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Clinical case

Periodontitis Treatment by Scaling and Root Planing with Antimicrobial and Anti-Inflammatory Solutions in a Patient with Systemic Lupus Erythematosus

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Abstract

Introduction: Systemic Lupus Erythematosus is a chronic autoimmune disease of unknown cause in which patients regularly consume immunosuppressants, causing a decrease in body fluids of proteins such as mucins, immunoglobulin A and G antibodies, which causes destruction of periodontal tissue. **Objective:** To report a clinical case on the benefits of scaling and root planing (SRP) with solutions based on hypochlorous acid (HOCl) and modified diallyl disulfide oxide (MDDO) in the periodontal inflammatory process in a patient with systemic lupus erythematosus,

tubulointerstitial nephritis and periodontitis. **Case presentation:** A 32-year-old woman, with systemic lupus erythematosus, tubulointerstitial nephritis and, according to the 2017 global workshop on the classification of periodontal diseases and conditions, was diagnosed with Stage 2 and Grade B periodontitis. Periodontal assessment revealed a high overall dental plaque index, with high-risk plaque being the most prevalent. SRP treatment was carried out by quadrants, applying a HOCl solution during periodontal debridement and periodontal pockets were irrigated with MDDO solution to disinfect them. **Conclusions:** The antimicrobial and anti-inflammatory solutions used as adjuvants to SRP in this novel periodontal irrigation therapy helped to reduce gingival inflammation and high-risk plaque, which favoured healing of periodontal tissues in a patient with systemic lupus erythematosus.

Keywords: Periodontitis; systemic lupus erythematosus; dental plaque; irrigation; scaling and root planing.

INTRODUCTION

Systemic lupus erythematosus (SLE) is a chronic autoimmune disease of unknown cause, in which patients regularly use immunosuppressant drugs to inhibit the powerful inflammatory response[1]. This can decrease proteins such as mucins, immunoglobulin A (IgA) and IgG antibodies, defensins, and can be associated with bacterial dysbiosis in the oral cavity with an increased risk for hyposalivation, aphthous ulcers, malar rash and periodontal disease. These changes may cause hyperactivation of B and T lymphocytes, production and accumulation of autoantibodies that cause periodontal tissue destruction[2]. Therefore, it is important for dentists to evaluate the use of solutions with cytoprotective and antimicrobial effects that favour the restoration of defense mechanisms of the oral mucosa in patients with SLE.

Hypochlorous acid (HOCl) solutions are generally very safe and have been shown to possess a broad antimicrobial spectrum, haemostatic, analgesic and anti-inflammatory effects. Likewise, they do not generate bacterial resistance and influence tissue regeneration positively by being chemoattractant of fibroblasts[3-5]. HOCl can inhibit the signalling pathways associated with the expression and translocation of transcription factors by oxidation, for example, the nuclear factor-kappa B (NF-kB) which is involved in the genetic transcription of inflammatory cytokines such as interlukin-1α (IL-1α), IL-1β, IL-2, IL-6 and tumour necrosis factor-alpha (TNF-α)[5]. It may also have an impact on the synthesis of other mediators that act on inflammation such as nitric oxide, prostaglandin E2, Transforming Growth Factor beta (TGF-β) and adhesion molecules, as well as inhibitors of apoptosis[3]. These molecules are related to periodontitis and their inhibition is beneficial in the process of periodontal tissue recovery[5].

There are also solutions based on modified diallyl disulfide oxide (MDDO), an active ingredient based on Allicin (diallyl dithiosulfinate) derived from garlic extract (*Allium sativum*), that has a broad antimicrobial spectrum effect[6-9]. MDDO is capable of breaking the sulfhydryl bonds that join the amino acids that make up bacterial proteins[10]. The main purpose behind this work is to present the benefits that HOCl and MDDO solutions had on the process of periodontal inflammation in an SLE patient with tubulointerstitial nephritis and periodontitis.

CLINICAL CASE PRESENTATION

A 32-year-old Mexican woman, dedicated to housework, with a history of SLE diagnosed 3 years ago for which she receives treatment with 10 mg of prednisone every 24 hours and 200 mg of hydroxychloroquine every 24 hours in the last three months. Renal biopsy demonstrated tubulointerstitial nephritis and focal segmental glomerulosclerosis with 50% tubular atrophy. She has used hydrocortisone, methylprednisolone intermittently during periods of exacerbation of her disease, and on four occasions, antibiotics for recurrent respiratory and urinary infections in the previous year (nitrofurantoin, meropenem, amoxicillin and clavulanic acid). The patient visited the Department of Stomatology due to gingival inflammation, gingival bleeding and gingival pain with six months of evolution. The patient referred no previous dental visits or treatments of any kind. Intraoral exploration revealed periodontal disease and poor oral hygiene habits, tooth brushing once a day with low intensity without the use of dental floss or mouthwash.

Pain intensity was evaluated using the visual analog scale (VAS)[11-12] where pain is classified as mild 1-3 points, moderate 4-6 points, and severe 7-10 points. Gingival inflammation was measured with the Löe gingival index[13,14] that allows to classify inflammation in grade 0= absence of it, grade 1= mild inflammation, grade 2= moderate inflammation, and grade 3= severe inflammation. Periodontitis was assessed according to the 2017 world workshop on the classification of periodontal and peri-implant diseases and conditions[15], being diagnosed in Stage 2 and Grade B periodontitis, with interdental clinical attachment loss (CAL) of 4 mm and maximum probing depth of 5 mm. The Papillary bleeding index[14, 16] was determined in the mesial and distal areas of the papilla of each dental organ and was classified as follows: 0= no bleeding, 1= one point of discrete bleeding, 2= several isolated bleeding points or a single blood line, 3= interdental triangle fills with blood after probing and 4= immediate profuse bleeding after probing with blood flowing into the tooth and marginal gingiva. Miller index of tooth mobility[17,18] was evaluated and interpreted as follows: grade 0= no movement, 1= distinguishable increase in mobility, 2= visible mobility <1 mm, and 3= mobility >1 mm in any direction. Finally, the O'Leary dental plaque index[19,20] was determined with a three-tone dental plaque disclosing gel (GC Tri Plaque ID Gel™, GC International AG, Lucerne, Switzerland) capable of staining dental plaque in three different colours (Figure 1). An evaluation of the type of plaque was performed considering its pathogenicity and was classified as follows: high-risk plaque (light blue colour, with a pH <4.5), old plaque (blue colour, >48 h), and new plaque (pink colour). The pre-treatment and post-treatment evaluation of gingival pain, gingival inflammation, bleeding on probing, tooth mobility, clinical attachment loss, and dental plaque index was assessed on all teeth and gingival tissues of the right upper quadrant (quadrant 1) and the lower right quadrant (quadrant 4), using the International Dental Federation (FDI) nomenclature. The research was approved by the Institutional Ethics Commission of the Dr. Miguel Silva General Hospital with registration number 460/01/09, complied with Mexico's General Law of Health, and conducted in accordance with the principles of the Declaration of Helsinki. The patient signed the informed consent to participate in the study.

0.9% saline solution is commonly used during the scaling and root planing (SRP) procedures. It only serves to remove contaminated biological material, because it lacks antimicrobial, anti-inflammatory and healing effects[21,22].

Conventionally, SRP has been the main treatment for periodontitis and is usually effective at reducing clinical inflammation and pocket probing depth. Yet, multiple studies report that following SRP a significant percentage of treated teeth will exhibit residual subgingival biofilm and

Figure 1. A) An inflammation score of 2 according to Löe's classification is observed on the entire gingival margin of the upper teeth and, on the lower teeth, an inflammation score of 3 is shown from the gingival tissue from teeth 33 to 44. The rest of the gingival tissue on the lower teeth shows an inflammation score of 2 (teeth: 37,36,35,34,45,46 and 47). B) There is abundant high-risk plaque (light blue, with a pH <4.5), old plaque (blue, >48 h) and new plaque (pink) on teeth, sulcus and gingival margins. C) Presence of dental plaque on the lingual side of the lower teeth, primarily on lower incisors.

calculus[23]. SRP has its limitations due to the difficulties to access deep periodontal pockets and to root surface irregularities[24]. Therefore, the use of conventional mechanical methods only causes a temporary reduction in bacteria and endotoxins at subgingival levels without stopping the pathological process, resulting in a possible recolonization of pathogenic microorganisms in the treated areas[24]. Due to this background, several authors have evaluated different antiseptics in periodontal treatment, and even though some of these active ingredients have an antimicrobial effect against certain periodontopathogenic bacterial species, they have turned out to be highly cytotoxic to periodontal tissue cells[25]. The application of chlorhexidine gluconate is considered the gold standard antiseptic treatment, being the most widely used active ingredient, primarily due to its bactericidal effect on pathogenic oral bacteria. However, chlorhexidine has been shown to be cytotoxic and can have adverse effects on oral tissues and cells at clinically used concentrations[25,26].

On the other hand, the solutions used in this clinical case do not present such adverse effects and contribute with diverse beneficial properties[3-10]. During the SRP treatment on quadrants 1 and 4, an anti-inflammatory and antimicrobial solution based on <100 ppm HOCl enhanced with phosphate buffered saline (PBS) was used during periodontal debridement with a piezoelectric ultrasonic scaler, using tips GD1 and GD5 (DTE® D5 LED, Guilin Woodpecker Medical Instrument Co., Ltd., Guilin, China) set at a resonance frequency of 30-25 kHz, irrigating 200 mL of solution per quadrant. Subsequently, manual instrumentation was performed with McCall Curettes SM13/14 and SM17/18 (Harmony™ Handle, Hu-Friedy Mfg. Co., Illinois, USA) for anterior and posterior teeth respectively on quadrants 1 and 4. During this manual instrumentation, a second antimicrobial solution was applied to the periodontal pocket using a 20 mL sterile disposable hypodermic syringe, with 5.6 ng/ml of the active ingredient, modified diallyl disulfide oxide (MDDO), diluted from 8 mg/mL of MDDO (Accua Aseptic® Solution, Cell Pharma S. de R.L. de C.V., Mexico City, Mexico) and enhanced with PBS. The purpose of using this second solution was to reduce the bacterial load present in the periodontal pockets and to benefit from its antimicrobial broad-spectrum effect. At the end of the periodontal therapy, a final gingival irrigation with 8 mg/mL of MDDO (Accua Aseptic Solution®, Cell Pharma) was applied with a 10 mL hypodermic syringe for 30 seconds, following an irrigation with HOCl/PBS with a 20 mL hypodermic syringe for one minute on the periodontal tissues receiving treatment.

In pre-treatment of quadrant 1, the patient presented an overall plaque index of 89%, with a predominance of high-risk plaque (with a pH <4.5) of 82% (Figure 2). In post-treatment, a decrease of the overall plaque index of 77% was observed, where new plaque predominated with 67%, and a low index of high-risk plaque with 7%. Pre-treatment of quadrant 4 presented a percentage of the overall plaque index of 100%, where also 100% of high-risk plaque was detected (Figure 3). Post-treatment showed a decrease in the overall plaque index to 74%, and the high-risk plaque decreased considerably to 42%, most of the plaque being primarily on the lingual side of posterior teeth (not shown).

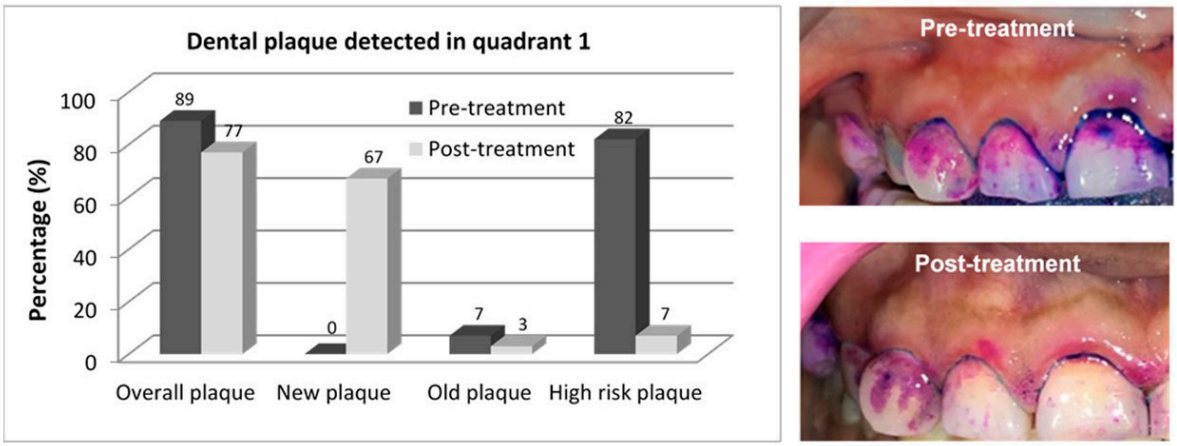

Figure 2. Quadrant 1. The percentage of the overall dental plaque index and three different types of plaque according to the GC Tri Plaque Disclosing Gel in the pre-treatment and post-treatment periodontal therapy using irrigation with antimicrobial and anti-inflammatory solutions is presented. While it is not possible to see the entire quadrant, what is shown in the images is representative of what was happening throughout the quadrant.

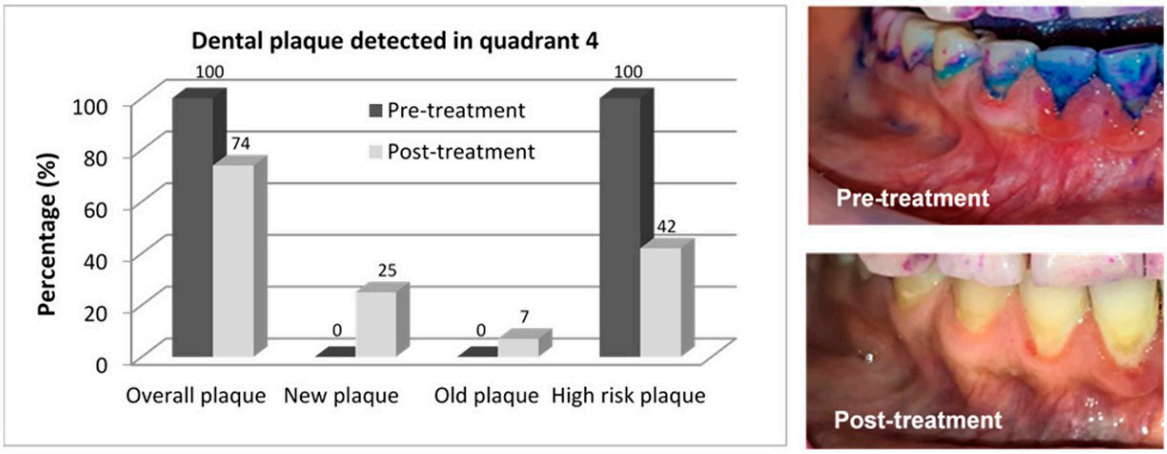

Figure 3. Quadrant 4. The percentage of the overall dental plaque index and three different types of plaque according to the GC Tri Plaque Disclosing Gel in the pre-treatment and post-treatment periodontal therapy using irrigation with antimicrobial and anti-inflammatory solutions is presented. Although it is not possible to see the entire quadrant, what is shown in the images is representative of what was happening throughout the quadrant. Most of the plaque in the post-treatment image was primarily on the lingual side of posterior teeth (not shown).

For the additional clinical parameters evaluated, pre-treatment and post-treatment assessment was obtained from both quadrants: gingival pain, gingival inflammation, bleeding on probing, tooth mobility and clinical attachment loss. All clinical data collected on quadrants 1 and 4 was assessed 8 days of post-treatment, obtaining a reduction of all the aforementioned clinical parameters on both quadrants. It is important to point out that the patient reported gingival pain during periodontal diagnosis, and 8 days after treatment she reported absence of pain on both quadrants. Regarding tooth mobility, in pre-treatment on quadrant 4, tooth 41 had a grade 2 mobility, tooth 42 and 43 had a grade 1 mobility. However, in the post-treatment checkup (8 days after), tooth 41 decreased to a grade 1 mobility and tooth 42 and 43 decreased to grade 0 mobility. CAL decreased in post-treatment on both quadrant 1 and quadrant 4.

DISCUSSION

In the dental area, electrolyzed solutions with HOCl have been used as an irrigant for root canal therapy[27], for biofilm control[28], for disinfection of dental cavity preparation[29] and to decrease biofilm in dental implants[30]. On the other hand, diallyl oxide (allicin) has been used in dentistry as mouthwash to reduce the number of microorganisms in saliva with a hydroalcoholic extract of garlic at a concentration of 5%[31,32]. Diallyl oxide is also used for the disinfection of dentin tubules as raw garlic extract on a concentration of 249 mg/mL[33], for biofilm inhibition both in orthodontic wire in concentrations of 64-128 mg/mL[34], as well as in orthodontic mini-implants in concentrations of 16-64 mg/mL[35].

Currently, there are no scientific publications related to the antimicrobial, healing, anti-inflammatory, haemostatic or tissue regeneration properties of these solutions based on MDDO, and HOCl enhanced with phosphate salts applied to patients with periodontal disease and systemic lupus erythematosus. Therefore, this clinical case research is new and completely innovative.

The antimicrobial effectiveness of these solutions as adjuncts to SRP was also confirmed. Before treatment, the patient had 82% of high-risk plaque on quadrant 1 and 100% of high-risk plaque on quadrant 4, and after using these solutions during the irrigation phase of the SRP treatment, a significant reduction of the high-risk plaque index was observed in the post-treatment check-up, having 7% on quadrant 1 and 42% on quadrant 4. This exemplifies the pharmacological synergism between these solutions as adjuncts to SRP, which represents an excellent alternative for the irrigation of the periodontal tissues and for the reduction of its bacterial biofilms.

In relation to gingival pain, inflammation and bleeding on probing on quadrants 1 and 4, a great improvement was observed in the clinical variables evaluated. These clinical benefits are specifically attributed to the HOCl solution enhanced with PBS. Different authors mention that this molecule is involved in the inhibition of inflammatory cytokines related to periodontitis[3,5], a useful mechanism for the recovery process of periodontal tissues. By inhibiting these inflammatory cytokines, hypercoagulation phenomena is inhibited, bleeding stops and healing improves. It has been pointed out that HOCl has a more powerful antimicrobial effect on Gram-negative microorganisms than on Gram-positive bacteria[36], which makes it useful to treat Gram-negative anaerobic bacteria that are associated with periodontitis. It also has regenerative effects as it favours the production of growth factors such as epidermal growth factor (EGF), fibroblast growth factor (FGF-1, FGF-2), vascular endothelial growth factor (VEGF), and connective tissue growth factor (CTGF)[5,37].

The solutions that we used present an encouraging future in the disinfection and preparation of periodontal tissues in patients with autoimmune diseases and on those who receive prolonged immunosuppressive therapy. Nonetheless, it is necessary to carry out controlled and randomized clinical studies with a greater number of cases to help support the use of these solutions in periodontal scaling and root planing treatments on patients with a high risk of infection recurrence.

CONCLUSIONS

The antimicrobial and anti-inflammatory solutions used as adjuncts to scaling and root planing in this novel periodontal irrigation therapy helped to reduce all clinical parameters evaluated, such as gingival inflammation, probing pocket depth, clinical attachment loss, bleeding on probing, tooth mobility, gingival pain and high-risk plaque, in only 8 days of post-treatment for each quadrant 1 and 4. Periodontal irrigation with modified diallyl disulfide oxide and hypochlorous acid enhanced with phosphate buffered saline accelerated the healing mechanisms of the periodontal tissues in a patient with systemic lupus erythematosus.

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