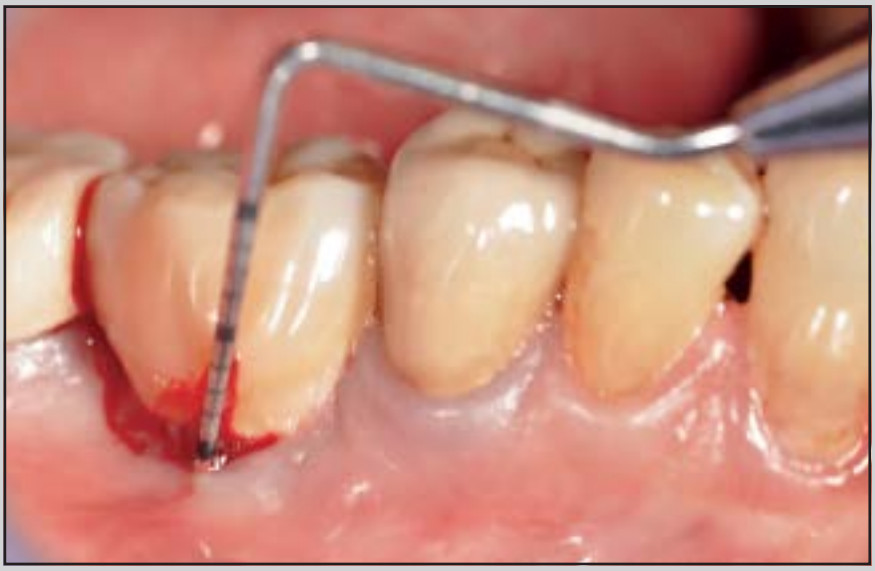
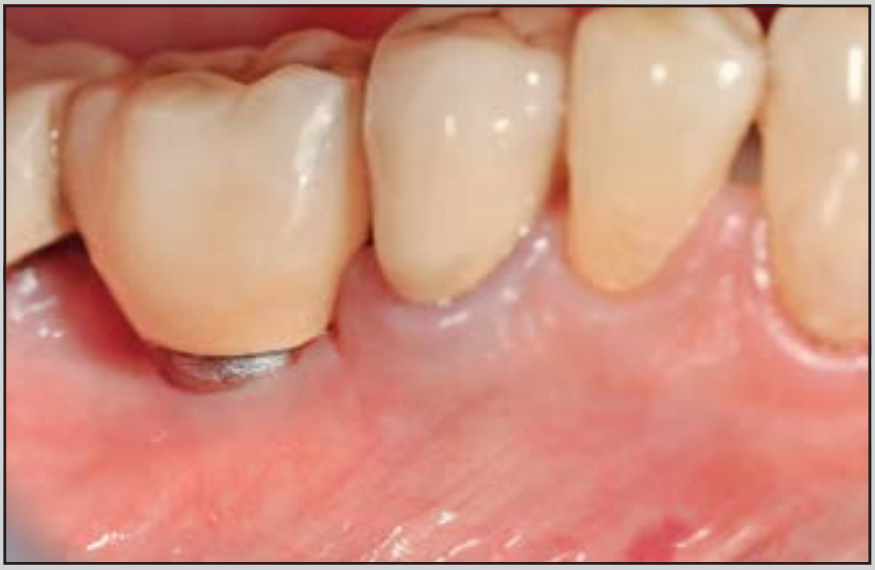
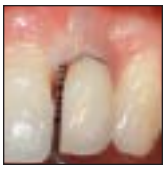




Nonsurgical Treatment of Peri-implantitis Using the Biofilm Decontamination Approach: A Case Report Study



Giovanpaolo Pini-Prato, MD, DDS, PhD[1]
Cristina Magnani, DDS[1]
Roberto Rotundo, DDS[2]

The aim of this preliminary study is to show the effect of the biofilm decontamination approach on peri-implantitis treatment. Clinical cases showing peri-implantitis were treated using an oral tissue decontaminant material that contains a concentrated aqueous mixture of hydroxybenzenesulfonic and hydroxymethoxybenzenesulfonic acids and sulfuric acid. The material was positioned in the pocket around the implant without anesthesia in nonsurgically treated cases. No instrumentation and no systemic or local antibiotics were used in any of the cases. A questionnaire was used for each patient to record the pain/discomfort felt when the material was administered. All of the treated cases healed well and rapidly. The infections were quickly resolved without complications. The momentary pain on introduction of the material was generally well tolerated and completely disappeared after a few seconds. The biofilm decontamination approach seems to be a very promising technique for the treatment of peri-implantitis. The local application of this material avoids the use of systemic or local antibiotics. Int J Periodontics Restorative Dent 2016;36:383–391. doi: 10.11607/prd.2653

[1]Private Practice, Florence, Italy.
[2]Honorary Lecturer, Periodontal Unit, Eastman Dental Institute, University College of London, London, UK.

Correspondence to: Prof Giovanpaolo Pini-Prato, viale Matteotti 11, 50121 Florence, Italy. Email: gpinipr@tin.it

Periodontitis is an infectious disease caused by a plaque biofilm; therapy is based on oral hygiene and root debridement with or without flap approach.[1] Local and systemic administration of antibiotics may be used as adjunctive therapy for reducing or eliminating the microbial flora.[2] Due to a similar bacterial etiology, peri-implant mucositis and peri-implantitis are treated with the aim of reducing and eliminating microbes.

Two types of peri-implant disease have been recently classified[3]: peri-implant mucositis that involves the marginal soft tissues without sign of crestal bone loss, and peri-implantitis showing soft tissue inflammation associated with bone loss. While peri-implant mucositis shows characteristics similar to gingivitis and is reversible after proper treatment, peri-implantitis is a different and complex entity. Peri-implantitis is an unpredictable disease depending on a multicausality model including genetics/host, environment, lifestyle, hardware, procedure, and hard/soft tissues, and an evidence-based treatment plan is lacking.[3]

A systematic review of the literature has shown that mechanical nonsurgical treatment could be effective in the treatment of peri-implant mucositis and the use of antimicrobial mouthrinses might improve the outcome of such lesions.

On the other hand, mechanical nonsurgical treatment was not found effective in the treatment of peri-implantitis and adjunctive use of chlorhexidine does not improve the clinical and microbiologic parameters.[4] Regarding the surgical treatment of peri-implantitis, another systematic review revealed that the available evidence on this therapy is limited.[5] Flap surgery associated with implant surface decontamination and use of systemic antibiotics was shown to be effective in only 58% of the cases. This is probably due to the difficulty in decontaminating implant surfaces. Saline wash, air powder abrasion, peroxide treatment, citric acid, ultrasonic and manual debridement, laser therapy, and topical medication have been used to demonstrate a reduced decontamination effect, but no single method was found to be superior.[5] A recent systematic review in which different nonsurgical interventions (five trials), adjunctive treatments to nonsurgical interventions (one trial), different surgical interventions (two trials), and adjunctive treatments to surgical interventions (one trial) were analyzed reached the same conclusion: There is no reliable evidence suggesting one method as the most effective intervention for treating peri-implantitis.[6] A more recent review[7] reports that peri-implant mucositis seems to be successfully treated using mechanical debridement with or without the additional use of antimicrobial agents and that peri-implant nonsurgical therapy does not seem to be effective in eliminating disease. Regarding peri-implant surgical therapy, the authors[7] suggest that an apically positioned flap may be used in case of predominant suprabony component in nonesthetic areas, while regenerative treatment should be carried out in case of circumferential bony defects. They also confirm that published data do not clearly indicate superiority of a specific decontamination approach.

Recent pharmacologic research on the treatment of biofilm-induced diseases has shifted from the antimicrobial effect to the effects of substances that destroy the biofilm so that the bacteria cannot survive. A biofilm is any group of microorganisms that are embedded within a self-produced matrix of extracellular polymeric substance (EPS) composed of extracellular DNA, proteins, and polysaccharides. In the oral cavity, biofilms may form on living (root surfaces) or nonliving surfaces (implants).[8] The microbial cells growing in a biofilm are physiologically distinct from planktonic cells of the same organism, which by contrast are single cells that float or swim in a liquid medium.

A sulfonic/sulfuric acid solution (HYBENX, EPIEN Medical)[9,10] shows characteristics of contact desiccants because it contains concentrated blends of sulfonic/sulfuric acids, which have a strong affinity for water. In fact, these components contain a concentrated aqueous mixture of hydroxybenzenesulfonic and hydroxymethoxybenzenesulfonic acids and sulfuric acid. The hydroxybenzenes are keratolitic, while the sulfonate group and sulfuric acid are hygroscopic and denaturing. The chemical action is due to the interaction between the sulfate group and water molecules. The sulfate group has an internal polar structure with the oxygen atoms on the outer surface of the group carrying a strong negative surface charge. Water molecules also have a structure with significant polarity, which gives them a negatively charged surface on one side and a positively charged surface on the other. A sulfate group tends to match up its large negative surface to the many positive surfaces of water molecules. Water molecules become reversibly bound to a sulfate surface through an electrostatic interaction known as a hydrogen bond, where the positive charge on the surface of the hydrogen atoms of the water molecule is attracted to the negative charge on the surface of a group of oxygen atoms.[9] Its chemical structure allows the solution to denature the biofilm matrix through a potent desiccating action that rapidly subtracts water from the matrix, coagulating and shrinking the matrix and microbes. The biofilm material precipitates, contracts together, and separates from the root surface. This action facilitates the removal of dental plaque, allowing the eradication of plaque microbes.[10]

A recent study[11] demonstrated the effectiveness of the oral tissue decontaminant material in the treatment of clinical cases showing acute periodontal abscess without the use of systemic or local antibiotics. The infections were quickly resolved without complications, and the pockets were reduced in a short period of time. A clinical case re-

port[12] evaluated the efficacy of oral tissue decontaminant (HYBENX) in the treatment of chronic periodontitis in 11 adult patients. Polymerase chain reaction methodology was used to detect microbial activity of *Porphyromonas gingivalis*, *Treponema denticola*, and *Tannerella forsythia* before treatment (T_0) and 15 days after (T_1) oral tissue decontaminant treatment. After the treatment, a remarkable decrease in bacteria amount was observed. The average reduction was about 99% for each of the red complex bacteria and about 96% for total bacteria. The authors concluded that the decontaminant material is an effective adjunct to eradicate bacterial loading in the pockets of patients affected by periodontitis.

Therefore, the use of a potent biofilm decontaminant material that is effective in eliminating biofilm on the root surface[11] could be also beneficial in the treatment of peri-implant lesions. The purpose of this study is to show the treatment effect of the biofilm decontamination approach on peri-implantitis through some clinical case reports.

Case reports

Patients presenting with peri-implantitis were treated using oral tissue decontaminant (approved as a Class I CE medical device by the Italian Ministry of Health, no. 483768, on February 7, 2012). All subjects were informed of the nature, potential risks, and potential benefits of their participation in the study. Patients provided written and signed informed consent in accordance with the Helsinki Declaration of 1975 as revised in 2000.

Case 1

A 70-year-old woman with periodontal disease was treated and then maintained every 4 months in a private office, showing good compliance and proper plaque control. Later, an implant was placed in the mandible, at the left premolar. After 10 years, signs of peri-implant mucositis and peri-implantitis occurred several times. The peri-implantitis was treated with various methods, such as local irrigation with antibiotics. Nevertheless, peri-implant mucositis and peri-implantitis persisted and systemic antibiotics were also prescribed, but without success. In fact, 2 years later the patient presented in a private practice (G.P.P.) with an acute abscess with pus, swelling, bleeding on probing, pain, impaired chewing, and a peri-implant pocket depth of 8 mm (Fig 1a). At that time, the decontaminant was buccally positioned inside the pocket using a syringe with blunt-tipped cannula and left in situ for 30 seconds without mechanical instrumentation or local anesthesia (Fig 1b). The patient reported acute pain for a few seconds during the injection. Then the material was removed by thorough water irrigation of the treated area. A white dehydrated area of superficial soft tissue developed around the implant (Fig 1c). The white area rapidly disappeared when the tissue rehydrated itself. No systemic antibiotic therapy was prescribed. After 4 days, the patient reported an improved clinical condition with decreased inflammation and no pain. After 8 days, the inflammation of the marginal tissues was completely eliminated, along with the recession of marginal tissue (Fig 1d). No additional treatment was administered, and at the control visit for professional supporting periodontal therapy (SPT) after 3 months the treated area appeared healthy (Fig 1e), with a shallow probing depth (2 mm) and no signs of inflammation. At 6 months, the clinical condition appeared stable and bone remineralization could be seen on a radiograph (Fig 1f).

Case 2

A 52-year-old man presented in a private practice (GPP) with acute signs of peri-implantitis, bleeding on probing, pain, and a peri-implant pocket depth of 8 mm on the lingual side of a mandibular central incisor (Fig 2a). The patient reported that episodes of peri-implantitis had occurred several times. The lesion was treated by another dentist with various methods, such as local irrigation with antibiotics, air powder abrasion, and ultrasonic debridement. Nevertheless, peri-implantitis persisted and systemic antibiotics were also prescribed, but without success. During the first visit, the decontaminant material was lingually positioned inside the pocket and left in situ for 30 seconds without mechanical instrumentation or local anesthesia (Fig 2b). The patient reported moder-

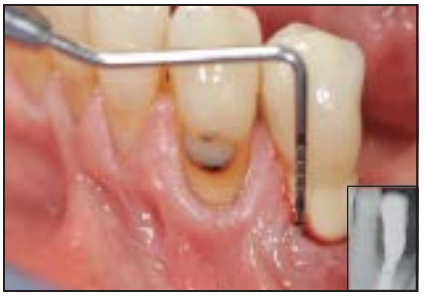


Fig 1a *Case 1. Clinical and radiologic view of chronic peri-implantitis on a mandibular implant associated with a peri-implant depth of 8 mm, swelling, and bleeding on probing.*

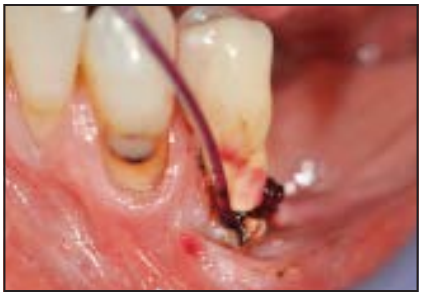


Fig 1b *Case 1. No instrumentation and no local anesthesia were used, and the material (gel) was positioned into the pocket buccally using a syringe and left in the site for 30 seconds.*

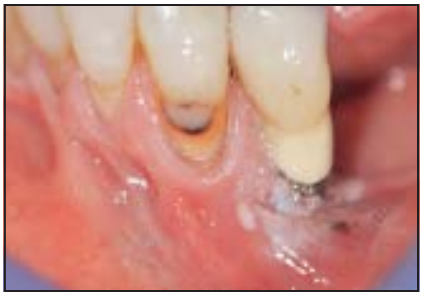


Fig 1c *Case 1. A white dehydrated area of soft tissue developed around the implant.*

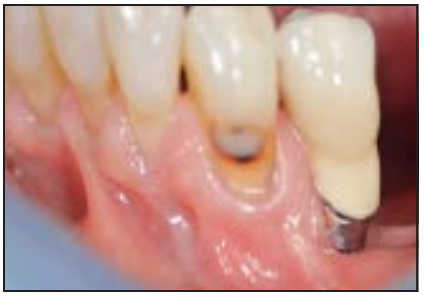


Fig 1d *Case 1. After 8 days, the inflammation and the marginal tissue recession were completely resolved.*

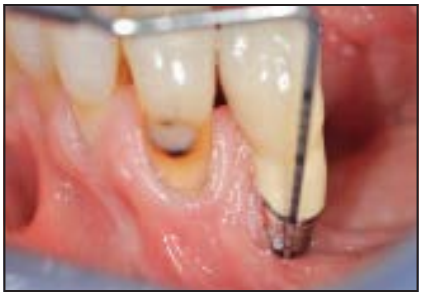


Fig 1e *Case 1. A shallow pocket depth (2 mm) was seen after 3 months.*

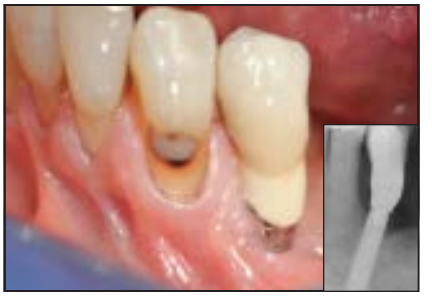


Fig 1f *Case 1. After 6 months, no additional treatment was performed and the treated area appeared healthy without signs of inflammation and with bone remineralization.*

ate pain for a few seconds during the injection. The material was then removed by thorough water irrigation of the treated area. No local or systemic antibiotic therapy was prescribed. After 8 days the patient reported an improved clinical condition with decreased inflammation and no pain (Fig 2c). After 16 days, the inflammation of the marginal tissues was completely eliminated and moderate recession of the marginal tissue was observed (Fig 2d). After 6 months the treated site was healthy, showing 2 mm of pocket depth and initial bony remineralization (Fig 2e).

Case 3

A 67-year-old woman came to the private office (GPP) showing an acute abscess with pus, bleeding on probing, pain, impaired chewing, and a 5-mm pocket depth on a mandibular implant placed 4 years earlier (Fig 3a). The patient complained of repeated episodes of acute inflammation around the implant since 3 years earlier that had been treated unsuccessfully by the previous dentist using various methods, such as local irrigation with antibiotics and peroxide and ultrasonic devices; systemic antibiotics were also prescribed several times.

After the first visit, the biofilm decontaminant material was buccally positioned inside the pocket with the syringe and left in situ for 30 seconds without mechanical instrumentation or local anesthesia (Fig 3b). The patient reported moderate

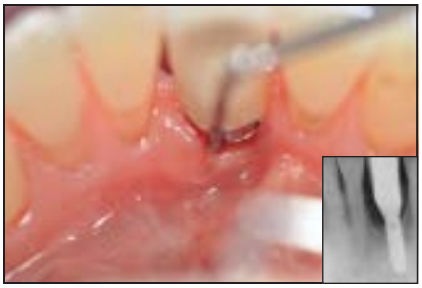


Fig 2a *Case 2. Clinical and radiographic view of peri-implantitis at the lingual side of a mandibular central incisor associated with 8-mm pocket depth and bleeding on probing.*

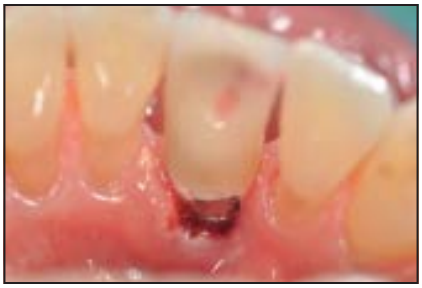


Fig 2b *Case 2. The material (liquid) was positioned intrasulcularly using the syringe and left in the pocket for 30 seconds.*

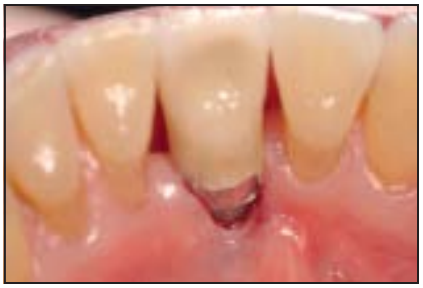


Fig 2c *Case 2. After 8 days, inflammation had almost disappeared.*

Fig 2d (left) *Case 2. After 16 days, the inflammation of the marginal tissues was completely eliminated and moderate recession of marginal tissue was observed.*

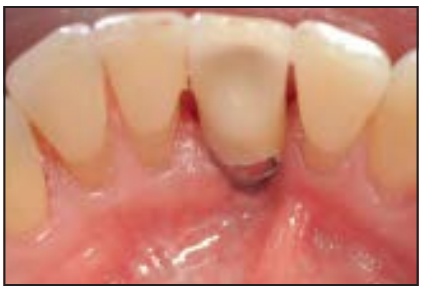
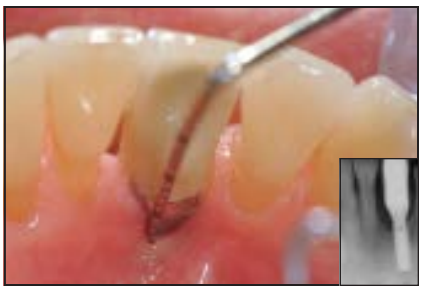


Fig 2e (right) *Case 2. After 6 months the treated area was healthy, with a reduced peri-implant pocket depth (2 mm), moderate recession of marginal tissue, and bone remineralization.*



pain for a few seconds during the injection of the biofilm decontaminant gel. The material was then removed by thorough water irrigation of the treated area. A white dehydrated area of superficial soft tissue developed around the implant (Fig 3c) and rapidly disappeared when the tissue rehydrated itself. No systemic antibiotic therapy was prescribed. After 7 days, the patient reported an improved clinical condition with decreased inflammation and no pain. After 20 days, the inflammation of the marginal tissues was completely eliminated (Fig 3d). After 3 months, the soft tissues were healthy and probing depth was 2 mm (Fig 3e). The patient declined further oral radiographic examination of the treated site during a concomitant antiblastic therapy.

Case 4

A 41-year old female patient came to the private office (R.R.) presenting peri-implantitis in the region of the maxillary left lateral incisor. The dental implant had been placed 11 years before (Fig 4a). In this area, repeated acute inflammatory events had occurred over the last 6 years and were treated using nonsurgical approaches such as 0.12% chlorhexidine digluconate subgingival irrigations with or without subgingival mechanical instrumentation.

After the first visit, the biofilm decontaminant material (gel) was injected into the peri-implant pocket and left for 30 seconds without mechanical instrumentation or local anesthesia. The patient reported

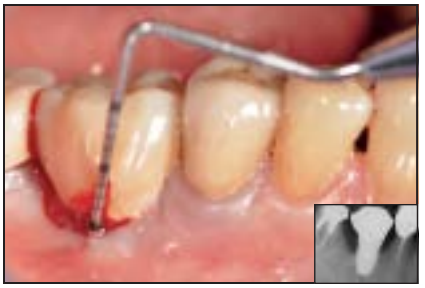


Fig 3a *Case 3. Peri-implant pocket depth of 5 mm on a mandibular implant placed 4 years earlier.*

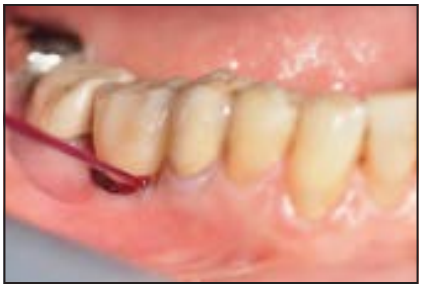


Fig 3b *Case 3. The biofilm decontaminant material (liquid) was buccally positioned inside the pocket with the syringe and left in situ for 30 seconds.*

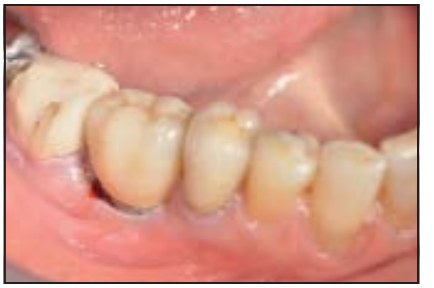
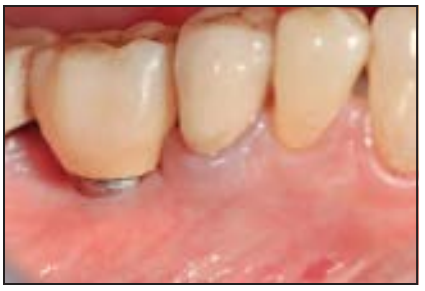


Fig 3c *Case 3. A white dehydrated area of superficial soft tissue developed around the implant.*



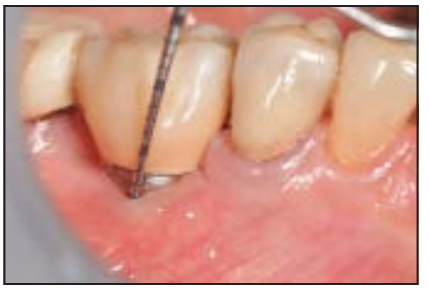


Fig 3d (left) *Case 3. No sign of inflammation of the marginal tissues was present after 20 days.*

Fig 3e (right) *Case 3. After 3 months, the marginal tissues were healthy and associated with 2 mm of probing depth.*

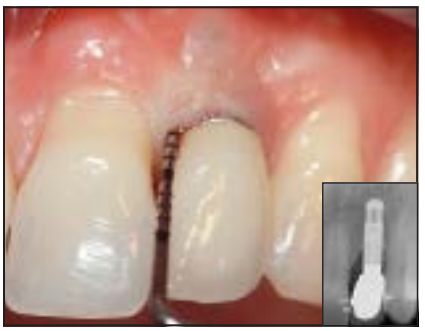


Fig 4a *Case 4. Clinical and radiographic presence of peri-implantitis (6-mm pocket depth) corresponding to the maxillary left lateral incisors.*

Fig 4b *Case 4. The absence of signs of inflammation in correspondence with the treated area 6 months later. Frontal view.*

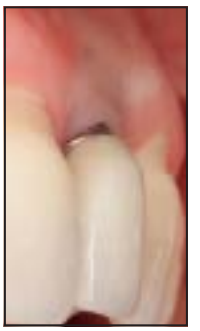
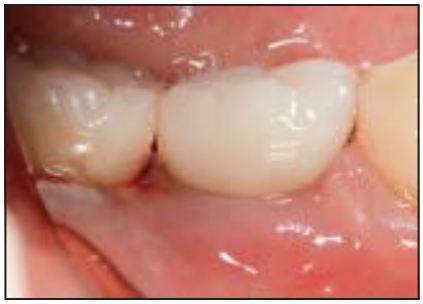


Fig 4c *Case 4. The absence of signs of inflammation in correspondence with the treated area 6 months later. Lateral view.*

moderate pain for a few seconds immediately after the gel injection. The material was then removed by abundant water irrigation. A white dehydrated area of superficial soft tissue developed around the implant and rapidly disappeared when the tissue rehydrated itself. No systemic antibiotic therapy was prescribed. After 6 months the soft tissues appeared healthy with no signs of inflammation (Figs 4b and 4c).

Case 5

A 56-year-old woman presented with recurrent peri-implantitis corresponding with the mandibular right second molar (Figs 5a and 5b).



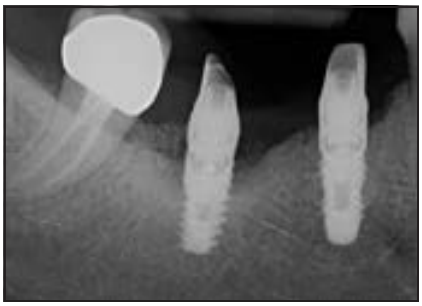
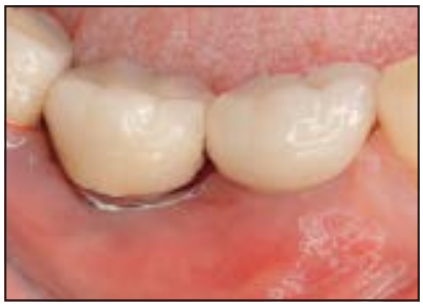


Fig 5a (left) *Case 5. Clinical aspect of the peri-implant tissues in correspondence with the mandibular second molar affected by peri-implantitis.*

Fig 5b (right) *Case 5. Radiographic view of the affected area.*



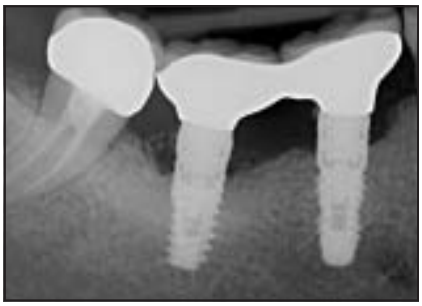


Fig 5c (left) *Case 5. Clinical image of the treated area 6 months posttreatment revealed an absence of inflammation.*

Fig 5d (right) *Case 5. Radiographic examination 6 months posttreatment showed signs of remineralization.*

Several nonsurgical and surgical interventions were performed, and during the last surgical intervention, 1 year before the examination, an attempt was made to regenerate the defect using deproteinized bovine bone. Nevertheless, peri-implant inflammation repeatedly occurred. The patient was sent to a periodontist (R.R.), who treated the site by means of the biofilm decontaminant gel. The gel was injected into the peri-implant pocket and left for 30 seconds without mechanical instrumentation or local anesthesia. The patient reported low to moderate pain for a few seconds immediately after the gel injection. The material was then removed by abundant water irrigation. No systemic antibiotic therapy was prescribed. After 6 months, a clinical and radiographic examination revealed healthy peri-implant soft tissues with initial but evident signs of remineralization (Figs 5c and 5d).

Table 1 **Results of the treated clinical cases**

Case	PD_0 (mm)	BoP_0	Rec_0 (mm)	VAS	PD_1 (mm)	BoP_1	Rec_1 (mm)	Discomfort (days)
1	8	yes	0	7	2	no	3	3
2	8	yes	1	5	1	no	2	4
3	5	yes	0	–	2	no	2	3
4	6	yes	0	5	3	no	1	1
5	7	yes	0	4	4	no	1	2

PD_0 = pocket depth at baseline; PD_1 = pocket depth at 3 months; BoP_0 = bleeding on probing at baseline; BoP_1 = bleeding on probing at 3 months; Rec_0 = gingival recession at baseline; Rec_1 = gingival recession at 3 months; VAS = visual analog scale from 0 (no pain) to 10 (very painful).

Pain discomfort assessment

The patients were asked to grade their discomfort during the injection of the material on a scale from 0 (no pain) to 10 (very painful). They reported moderate pain (3 to 6). In addition, the patients were asked to state the number of days in which they experienced discomfort following the treatment day. All patients reported that the discomfort disappeared after 2 to 3 days (Table 1).

Discussion

Modern research has now shifted the therapeutic target from attacking the microbes directly with antiseptics or antibiotics to destroying the structure of the biofilm and thereby causing the death of the bacteria it contains. Recently a biofilm decontaminant material became available for use in the dental routine.[10] The rapid and immediate dehydration and coagulation of the biofilm and the death of the bacteria are caused by the chemical properties of the material. The sulfuric and sulfonic groups with their strong negative charge exert a strong attraction on the water molecule of the biofilm matrix, which has a positive surface charge due to the presence of hydrogen atoms. The antibacterial effect and safety of the oral decontaminant have been successfully documented in the treatment of oral aphthae, where the denaturing of the ulcer surface led to rapid healing of the aphthous lesions as reported in a randomized clinical study.[13] A recent report study[11] demonstrated the effectiveness of the oral tissue decontaminant material in the treatment of acute periodontal abscess without the use of systemic or local antibiotics. The infections were quickly resolved without complications, and the pockets were reduced in a very short time. Another study[12] reported that the decontaminant material is effective for the elimination of red complex bacteria in the pockets of patients affected by moderate periodontitis.

On the basis of this knowledge, the material was tested in cases of peri-implantitis with the purpose of destroying the bacterial biofilm. The true problem in the treatment of peri-implantitis is the difficulty of achieving complete decontamination of the implant surfaces; this may explain the frequent failures in the treatment of peri-implantitis. Saline wash, air powder abrasion, peroxide treatment, citric acid, ultrasonic and manual debridement, laser therapy, and topical medication have all demonstrated a reduced decontamination effect, but published data do not clearly indicate superiority of a specific decontamination approach.[5–7]

The five cases presented in this article were treated with a nonsurgical approach in which the decontaminant material was placed in the peri-implant pockets without anesthesia or local or systemic antibiotics. Persistent contact with the marginal tissues was avoided. The soft tissues were gently separated from the implant using a periosteal elevator and dry gauze. This caused the white dehydrated area of superficial soft tissues that developed around the implant as a consequence of the dehydration action to disappear in a few minutes, when the tissue rehydrated itself.

All of the cases treated with the decontaminant material healed well and rapidly. The inflammation and pain that had been ongoing while the patient was treated with local and systemic antibiotics disappeared completely in a few days, and the patient's condition remained stable over the following months with no further mechanical or antibacterial treatment. The momentary pain upon introduction of the material was generally well tolerated and completely disappeared after 2 to 3 days (Table 1).

The rapid resolution of this case leads us to believe that because it quickly causes desiccation of the biofilm on the implant surface, this technique could be particularly useful and indicated in the treatment of peri-implantitis. Nevertheless, it certainly merits further controlled randomized studies for a full evaluation.

However, the most important aspect of local application of this material aimed to eliminate the bacterial biofilm on the implant surface is that no systemic or local antibiotics were used in any of the cases presented. Avoiding the use of antibiotics in the treatment of peri-implantitis is an enormous step forward in the treatment of bacterial infections. It is a well-known and widely accepted fact that indiscriminate and repeated use of local antibiotics can lead to antimicrobial resistance that may be life threatening for patients.[14]

Conclusions

The biofilm dehydration approach seems to be a promising technique for the treatment of peri-implantitis and avoids the use of antibiotics.

Acknowledgments

The authors reported no conflicts of interest related to this study.

References

1. Greenwell H. Position Paper: Guidelines for periodontal therapy. J Periodontol 2001;72:1624–1628.
2. Mombelli A. The use of antibiotics in periodontal therapy. In Lindhe J, Karring T, Lang NP (eds). Clinical Periodontology and Implant Dentistry ed 4. Oxford: Blackwell Munksgaard, 2003: 494–507.
3. Quirynen M, Herrera D, Teughels W, Sanz M. Implant therapy: 40 years of experience. Periodontol 2000 2014;66:7–12.
4. Renvert S, Roos-Jansåker AM, Claffey N. Non-surgical treatment of peri-implant mucositis and peri-implantitis: A literature review. J Clin Periodontol 2008; 35:S305–S315.
5. Claffey N, Clarke E, Polyzois I, Renvert S. Surgical treatment of peri-implantitis. J Clin Periodontol 2008;35:S316–S332.
6. Esposito M, Grusovin MG, Worthington HV. Treatment of peri-implantitis: What interventions are effective? A Cochrane systematic review. Eur J Oral Implantol 2012;5:S21–S41.
7. Figuero E, Graziani F, Sanz I, Herrera D, Sanz M. Management of peri-implant mucositis and peri-implantitis. Periodontol 2000 2014;66:255–273.
8. Hall-Stoodley L, Costerton JW, Stoodley P. Bacterial biofilms: From the natural environment to infectious diseases. Nat Rev Microbiol 2004;2:95–108.
9. Costerton JW. USC Dental Oral Microbial Biofilm Disruption Assays. Contract Research, EPIEN Medical, Inc, 2007.
10. Basara M. HYBENX® Oral Tissue Decontaminant Technical Dossier. Design History Section. EPIEN Medical. December 2014.
11. Pini-Prato G, Magnani C, Rotundo R. Treatment of acute periodontal abscesses using the biofilm decontamination approach: A case report study. Int J Periodontics Restorative Dent 2016;36: 55–63.
12. Lauritano D, Girardi A, Carinci F. The efficacy of HybenX oral tissue decontaminant for periodontal disease treatment: A case series study. Int J Adv Case Reports 2015;2:405–408.
13. Porter SR, Al-Johani K, Fedele S, Moles DR. Randomised controlled trial of the efficacy of HybenX in the symptomatic treatment of recurrent aphthous stomatitis. Oral Dis 2009;15:155–161.
14. World Health Organization. Antimicrobial resistance: Global report on surveillance. http://www.who.int/drugresistance/documents/surveillancereport/en/. Accessed 8 December, 2014.