SILICA DIOXIDE COLLOIDAL SOLUTIONS IS EFFICIENT IN THE TREATMENT OF CHRONIC PERIODONTITIS: A CASE CONTROL STUDY

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The objective of this study was to compare the efficacy of supportive periodontal therapy (i.e. scaling and rooth planning, SRP) alone versus a chemical device silica dioxide (SiO_2) colloidal solutions (SDCS) used in association with SRP in the treatment of chronic periodontitis in adult patients. A total of 20 patients with a diagnosis of chronic periodontitis (40 localized chronic periodontitis sites) in the age group of 35 to 55 were selected. None of these patients have previously received any surgical or non-surgical periodontal therapy and demonstrated radiographic evidence of moderate bone loss. Two non-adjacent sites in separate quadrants were selected in each patient to monitorize treatment efficacy (split mouth design). Clinical pocket depth (PD) and microbial analysis (MA) were analyzed at baseline and 15th day. SPSS program and paired simple statistic T-test were used to detect significant differences. Total bacteria loading, *Tannerella Forsitia* and *Treponema Denticola* loading were statistically reduced when SiO2 is locally delivered. SDCS gel is an adjuvant therapy which should be added to SRP in the management of moderate to severe chronic periodontitis.

Periodontal disease is one of the prevalent hillness in adult population (1-4). It is characterized by a symptom triad: tooth mobility, foetor ex ore, gingival bleeding. If left untreated the disease can lead to tooth loss. Pathogenesis of periodontal disease is multifactorial and bacterial have a preminent role (5). The main pathogens implicated in periodontal disease are anaerobic gram-negative bacteria of which the most aggressive were identified in the "red complex" group: *Porphyromonas gingivalis, Tannerella forsythia*, and *Treponema denticola* (6).

The aim of periodontal treatment is to eliminate oral infection, and prevent the progression of the disease (7). Many studies have widely demonstrated that the non-surgical therapy including scaling and root planing (SRP) associated with a good level of oral hygiene can prevent the onset of periodontal disease and allow for proper maintenance of oral health (8, 9).

The aim of the present study is to evaluate the effectiveness of a new chemical device (i.e. silica dioxide colloidal solutions, SDCS) used in association with SRP in the treatment of chronic periodontitis in adult patients.

MATERIALS AND METHODS

A total of 20 patients with a diagnosis of chronic periodontitis were randomly selected. Patients were qualified for the study if they have two non-adjacent sites located in separate quadrants which required periodontal treatment, in the age group of 35-55. Subjects have

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not received previously any surgical or non-surgical periodontal therapy. The patients were excluded from the study if they meet any of the following criteria: (1) pregnancy; (2) an history of taking antibiotics or using antibacterial mouth rinses for past 6 months; (3) teeth with furcation involvement; (4) smoking, and drug or alcohol abuse. This study has been approved by the ethics Committee of the hospital. Subjects participating in the study volunteered will follow a detailed verbal description of the procedure and by signing consent forms.

Clinical methods

A total of 20 patients (i.e. 40 sites) were selected and grouped into two categories: control and test (split mouth design). The control group (20 sites) was treated with SRP without using SDCS (control site). The test group (20 sites) was treated by SRP plus SDCS (test site). All patients underwnt to SRP at the baseline measurement. Prior to SRP clinical pocket depth and microbial analysis was performed in each selected site. Then SRP was done at both sites using ultra sonic scaler. After SRP, SDCS was adjunct in the test site of each enrolled patient. After 2 weeks, microbiological samples were collected again from from both sites in each patient. For bacteria analysis, sites were isolated using cotton rolls. Sterile absorbable paper points (size 60) were used for the collection of subgengival samples and were immediately transferred to microbiological lab for processing. *Porphyromonas gingivalis, Tannerella forsythia*, and *Treponema denticola* and total bacterial loading were evaluated.

Real-Time Polymerase Chain Reaction

Probes oligonucleotides were designed basing on 16S rRNA gene sequences of the Human Oral Microbiome Database (HOMD 16S rRNA RefSeq Version 10.1) counting 845 entries. All the sequences were aligned in order to find either consensus sequence or less conservate spots. Two real-time polymerase chain reaction (PCR) runs were performed for each sample. The first reaction quantified the total amount of bacteria using two degenerate primers and a single probe matching an highly conservated sequence of the 16S ribosomal RNA gene. The second reaction detected and quantified the three red complex bacteria, i.e. *P. gingivalis, T. forsythia and T. denticola*, in a multiplex PCR. This reaction included a total of six primers and three probes that were highly specific for each specie. Oligonucleotide concentrations and PCR conditions were optimized to ensure sensitivity, specificity and no inhibitions in case of unbalanced target amounts. Absolute quantification assays were performed using the Applied Biosystems 7500 Sequence Detection System. The amplification profile were initiated by a 10 min incubation period at 95°C to activate polymerase, followed by a two- step amplification of 15 s at 95°C and 60 s at 57°C for 40 cycles. All these experiments were performed including nontemplate controls to exclude reagents contamination.

Plasmids containing synthetic DNA target sequences (Eurofin MWG Operon, Ebersberg Germany) were used as standard for the quantitative analysis. Standard curves for each target were constructed in a triplex reaction, by using a mix of the same amount of plasmids, in serial dilutions ranging from 101 to 107 copies. There was a linear relationship between the threshold cycle values plotted against the log of the copy number over the entire range of dilutions (data not shown). The copy numbers for individual plasmid preparations was estimated using the Thermo NanoDrop spectrophotometer.

The absolute quantification of total bacterial genome copies in samples allowed for the calculation of relative amount of red complex species. To prevent samples and polymerase chain reaction contamination, plasmid purification and handling was performed in a separate laboratory with dedicated pipettes.

Statistical analysis

SPSS program and paired simple statistic T-test were used to detect significant differences.

RESULTS

A statistical significant differences was detected between (A) Total Bacterial Loading pre and post SDCS treatment, (B) *T. forsythia* pre and post SDCS treatment and (C) *T. Denticola* and post SDCS treatment. Notheworthy, no statistical significant difference was detected between control and test site as regard pre-treatment bacteria concentration as well as pre vs. post-treatment bacteria concentration in control site (i.e. only SPR). When p-value is less than 0.05 then the difference between the twocompared bacterial loadingsis statistically significant.

DISCUSSION

It is well understood that most destructive types of periodontal diseases occur due to the presence of pathogenic micro-organisms colonizing the subgingival area and the suppression or eradication of these microbes result in improvement in periodontal health. Mechanical debridement is effective in both disturbing the biofilm and reducing the bacterial load. However, sometimes mechanical instrumentation may not be sufficient to control the disease due to tissue invasive pathogens, or other tooth related anatomic factors (10-13). In such conditions, adjunctive use of a chemical device provides an additional benefit in controlling the disease. This material can be potentially used in protecting the healing process in oral surgery (14-24). Support periodontal therapy is widely used, but a greater effectiveness is demonstrated by the administration of topical antimocrobicals in association. The advantages of topical therapy involve the use of antimicrobical agents directly into the periodontal pocket, minimizing the adverse effects related to systemic therapy (9). Some patients with oral pathologies (4, 21, 25-33) can use additional drugs so that there is no risk of drug interaction. The potential benefits of local drug delivery include improved patient compliance, an easier access to periodontal pocket and a lower dosage of antimicrobial agent. Periodontal cleaning is of paramount importance in prosthetic patients (34-37). The most commonly used methods for local drug delivery are local gengival irrigations (5). The antimicrobial agents used as local drug delivery agents include tetracycline, ofloxacin, clindamycin, chlorhexidine, etc. (9). These local drug delivery devices have been used either alone or as adjunct with SRP. These local antimicrobials are administered directly into the periodontal pocket and the effectiveness of these chemical device is related to their bactericidal activity and the subsequent reduction of gingival inflammation (38).

The topical use of chemical device along with mechanotherapy dramatically improves clinical results, and at the same time is free from its inherent adverse effects and disadvantages. Local delivery of chemical devices into the pocket achieves a greater concentration of the drug locally, proving bactericidal for most periopathogens, and at the same time, exhibits negligible impact on the microflora residing in other parts of the body.

Our study evaluated the efficacy of SDCS gel in the management of moderate to severe chronic periodontitis. The results of this investigation demonstrated an overall improvement in most of bacterial parameters. Microbiological testing was thought appropriate to evaluate the effect of SDCS gel on subgingival microbial population, the primary etiological factor for periodontitis. Several methods have been used for microbiological testing in periodontitis (39). However, many techniques have not been fully accepted due to low sensitivity or specificity. Moreover sometimes they are slow, expensive and laborious. Recently, a rapid and sensitive test (LAB SRL, Ferrara, Italy) was developed to detect and quantify the three bacterial species more involved in periodontitis: *Porphyromonas gingivalis, Tannerella forsythia*, and *Treponema denticola.*

It is well known that both *P. gingivalis* and *T. denticola* occur concomitantly with the clinical signs of periodontal destruction (40). They appear closely 'linked' topologically in the developing biofilm, shown an in vitro ability to produce a number of outer membrane- associated proteinases. They are considered the first pathogens involved in the clinical destruction of periodontal tissues. Moreover both them and *T. forsythia,* show an higher prevalence in disease than in health suggesting that these bacterial are associated with the local development of periodontitis. Based on this reported data, red complex triad was investigated and SDCS was able to significantly reduce their concentration. Oral health and a pleasant smile are a goal of every person and a civil society.

In conclusion, SDCS gel is an adiuvant therapy which should be added to SRP in the management of moderate to severe chronic periodontitis.

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