10.5005/jp-journals-10024-1714

CASE REPORT

Cyanoacrylate Adhesive as an Alternative Tool for Membrane Fixation in Guided Tissue Regeneration

[1]Maria Lúcia Rubo de Rezende, [2]Paula de Oliveira Cunha, [3]Carla Andreotti Damante
[4]Adriana CP Santana, [5]Sebastião LA Greghi, [6]Mariana SR Zangrando

ABSTRACT

Aim: To report a well succeeded use of cyanoacrylate adhesive for fixating a resorbable membrane during a guided tissue regeneration procedure (GTR).

Background: The immobilization of membranes in GTR is essential for establishing proper environment for cell differentiation and tissue regeneration. However, some membranes are very difficult to be kept in position by sutures and its fixation by mini screws or pins may be time consuming and expensive.

Case description: A 47-year-old woman presenting a vertical bone defect at the palatal aspect of the left central incisor was treated by GTR using particulate autogenous bone graft associated to a collagen membrane. The membrane was glued to the bone surrounding the defect and to the tooth surface with cyanoacrylate adhesive. The postoperative period was uneventful and 4 years later, excellent results in terms of radiographic filling of the defect and reduction of the probing depth were seen. For illustrative purposes, histological findings obtained during a previous experiment in calvaria of guinea pigs is shown, characterizing a foreign body granuloma and proving that the cyanoacrylate adhesive is a safe tool in GTR.

Conclusion: The use of a membrane glued with cyanoacrylate to immobilize membranes in GTR is viable and safe from both technical and biological standpoints and may be advantageous for clinical and research purposes.

Clinical significance: The alternative method for membrane fixation shown in this case report can contribute to simplify the technique in GTR procedures.

[1-6]Department of Prosthodontics, Division of Periodontics, Bauru School of Dentistry, University of São Paulo, Bauru, SP, Brazil

Corresponding Author: Maria Lúcia Rubo de Rezende Department of Prosthodontics, Division of Periodontics, Bauru School of Dentistry, University of São Paulo, Bauru, Alameda Octávio Pinheiro Brisolla, 9-75/Vila Universitária, Bauru, SP Zip Code: 17012-901, Brazil, e-mail: malurezende@usp.br

Keywords: Cyanoacrylate, Guided tissue regeneration, Periodontal bone loss, Case report.

How to cite this article: de Rezende MLR, de Oliveira Cunha P, Damante CA, Santana ACP, Greghi SLA, Zangrando MSR. Cyanoacrylate Adhesive as an Alternative Tool for Membrane Fixation in Guided Tissue Regeneration. J Contemp Dent Pract 2015;16(6):512-518.

Source of support: Nil

Conflict of interest: None

BACKGROUND

Guided tissue regeneration (GTR) is a widely accepted regenerative surgical technique in periodontology and many factors can contribute to the success of this kind of therapy, including barrier's occlusion and stability, peripheral sealing as well as adequate access to the bone forming cells.[1]

The rigid fixation of membranes to the periodontal defects scheduled for treatment with GTR is essential for the predictability of new attachment achievement.[2-4] Although sutures are widely used to keep membranes in position, some authors have reported that this procedure is not only technically difficult, but also time consuming.[5] Some others have also attributed many of the failures faced by clinicians to the complexity of the method itself.[6]

Considering that proper adaptation of membranes used in GTR must embrace the entire circumference of the involved tooth, the 4-methacryloxy ethyl trimellitate anhydride/methyl methacrylate-tri-n-butyl borane (4-META/MMA-TBB) resin has been successfully used as an alternative to sling sutures for fixation of resorbable and nonresorbable membranes in dehiscence defects in dogs.[7] This resin is commonly used in operative dentistry and has promoted membrane fixation to tooth with effectiveness in inhibiting epithelial migration and in encouraging formation of regenerated periodontal tissues

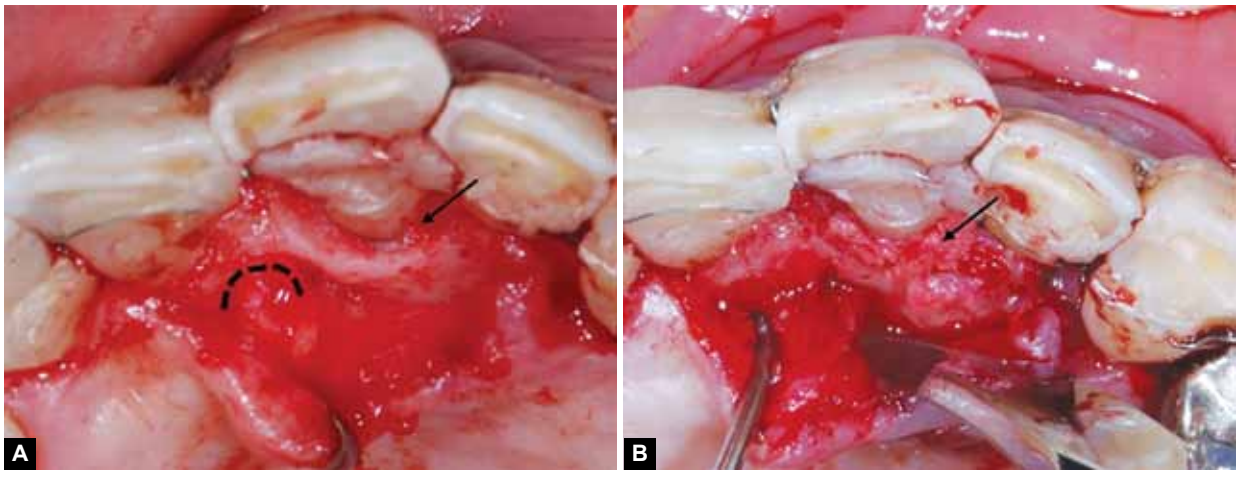
around the root surfaces. However, after a period of 4 to 6 weeks, the resin has to be removed by surgical means to prevent the build-up of bacterial deposits.[7]

Cyanoacrylates, on the other hand, have been used as adhesives in medicine and dentistry for decades. In 1960, these adhesives began to be used in nerve repair,[8] union of blood vessels[9] and years later, its use was extended to skin wounds, bone and cartilage grafts, corneal surgeries, occlusion of esophageal varices, leaks of cerebrospinal fluid and embolization of arteriovenous malformations.[10,11] Cyanoacrylates have well known properties as biocompatibility,[12,13] besides being bacteriostatic,[14] hemostatic,[15] and anti-inflammatory.[16] This adhesive presents fast polymerization even in wet environment with strong adhesion to a number of surfaces.[17] A recently published study[18] showed a novel method for immobilizing onlay bone grafts on calvaria of guinea pigs. The method consisted in covering the grafts with a resorbable membrane glued to the recipient bone bed with cyanoacrylate adhesive. The favorable histological findings presented by the authors encouraged the extension of this membrane fixation method to the clinical practice.

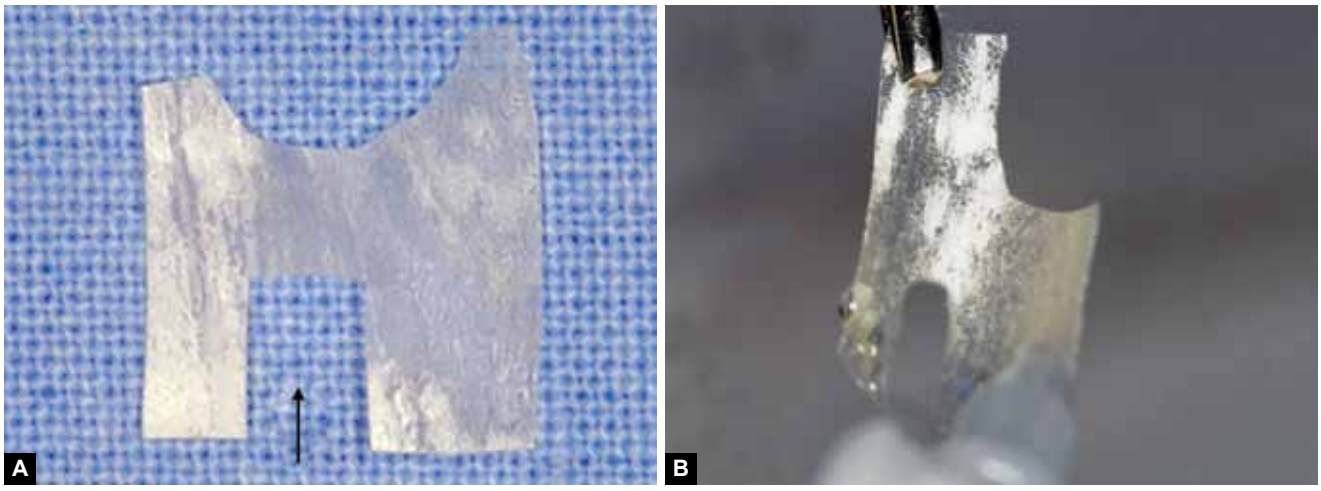
As far as we know, this is the first case report in the available literature relative to the cyanoacrylate adhesive as a clinical method for membrane fixation in GTR procedures.

CASE REPORT

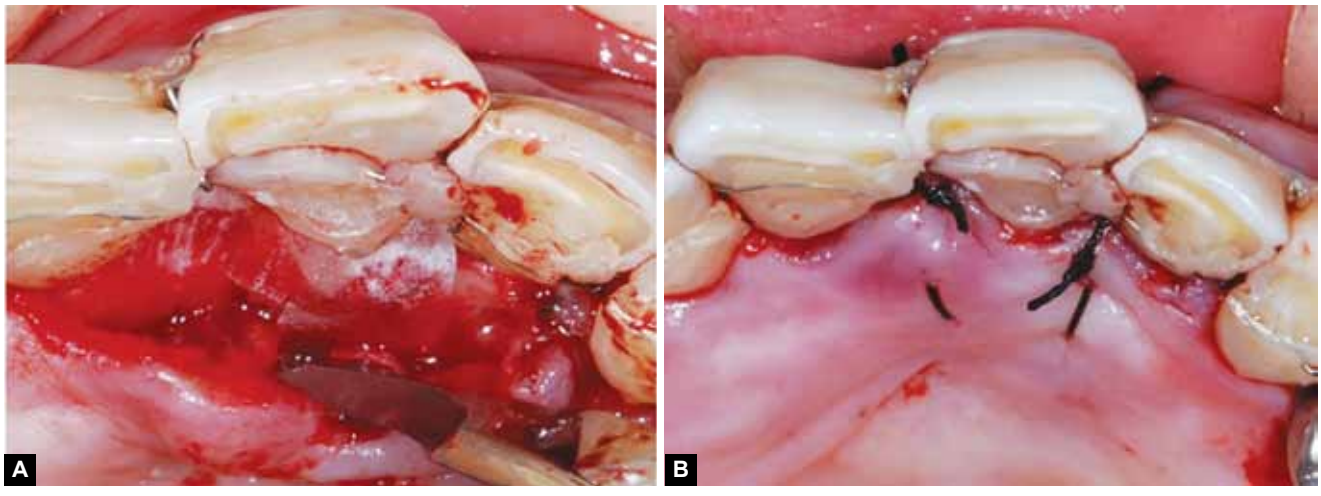
A systemically healthy and nonsmoking 47-year-old Caucasian female was referred to the Periodontics clinic at Bauru School of Dentistry, University of São Paulo, Brazil, in 2010, presenting generalized chronic periodontitis. Initial examination revealed good oral hygiene status, but a deep periodontal pocket (6 mm) was detected at the palatal aspect of the left central incisor with mobility grade 2. The periapical radiograph suggested the presence of a semicircumferential bone defect. After basic periodontal procedures of scaling and elimination of local factors, including occlusal adjustment, a provisional splinting of maxillary anterior teeth was performed to provide a stable environment for regenerative surgical procedure. Particulate autogenous bone graft was the choice for bone regeneration. After a full thickness flap elevation at the palatal aspect of the left central incisor, the soft tissue was debrided and the defect was characterized as a vertical bone defect with three walls (Fig. 1A). Care was taken to preserve the nasopalatine plexus. After scaling and root planning followed by root biomodification with citric acid (pH 1) for 90 seconds, particulate autogenous bone was harvested from the tuberosity of the maxilla on the right side and transplanted to the bone defect (Fig. 1B). A resorbable membrane from bovine origin (GenDerm®, Baumer, SP), was trimmed to adapt both to the tooth contour and the incisive nerve (Fig. 2A) and, before being positioned, small drops of n-butyl-2 cyanoacrylate (Histoacryl® Topical Skin Adhesive) were applied to the membrane's margins (Fig. 2B). The membrane was then glued both to the host bone surrounding the graft and to the tooth surface ensuring complete sealing of the graft environment (Fig. 3A). The flap was sutured covering the membrane (Fig. 3B) and the patient received postoperative medication consisting of amoxicillin (500 mg, 8/8 hours) for 7 days and anti-inflammatory (nimesulide, 100 mg, 12/12 hours) for 3 days. The suture was removed after 7 days and the postoperative period was uneventful without exposure of the membrane (Figs 4A and B). One month after the surgery, there was no sign of inflammation or disturbance of the healing process (Figs 4C and D). The splinting was maintained for 6 months after which the tooth mobility was clinically imperceptible. The 4-year follow-up attests the success



Figs 1A and B: Regenerative surgery, (A) vertical three wall bone defect at the left central incisor after soft tissue debridement (arrow). The segmented line identifies the anterior palatal plexus and (B) bone defect filled with particulate autogenous bone (arrow) harvested from the right maxillary tuberosity



Figs 2A and B: Resorbable membrane used in the GTR procedure, (A) the membrane trimmed to adapt to the tooth contour and to the incisive nerve (arrow) and (B) cyanoacrylate being applied to the borders of the membrane



Figs 3A and B: Membrane fixation on the graft and suture, (A) note the perfect adaptation of the membrane around the nerve and tooth and (B) suture of the flap covering the membrane

of the therapy with significant reduction of the probing depth from 6 to 2 mm (Fig. 4F), and radiographic filling of the defect (Figs 5A to C).

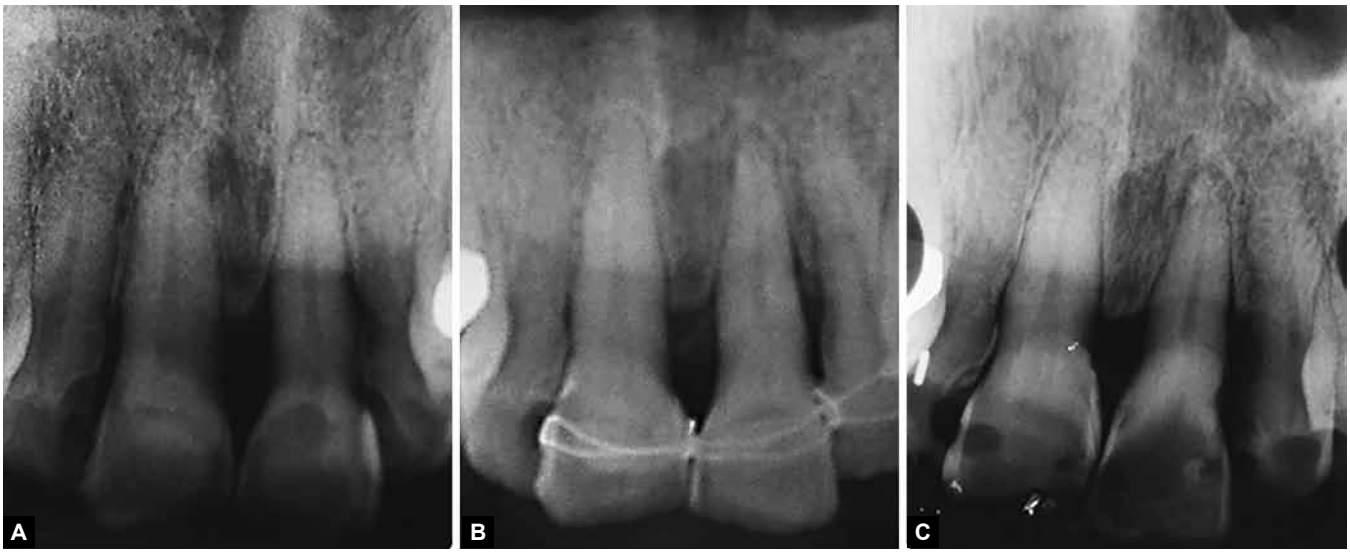
Histological Findings from Calvaria of Guinea Pigs

During an experiment carried out to study, the consolidation of autogenous onlay bone grafts, the grafts were immobilized to the bone bed by covering them with the same resorbable membrane used in the presented clinical case glued to the bone bed with cyanoacrylate adhesive (Loctite—Super Bonder Flex Gel, Henkel Ltda.). Biopsies were taken at 7, 30 and 90 days and were subjected to microscopic analysis. The tissue reaction to cyanoacrylate was similar in all periods and was characterized by discrete foreign body granulomas consisting mainly of macrophages and multinucleated giant cells, some of which had evidence of adhesive particles within the cytoplasm (Figs 6A to F). After 7 days the inflammatory reaction to the cyanoacrylate was characterized by discrete foreign body granulomas consisting mainly of macrophages and multinucleated giant cells (Fig. 6A). At 30 days, the foreign body granulomas were, sometimes discrete, sometimes more exuberant (Fig. 6B). At 90 days, particles of the cyanoacrylate could still be visualized within the cytoplasm in a few granulomatous cells (Fig. 6C). There was no significant neutrophilic inflammatory reaction that could indicate an acute response to bacterial or chemical stimulus induced by the cyanoacrylate. These events show the feasibility of using the adhesive as proposed in this study.

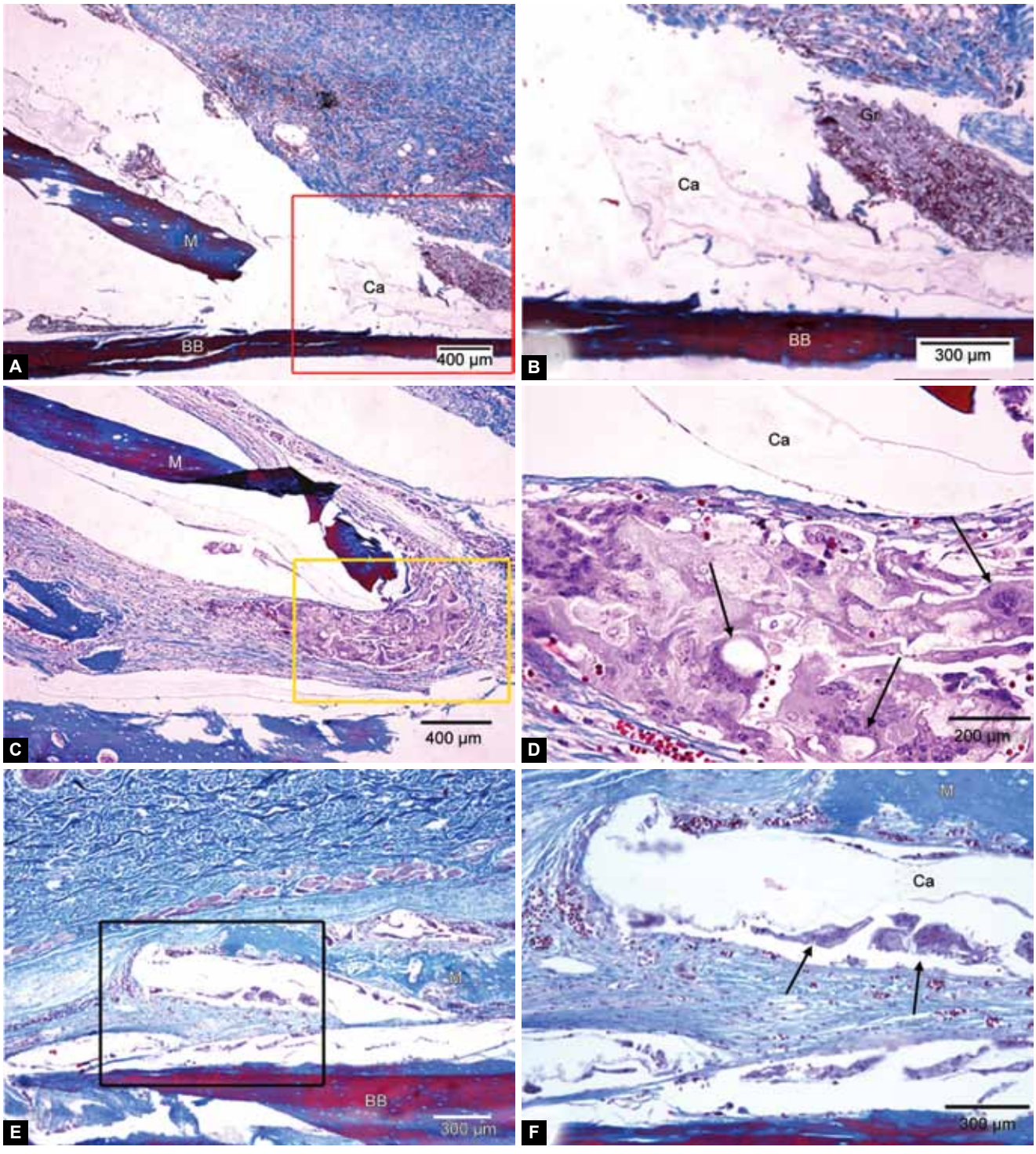
DISCUSSION

This clinical report has demonstrated the efficient use of the cyanoacrylate adhesive for membrane fixation in GTR procedure. The convenience of this method lies in the absence of some disadvantages commonly seen in conventional methods as sutures or metallic pins and screws.[5,6] Membrane exposure, contamination, inflammatory reaction or tissue necrosis did not occur in any time of the follow-up period.

Figs 4A to F: Clinical follow-up: Frontal (A) and palatal (B) aspect 7 days after the surgery, frontal (C) and palatal (D) aspect 1 month after the surgery, and frontal (E) and palatal (F) aspect 4 years after the surgery. Note the probing depth of 2 mm



Figs 5A to C: Radiographic follow-up of the treatment: (A) Initial periapical radiography showing bone loss around the left central incisor, (B) periapical radiography taken 1 month after the GTR procedure and (C) periapical radiography 4 obtained 4 years after the surgery in which bone filling of the defect is present



Figs 6A to F: Microphotographs of histologic sections of membranes glued with cyanoacrylate to guinea pigs calvaria, (A) specimen obtained at 7 days showing inflammatory reaction to the cyanoacrylate (Ca) characterized by a discrete granuloma (M: Membrane; BB: Bone bed), (B) magnification of the area highlighted in A where the cyanoacrylate (Ca) and the granuloma (Gr) can be observed, (C) specimen obtained at 30 days showing the tissue reaction at the extremity of the membrane (M), (D) magnification of the area highlighted in C where the granuloma related to the adhesive (Ca) shows multinucleated giant cells with phagocyted particles of the adhesive within their cytoplasm (arrows), (E) specimen obtained at 90 days in which membrane (M) and adhesive remnants are still present, but there is no signs of inflammation in the surrounding tissues, (F) magnification of the area highlighted in E where macrophages and multinucleated giant cells can be seen (arrows) directly related to cyanoacrylate remnants (Masson trichrome)

The main role of the resorbable/nonresorbable barriers used in GTR therapy is to prevent epithelial cell migration on diseased roots surfaces during the healing period and this goal is strongly depending on the tight fixation of the membrane to the tooth surface.[19] This concept has led to innovator attempts to simplify the method of membrane fixation as the use of acrylic resins.[7] However, the resin has to be surgically removed after 4 to 6 months while cyanoacrylate is a biodegradable material.[12,18]

Some authors have stated that the most common form of surgical wound healing involves the proliferation of junctional epithelium regardless of treatment.[20] In this aspect, a recent review referring to the rate of epithelial cells proliferation, pointed out that it would be inevitable that after just a few days a large proportion of the periodontal wound would be effectively blocked by epithelium unless clinical procedures and devices were envisioned to retard or block epithelial tissues from early access to the root surface.[21] Conversely, in this case report, the long-term follow-up took together with the favorable clinical and radiographic findings suggests that principles of the wound compartmentalization recommended for GTR[19] may have effectively allowed for cells from the periodontal ligament populate the root surface, since a shallow gingival sulcus was present 4 years after the regenerative procedure. Furthermore, it must be remembered that the wound stabilization is also an important characteristic of barrier membranes[22] that allows the adhesion of the fibrin clot to the root surface and prevents the formation of long junctional epithelium.[23]

The complete covering of the membrane by the flap seems to be a necessary caution to avoid infection, but occlusive membranes challenge the flap nutritional supply, increasing the chances of wound dehiscence and failure of the procedure.[21] The membrane used in this clinical case, besides being a macroporous material, takes at least 90 days to be totally resorbed in guinea pigs as can be seen in Figure 6. This is advantageous not only for the periodontal ligament cells migration in relation to other membranes with shorter periods of resorption, but also for enabling better nutritional support of the gingival flaps, which can diminish the frequently observed membrane exposure.

One interesting proposal for further investigation would be a histological study of the eventual capacity of membranes glued with cyanoacrylate on the tooth surfaces in preventing the early migration of junctional epithelial cells.

CONCLUSION

It was concluded that the use of membranes glued to the host bone and tooth surfaces with cyanoacrylate in GTR procedures seems to be secure and effective in promoting periodontal regeneration, without harmful effects to the hard and soft tissues.

CLINICAL SIGNIFICANCE

The alternative method for membrane fixation shown in this case report can contribute to simplify the technique in GTR procedures.

REFERENCES

1. Garg A. Barrier membranes—materials review, part I of II. Dent Implantol Update 2011;22:61-64.
2. Ashammakhi N, Renier D, Arnaud E, Marchac D, Ninkovic M, Donaway D, Jones B, Serlo W, Laurikainen K, Törmälä P, et al. Successful use of biosorb osteofixation devices in 165 cranial and maxillofacial cases: a multicenter report. J Craniofac Surg 2004;15:692-701.
3. Lundgren AK, Sennerby L, Lundgren D. Guided jaw-bone regeneration using an experimental rabbit model. Intl Oral Maxillofac Surg 1998;27:135-140.
4. Polson AM. The root surface and regeneration; present therapeutic limitations and future biologic potentials. J Clin Periodontol 1986;13:995-999.
5. Hardwick R, Scantlebury TV, Sanchez R, Whitley N, Ambruster J. Membrane design criteria for guided bone regeneration of the alveolar ridge. In: Buser D, Dahlin C, Schenk RK, editors. Guided Bone Regeneration in Implant Dentistry. Chicago: Quintessence; 1994. p. 101-135.
6. Murphy KG. Postoperative healing complications associated with Gore-tex periodontal material. Part II. Effect of complications on regeneration. Int J Periodontics Restorative Dent 1995;15:549-561.
7. Tomita S, Yamamoto S, Shibukawa Y, Kaneko T, Miyakoshi S, Shimono M, Yamada S. Application of 4-META/MMA-TBB resin for fixation of membrane to tooth in guided tissue regeneration in dog. Dent Mater J 2010;29690-29696.
8. Kline DG, Hayes GJ. An experimental evaluation of the effect of a plastic adhesivemethyl-2-cyanoacrylate on neural tissue. J Neurosurg 1963;20:647-654.
9. Yashon F, Jane JA, Gordon MC, Hubbard JL, Sugar O. Effects of methyl 2-cyanoacrylate adhesives on the somatic vessels and the central nervous system of animals. J Neurosurg 1966;24:883-888.
10. Bradley JP, Zide BM, Berenstein A, Longaker MT. Large arteriovenous malformations of the face: aesthetic results with recurrence control. Plast Reconstr Surg 1999;103:351-361.
11. Penoff J. Skin closures using cyanoacrylate tissue adhesives: safety and efficacy report. Plast Reconstr Surg 1999;103: 730-731.
12. Tseng YC, Hyon SH, Ikada Y. Modification of synthesis and investigation of properties for 2-cyanoacrylates. Biomaterials 1990;11:73-79.
13. Moretti-Neto RT, Mello I, Moretti ABS, Robazza CR, Pereira AA. In vivo qualitative analysis of the biocompatibility of different cyanoacrylate-based adhesives. Braz Oral Res 2008;22:43-47.
14. Eiferman RA, Snyder JW. Antibacterial effect of cyanoacrylate glue. Arch Ophthalmol 1983;101:958-960.
15. Al-Belasy FA, Amer MZ. Hemostatic effect of n-butyl-2-cyanoacrylate (Histoacryl) glue in warfarin-treated patients undergoing oral surgery. J Oral Maxillofac Surg 2003;61: 1405-1409.
16. Kutcher MJ, Ludlow JB, Samuelson AD, Campbell T, Pusek SN. Evaluation of a bioadhesive device for the management of aphthous ulcers. J Am Dent Assoc 2001;132:368-376.
17. Alkan S, Dadaş B, Celik D, Coskun BU, Yilmaz F, Başak T. The efficacy of N-2-butyl cyanoacrylate in the fixation of nasal septum to the anterior nasal spine in rabbits: experimental study. Eur Arch Otorhinolaryngol 2007;264:1425-1430.

18. Rezende ML, Consolaro A, Sant'Ana AC, Damante CA, Greghi SL, Passanezi E. Demineralization of the contacting surfaces in autologous onlay bone grafts improves bone formation and bone consolidation. J Periodontol 2014;85:e121-129.
19. Gottlow J, Nyman S, Lindhe J, Karring T, Wennström J. New attachment formation in the human periodontium by guided tissue regeneration. Case reports. J Clin Periodontol 1986;13: 604-616.
20. Wirthlin MR. The current status of new attachment therapy. J Periodontol 1981;52:529-544.
21. Susin C, Wikesjö UM. Regenerative periodontal therapy: 30 years of lessons learned and unlearned. Periodontol 2000 2013;62:232-242.
22. Gottlow J. Guided tissue regeneration using bioresorbable and non-resorbable devices: initial healing and long-term results. J Periodontol 1993;64:1157-1165.
23. Wikesjö UM, Nilveus R. Periodontal repair in dogs: effect of wound stabilization on healing. J Periodontol 1990;61: 719-724.