cardiac surgery [8]. Common indications for use include oesophageal fistula closure, myocardial surgery, bilateral mammoplasty, skin wound closure, bone and cartilage grafting, corneal surgeries, varicose vein occlusion, and embolization of arteriovenous malformations [7–11]. However, the usefulness of this material in the field of dentistry remains unclear because there are several procedures that allow its application.

Mehta et al [10] conducted one of the first studies on the use of a cyanoacrylate adhesive in dental surgery. The authors used butyl cyanoacrylate during osteosynthesis of ten mandibular fractures with follow-up periods of 1–6 months, observing no adverse effects or chromosomal changes in the patients. Salata et al. [11] in a short-term period (4–8 days) analysed the gene expression and the variations of mineralized tissue of autogenous grafts fixed with n-butyl cyanoacrylate in the mandible of six rabbits

and compared this with screw fixation. It was identified that the cyanoacrylate adhesive caused less inflammation and induced a higher mineralized tissue volume than the screw. However, a study in 24 rabbits with 40 days as an evaluation period, in which an adhesive of n-butyl-cyanoacrylate was applied to bond a block of autogenous bone graft to the lateral aspect of the mandible and then analysed histomorphometrically, demonstrated that the bone graft was maintained fixed during the whole observation period (3-7-20-40 days) but this was not biologically incorporated into the recipient site [12].

In the field of oral and maxillofacial surgery, Choi et al [13] evaluated the usefulness of a cyanoacrylate adhesive for the closure of maxillary sinus membrane perforations in rabbits by using histological analysis. The authors identified complete healing of the Schneiderian membrane without any signs of inflammation. Bozkurt et al. and Saydam et al. [13,14] used cyanoacrylate adhesives for wound closure after head and neck surgeries of 80 patients, reporting no complications and a high satisfaction of the patients related to scarring when this adhesive was used, while Sagar et al [5] used them for intraoral wounds closure such as mucosal incision, biopsies, fractures, adenoma excision, and apical surgery. These adhesives have also been used as haemostatic agents in high-risk extraction cases, such as those involving third molar removal [15,16].

In the field of esthetic surgery, cyanoacrylate adhesives have been used for wound closure and in skin grafting procedures, blepharoplasty, face and brow lift procedures, and other cosmetic surgeries. Moreover, they have been used for the management of lacerations in children to avoid anaesthetic procedures. In general, cyanoacrylate can be used in any region of the body where there is no tension.

MATERIALS AND METHODS

The study was conducted in the department of oral and maxillofacial surgery, Saveetha Dental College and Hospitals. Patients who need bilateral intraoral procedures were selected for the study; 32 patients aged between 18 to 60 years were selected for this clinical study. Patients with normal general health were selected; patients with diabetes, acute infection and hypertension were excluded.

The procedure was carried on by elevating a mucoperiosteal flap under local anaesthesia, once haemostasis was achieved the mucoperiosteal flap was positioned in place and sutured on one side with 3-0 black silk suture and on the other side, n-butyl-2-cyanoacrylate was used by just delivering a drop of it in the incision line to seal the incision.

Clinical examinations were made on the 1st, 3rd and 7th postoperative day, each side of the frenum was evaluated for parameters like pain, oedema, bleeding. On the seventh postoperative day sutures were removed and cyanoacrylate remnants were removed by gentle irrigation with normal saline.

RESULTS

In this study 32 patients between age group of 18-60 years with satisfactory general health were taken into consideration, in each patient the bilateral intraoral procedures were done and silk suture on one side and cyanoacrylate on other side of the frenum was used for the closure of the incision, the evaluation of the treated sites was done and the grading of the swelling was done in maxilla and graded as follows, 1) Mild-when there is only local mucosal swelling, 2) Moderate-when swelling extending superiorly up to the ala of the nose and crossing the corner of mouth laterally, 3) Severe-when swelling extending superiorly up to the infraorbital margin and extending towards the angle of the mandible. In mandible it was graded mild when only local mucosal swelling was there, moderate when swelling was extending up to submental region and severe when the swelling involved submandibular region, accordingly pain was graded 1) Mild only when there was dull intermittent pain, 2) Moderate when there was throbbing intermittent pain, 3) Severe when there was continuous throbbing pain.

Results showed that all the operative areas healed uneventfully by the 7th postoperative day, on the first postoperative day, moderate swelling was observed on both sides in 28 cases and in 4 cases moderate swelling on cyanoacrylate treated side and severe swelling on sutured side, on the 2nd postoperative day the same condition was observed, on the 3rd postoperative day, it was mild swelling in 28 cases on both sides and moderate swelling in 4 cases on sutured side and mild swelling on cyanoacrylate side. On the seventh postoperative day there was no swelling in 28 cases but mild swelling was observed in 4 cases on the sutured sides, on the 1st postoperative day mild pain was reported in 28 cases on both the sides, in other 4 cases mild pain was reported on the cyanoacrylate side and moderate pain on sutured side, the condition remained unchanged on the 2nd postoperative day, on the 3rd postoperative day there was no pain in all the cases except in one case who reported mild pain on the sutured side, on the 7th postoperative day there was no pain in all the cases. There was no evidence of necrosis in any of the treated cases.

DISCUSSION

Healing after closure of wound can be enhanced by proper approximation of the wound edges and proper isolation of the wound. Superficial contamination of the wound occurs postoperatively and often results in delayed epithelialization of the wound surface and the production of excessive granulation tissues, all these factors contribute to failure of the surgery to produce the desired result and lead to greater postoperative pain and discomfort.

Plaque, food debris and excessive manipulation of tissues during surgery retard healing. The incidence of infection can be reduced by careful attention to asepsis and gentle handling of the tissues to prevent the implantation of

foreign material into them. Postoperatively the immediate concern is the protection of the tissues and to control the infection while healing. Healing is improved by immobilization of the healing area. Immobilization of the healing area can be achieved by suture or tissue adhesive.

In the field of periodontics, Rezende et al [7] reported a case using the cyanoacrylate adhesive for fixing a resorbable membrane to the recipient bone in a vertical defect to allow guided tissue regeneration, showing esthetical results four years after the procedure, while Perez [8], in a prospective ´ study, used this adhesive in 19 patients for fixing mucogingival grafts, identifying a good tolerance. In addition, the cyanoacrylate adhesive has been used in free gingival grafting [8,17-19], apicectomy [8], root sectioning [20], and bonding of fractured tooth fragments [21,22]. Kulkarni et al. [21] reported the use of cyanoacrylate in periodontal pockets during surgical procedures involving periodontal faps in 24 individuals, Ozcan et al. used it to promote palatal wound healing after free gingival graft harvesting, and Ranson et al. [23] used it for stabilizing pedicle grafts during soft tissue surgeries.

In the field of oral and maxillofacial surgery, Choi et al [13,23] evaluated the usefulness of a cyanoacrylate adhesive for the closure of maxillary sinus membrane perforations in rabbits by using histological analysis. The authors identified complete healing of the Schneiderian membrane without any signs of inflammation. Bozkurt et al. [14] used cyanoacrylate adhesives for wound closure after head and neck surgeries of 80 patients, reporting no complications and a high satisfaction of the patients related to scarring when this adhesive was used, while Sagar et al. [5] used them for intraoral wounds closure such as mucosal incision, biopsies, fractures, adenoma excision, and apical surgery. Tese adhesives have also been used as haemostatic agents in high-risk extraction cases, such as those involving third molar removal [24].

In the field of esthetic surgery, cyanoacrylate adhesives have been used for wound closure and in skin grafting procedures, blepharoplasty, face and brow lift, and other cosmetic surgeries. Moreover, they have been used for the management of lacerations in children in order to avoid anaesthetic procedures. In general, cyanoacrylate can be used in any region of the body where there is no tension.

Contraindications for the use of cyanoacrylate adhesives are limited. Specifically, they cannot be used in areas of tension, such as joints, areas subjected to friction, and areas showing infection and/or contamination with exudate. In addition, they cannot be used in conjunctival procedures and patients with allergy to cyanoacrylate.

Cyanoacrylate adhesives become hard in the presence of fluids such as blood or saliva (Figure 1), with good biodegradability and haemostatic and bacteriostatic properties [1]. The simple and fast application of cyanoacrylate adhesives, along with their good haemostatic properties, allows the satisfactory closure of oral mucosal wounds. Al-Belasy et al. confirmed the haemostatic effects of cyanoacrylate in patients who underwent oral surgeries while receiving warfarin treatment, observing satisfactory healing without complications.

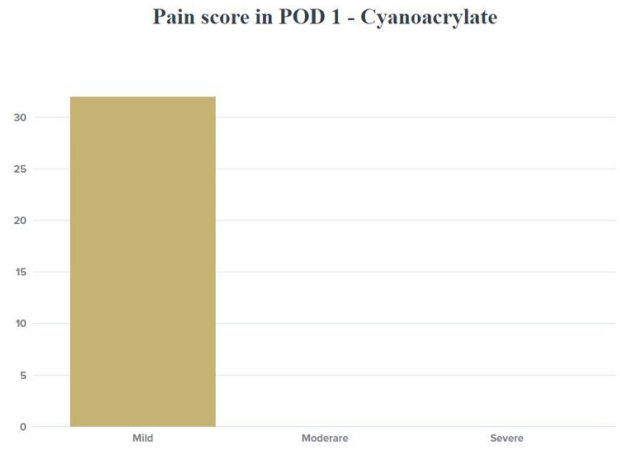

Figure 1: Bar graph shows the number of patients having mild pain at POD 1 and non of the patients had either moderate or severe pain.

In addition, cyanoacrylate adhesives provide a mechanical barrier that prevents detritus collection, thus reducing the healing time and accelerating epithelial keratinization. Patients have also reported high satisfaction levels for this material.

In cases of guided bone regeneration, cyanoacrylate adhesives simplify membrane fixation and reduce time and discomfort for the clinician. Gum¨ us and Buduneli ¨reported less shrinkage of free gingival grafts when they used a cyanoacrylate adhesive, identifying lesser dimensional changes, clinical time, and pain at the recipient site with cyanoacrylate than with microsurgical (suture: 7.0, magnifying) and conventional (suture: 5.0) techniques. Because cyanoacrylate adhesives do not require any needles for application, they eliminate the risk of puncture accidents for both clinicians and auxiliary personnel.

The pain-free application procedure for these adhesives allows their use in cases where the anaesthetic effect has diminished and for anxious or fearful patients such as children. Moreover, cyanoacrylates do not exhibit genotoxic activity or systemic toxicity, and they do not cause mucosal irritation or cutaneous sensitivity. Researchers have also reported minimal inflammatory response in regions of use, with zero potential for necrosis. Finally, some authors have reported excellent cosmetic results without dehiscence or allergic reactions.

Not many disadvantages of cyanoacrylate adhesives have been discussed in the literature, although the high cost of octyl and isoamyl compounds and reduced tensile strength have been reported. Till date, there is no sufficient evidence showing that cyanoacrylates are carcinogenic for humans [2].

The toxicity of cyanoacrylates remains a controversial topic. Avery and Ord described good tolerance of tissues to butyl cyanoacrylate and reported that all

cyanoacrylates except methyl cyanoacrylate allow for satisfactory healing without necrosis and promote the proliferation of connective tissue. Some authors have reported concerns about ethyl cyanoacrylate causing skin toxicity, necrosis, and allergic dermatitis. Tese authors stated that an increase in the number of lateral chains in the cyanoacrylate molecule decreases the degree of cytotoxicity, increases the healing time, and reduces its adhesiveness. However, some researchers have reported that ethyl cyanoacrylate is a safe and inexpensive adhesive that aids in joining of wound edges, results in an acceptable inflammatory response with decreased polymorphonuclear infiltration and an esthetically acceptable scar, and does not cause necrosis or allergic reactions [9]

Cyanoacrylate adhesives exhibit good bacteriostatic properties that are explained by the strong electronegative charge of the polymer and its ability to form a mechanical barrier that prevents the entry of any material or organisms. In addition, butyl cyanoacrylate adhesives have been reported to exhibit antibacterial effects on Gram-positive organisms [1].

Cyanoacrylate adhesives also provide immediate haemostasis on application; this is attributed to their ability to form a mechanical barrier at the wound site, which favours the coagulation process and allows haemorrhage control (Figure 2).

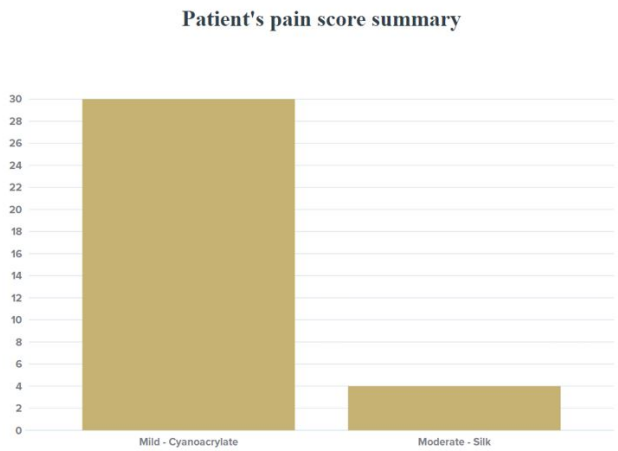

Figure 2: Patients pain score summary.

Currently, suturing is the most used method for intraoral wound closure; however, reported disadvantages have fuelled the search for new methods and materials. In general, wounds show great potential for reinfection during the healing process, which is frequently observed in the oral cavity because of biofilm formation and food accumulation that are further aggravated by the presence of sutures. Suturing requires anaesthesia and needles, a significantly longer duration, and a second visit for suture removal, thus increasing patient discomfort and the risk of puncture accidents for clinicians and auxiliary personnel.

Joshi et al. compared sutures with an isoamyl cyanoacrylate adhesive for wound closure after third-molar disimpaction procedures in 30 patients. Pain during the first 3 days after surgery and bleeding were significantly lesser with the cyanoacrylate adhesive than with sutures. The authors concluded that cyanoacrylate adhesives are associated with minimal inflammation and tissue manipulation when compared with sutures. Vastani et al. [25] conducted a study including 30 patients who underwent an alveoloplasty procedure with suturing on one side and isoamyl cyanoacrylate application on the other side. Clinical and histological examinations were performed at 1, 7, 14, and 21 days after surgery. For up to 14 days, sensitivity and erythema were significantly lesser with the cyanoacrylate than with sutures, whereas there were no differences at 21 days. No patient showed infection or wound dehiscence. Histological analysis of biopsy specimens obtained at 7 and 14 days after surgery showed significantly greater inflammatory cell infiltration and vascularity on the sutured side. These findings indicate that inflammation after wound closure is greater with sutures than with cyanoacrylate adhesives.

CONCLUSION

This study showed that the amount of inflammation on the sutured and glued incision line was different because the epithelialization on the sutured side was not uniform and there was significant scar formation. Besides the soft tissue applications, cyanoacrylates have also been used for the hard tissues. Previous literature reported that the use of n-butyl-2-cyanoacrylate adhesives in the surgical treatment of fractures seems very promising and he stated that n-butyl-2-cyanoacrylate was nontoxic, non-mutagenic and non-carcinogenic.

Cyanoacrylates can be used as an alternative to sutures for gluing the mucoperiosteum to bone, for example, after impaction removal, periapical surgeries, cleft closure, or biopsy. It can be used as an adjuvant to sutures in many situations to offer wound protection and reduce dehiscence and infection rates, for example, at bone graft sites, for skin grafts or collagen retention, and for mucosal closure at fracture sites. its haemostatic, antimicrobial, and analgesic properties require further evaluation.

REFERENCES

1. Montanaro L, Arciola CR, Cenni E, et al. Cytotoxicity, blood compatibility and antimicrobial activity of two cyanoacrylate glues for surgical use. Biomaterials 2000; 22:59–66.
2. Sahu S, Mishra S, Lenka S, et al. Comparison between N-butyl cyanoacrylate tissue adhesive and Ethilon nylon sutures in extraoral maxillofacial incisions: A randomized prospective study. J Oral Biol Craniofac Res 2019; 9:173–178.
3. Neto RTM, Mello I, da Silveira Moretti AB, et al. In vivo qualitative analysis of the biocompatibility of different cyanoacrylate-based adhesives. Brazilian Oral Res 2008; 22:43–47.
4. Soni A, Narula R, Kumar A, et al. Comparing cyanoacrylate tissue adhesive and conventional

subcuticular skin sutures for maxillofacial incisions —A prospective randomized trial considering closure time, wound morbidity, and cosmetic outcome. J Oral Maxillofac Surg 2013; 71:2152.e1–2152.e8.

5. Sagar P, Prasad K, Lalitha RM, et al.. Cyanoacrylate for intraoral wound closure: A possibility? Int J Biomater 2015; 2015:1–6.
6. İnal S, Yılmaz N, Nisbet C, et al. Biochemical and histopathological findings of N-Butyl-2-Cyanoacrylate in oral surgery: An experimental study. Oral Surg Oral Med Oral Pathol Oral Radiol Endodontol 2006; 102:e14–7.
7. Rezende MLR de, de Rezende MLR, de Oliveira Cunha P, et al. Cyanoacrylate adhesive as an alternative tool for membrane fixation in guided tissue regeneration. J Contemporary Dent Practice 2015; 16:512–518.
8. Perez M, Fernandez I, Marquez D, et al. Use of N-Butyl-2-Cyanoacrylate in oral surgery: Biological and clinical evaluation. Artificial Organs 2000; 24:241–243.
9. Vásquez B, Schencke C, Rodríguez C, et al. Comparison between Ethyl-cyanoacrylate and conventional suture in the closure of rabbit skin incisions (Oryctolagus cuniculus). Int J Morphol 2012; 30:797–802.
10. Mehta MJ, Shah KH, Bhatt RG. Osteosynthesis of mandibular fractures with N-butyl cyanoacrylate: A pilot study. J Oral Maxillofac Surg 1987; 45:393–396.
11. Salata LA, Mariguela VC, Antunes AA, et al. Short-term evaluation of grafts fixed with either n-butyl-2-cyanocrylate or screws. J Oral Maxillofac Surg 2014; 72:676–682.
12. Santis ED, De Santis E, Silva ER, et al. Healing at the interface between autologous block bone grafts and recipient sites using n-butyl-2-cyanoacrylate adhesive as fixation: Histomorphometric study in rabbits. J Oral Implantol 2017; 43:447–455.
13. Choi B-H, Kim BY, Huh JY, et al. Cyanoacrylate adhesive for closing sinus membrane perforations during sinus lifts. J Cranio-Maxillofac Surg 2006; 34:505–509.
14. Bozkurt MK, Saydam L. The use of cyanoacrylates for wound closure in head and neck surgery. Eur Arch Oto-Rhino-Laryngol 2008; 265:331–335.
15. Chadwick JW, terBrugge K, Lam DK. Novel technique using cyanoacrylate and local hemostatic agents in the management of high-risk exodontia bleeding in a patient with a large facial arteriovenous malformation. J Oral Maxillofac Surg 2016; 74:1574–1583.
16. Oladega AA, James O, Adeyemo WL. Cyanoacrylate tissue adhesive or silk suture for closure of surgical wound following removal of an impacted mandibular third molar: A randomized controlled study. J Cranio-Maxillofac Surg 2019; 47:93–98.
17. Gümüş P, Buduneli E. Graft stabilization with cyanoacrylate decreases shrinkage of free gingival grafts. Australian Dent J 2014; 59:57–64.
18. PR680: Dimensional changes of recipient and donor sites following free gingival graft surgery around dental implants in smokers and non-smokers: a preliminary study. J Clin Periodontol 2018; 45:354–354.
19. Tavelli L, Asa'ad F, Acunzo R, et al. Minimizing patient morbidity following palatal gingival harvesting: A randomized controlled clinical study. Int J Periodont Restorative Dent 2018; 38:e127–34.
20. Giray CB, Atasever A, Durgun B, et al. Clinical and electron microscope comparison of silk sutures and n-butyl-2-cyanoacrylate in human musosa. Australian Dent J 1997; 42:255–258.
21. Kulkarni S, Dodwad V, Chava V. Healing of periodontal flaps when closed with silk sutures and N-butyl cyanoacrylate: A clinical and histological study. Indian J Dent Res 2007; 18:72.
22. Hile LM, Linklater DR. Use of 2-octyl cyanoacrylate for the repair of a fractured molar tooth. Annals Emerg Med 2006; 47:424–426.
23. Ranson JM, Amin K, Schechter EMM, et al. Haemostatic property of cyanoacrylate in pedicled flaps. Br J Oral Maxillofac Surg 2016; 54:1046–1047.
24. Sagara Y, Kiyosue H, Tanoue S, et al. Selective transarterial embolization with n-butyl-2-cyanoacrylate for the treatment of arterial hemorrhage after third molar extraction. Neuroradiol 2013; 55:725–731.
25. Vastani A, Maria A. Healing of intraoral wounds closed using silk sutures and isoamyl 2-cyanoacrylate glue: A comparative clinical and histologic study. J Oral Maxillofac Surg 2013; 71:241–248.