Comparison of the Clinical Efficacy of Scaling and Root Planning with and without Topical Application of Vitamin E via Tray Method for Treatment of Chronic Periodontitis: A Randomized Clinical Trial

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Abstract

Objective: Microbial plaque is the main cause of periodontal disease. Production of free oxygen radicals is an immune system mechanism to destroy invading microorganisms which per se results in further destruction of periodontal tissues. The present study sought to assess the efficacy of anti-oxidant application (vitamin E) as an adjuvant treatment following scaling and root planning in periodontal patients.

Methods: For this randomized clinical trial 10 patients aged 30 to 50 years suffering from moderate to severe periodontitis with no systemic disease were selected. After scaling and root planning, 5% vitamin E for one side and placebo for the opposite side were poured in a maxillary custom tray and placed inside the mouth.

Results: Type of treatment did not have a significant effect on the understudy factors. However, time had a significant effect on the majority of indices. Healing was significantly better at week 4 following initiation of treatment compared to week 2. The values in proximal and radicular sites were -0.151, p=0.002 and -0.31, p=0.001 for pocket depth, -0.217, p=0.002 and -0.401, p=0.001 for CAL, -4.188, p=0.001 and -0.391, p=0.272 for BOP and -0.219, p=0.05 for GI, respectively.

Conclusion: The present study showed that the effect of time was greater than the type of treatment on improvement of indices.

Key words: Periodontitis, Anti-oxidant, Vitamin E, Tray method

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Introduction:

Periodontitis is the inflammation of the tooth supporting tissues. It is caused by specific microorganisms present in dental plaque. Neutrophils kill microorganisms via the production of toxic oxygen metabolites like superoxide anion (O2−) which is produced by NADPH Oxidase. Superoxide anion also participates in the production of hydrogen peroxide which has the ability to pass through the cell membrane. Inside the target cell, H2O2 is further reduced to hydroxyl radicals that per se can damage the tissue (1). Free radicals are released to eliminate and kill pathogenic bacteria. Periodontal tissue depends on natural antioxidants to overcome oxidative stress and maintain homeostasis. When the tissue is depleted of antioxidants, the ability of gingiva to overcome oxidative stress, maintain normal tissue and control bacterial damage is compromised (2).

According to Battino et al, (2005) the inflammatory infiltration in gingivitis mainly consisted of lymphocytes, plasma cells and neutrophils. Dramatic reduction in vitamin E level was also reported in this condition. They noticed that despite the increased amount of cells present in periodontal tissue, level of coenzyme Q (CoQ10) remained unchanged which was indicative of the fact that continuous oxidative stress which occurred in these structures affected the antioxidant pattern of the tissue (3). Changes in the gingival microenvironment can result in impaired apoptosis (programmed cell death), promotion of
enhanced release of reactive oxygen species (ROS) by phagocytes, reduced activity of catalase (CAT) and superoxide dismutase, accumulation of ROS and additional destruction of tissue (4).

Krol in 2004 evaluated total antioxidant status in peripheral and gingival serum and its correlation with clinical periodontal status. He showed significantly low level of total antioxidants in venous blood serum of test groups in comparison with controls. He concluded that oxidative stress in periodontitis expressed by elevated levels of ROS and accompanied by suppressed antioxidant activity in gingival blood may accelerate formation of lesions in periodontal tissues (5).

The increasing body of evidence implicating the role of reactive oxygen species (ROS), derived from many metabolic sources, in the pathogenesis of periodontal tissue destruction was discussed by Waddington et al., in 2000. Polymorphonuclears are very destructive during an inflammatory response. ROS oxidation products result in elevation of iron and copper ions, which catalyze the production of the most reactive radical species and the identification of an imbalance in the oxidant/antioxidant activity within periodontal pockets. Also, the presence of connective tissue metabolites in the gingival crevicular fluid (GCF) leads to the destruction of periodontal tissues and especially the alveolar bone (6).

Vitamins B2 and B6, copper, zinc and selenium are required to maintain systemic glutathione and selenium-dependent GSH enzymes for antioxidant defense, regulation of immunity and neutralizing the inflammation process at the cellular level. Micronutrients like beta carotene and vitamins A, C and E are depleted during an inflammation (7). Vitamins support and protect the function of immune system and are involved in maintenance of structural and functional integrity of epithelial tissues and physiological or metabolic parameters related to periodontal health (8). Periodontal diseases are associated with an imbalance between oxidants and antioxidants due to an increase in free radical production and a defect in the total antioxidant activity of saliva (9). It is noteworthy that the concentration of antioxidants in saliva does not seem to mirror those of plasma.

Sculley, et al. in 2002 stated that the effect of nutrition on antioxidant status may lead to possible nutritional strategies for treatment of periodontal disease (10). They later stated that periodontal disease is associated with reduced salivary antioxidant status and increased oxidative damage in the oral cavity (11).

Vitamin E (tocopherol) is lipid soluble. It is located within cell membrane phospholipids and is a major chain breaking (scavenger) antioxidant. It prevents the oxidation of unsaturated cellular phospholipids by eliminating free radicals. Plasma, saliva and GCF are the sites of vitamin activity (12). Drug concentration at the site of action is much higher when it is used topically compared to its systemic administration. Also, topical application of drugs prevents the potential side effects of their systemic consumption (1).

Cohen et al., in 1991 compared the effects of a topical 5% vitamin E gel (through topical application of 12 ml of a vitamin E containing gel delivering 800 mg of alpha tocopherol), a placebo gel and chlorhexidine with and without scaling and root planing on periodontal disease and reported that the vitamin E group did not show a significant improvement in comparison with the placebo group (13).

HanioKa et al., in 1994 compared the effect of topical application of coenzyme Q10 (a type of antioxidant) and the placebo (soybean oil) with and without mechanical debridement on adult periodontitis and showed a significant improvement in the CO-Q10 group in combination with mechanical debridement (14).

Chandra et al., in 2007 evaluated the efficacy of systemically administered lycopene (a type of antioxidant) as a monotherapy and as an adjunct to scaling and root planning in gingivitis patients. A significant improvement was observed as the result of using lycopene (15).

Since the pathogenesis of periodontal disease has an immunity and inflammatory basis and since use of antioxidants is considered a treatment option, the present study sought to assess the efficacy of vitamin E, an important antioxidant, as an adjuvant treatment after scaling and root planning in periodontal treatment. The tray method was used because in this method, the medication cannot be easily washed away by the saliva and the patients do
not need to stay in dental clinics for long periods of time.

**Methods:**

In this randomized clinical trial 10 non-smoker patients (4 males and 6 females) with a mean age of 41.9±8.2 yrs. with no systemic disease, clinical attachment loss more than 3 mm and bleeding on probing were enrolled. The exclusion criteria were receiving any periodontal treatment during the past 1 month, antibiotic intake during the previous 3 months and current orthodontic, fixed or removable prosthodontic treatment. The samples were selected among patients presenting to the Behfar Clinic affiliated to Shahid Beheshti Dental University. Clinical examinations were done using a dental mirror and a periodontal probe. After expressing the need for scaling by the patient, they were informed about the study protocol and all the related details and written informed consent was obtained from them. Sample size was selected as 10 subjects by the statistician according to similar studies. An alginate impression was taken from the maxillary arch of patients. The impression was poured with dental stone. The gingival part of the cast was relieved with nail polish. A bleaching tray was fabricated using a vacuum forming machine (made in South Korea). The tray was cut in half using a scalpel. By doing so, the medication poured in each half tray would not be mixed with the medication in the opposite side tray. An acrylic stand was fabricated using Acropars white acrylic resin. The powder was mixed with the monomer, placed on the cast teeth and extended to the height of contour of the teeth. After setting and removal of the appendages, 6 grooves were prepared on the acrylic resin around each tooth at mesiobuccal, mid-buccal, distobuccal, mesiopalatal, mid-palatal and distopalatal using a piezoelectric micromotor. The grooves had to be large enough to accommodate the probe. In the second session, the following indices were measured: pocket depth (PD), clinical attachment loss (CAL), bleeding on probing according to Ainamo and Bay (16) (BOP), gingival index (GI)(1) and O’Leary’s plaque index (17).

PD and CAL were measured in mm, BOP was reported as percentage and GI was recorded as normal gingiva (0), mild inflammation (1), moderate inflammation (2) or severe inflammation (3). Measurements were carried out using Michigan University probe while the acrylic stand was placed over the teeth. By doing so, the future measurements would be performed at the same sites as in previous measurements. PD, CAL and BOP were measured at 6 sites around each tooth and GI was calculated as the mean of 6 measurements. Data were recorded in the related forms.

Scaling was done using an ultrasonic scaler attached to the dental unit. Root planning was carried out with Gracey curettes and the teeth were polished using a prophylactic polishing paste and a rubber cup attached to the low speed hand piece. All the measurements and scalings were performed by one of the authors. Oral hygiene instructions included the correct use of dental floss and tooth brushing with the modified bass method. Patients were monitored throughout the study to make sure they follow hygiene control instructions with the same method and at the same time with similar tooth brushes and dental floss. O’Leary’s plaque index was calculated and recorded at the onset, at week 2 and at week 4 of the study (17). The obtained values indicated a reduction in the amount of dental plaque at weeks 2 and 4 compared to the baseline value. This reduction was almost the same in all patients. After completion of intervention, one side of the maxillary arch was randomly selected as the test and the opposite side as the control side. 5% vitamin E was applied at the test and soybean oil at the control side. Patients presented to the clinic twice a week for drug application. Each patient received a total of 8 applications of vitamin E and placebo. The trays containing vitamin E and placebo remained in the patient’s mouth for 2 hours. After tray removal, patients were asked not to rinse for an hours. The tray was custom-made for each patient and placed with pressure. Thus, we assume that the medication penetrated into the pockets. In order to prepare the medication, 5 g alpha tocopheryl acetate (Dana Tabriz Co.) was dissolved in 95 g soybean oil (Dana Tabriz Co.). The soybean oil alone was used as the placebo.
Measurements were repeated after 2 and 4 weeks. Drug application was done by the supervising professor or another clinician. We tried our best to follow the double blind fashion of the study.

Data were entered SPSS version 16 software. In order to analyze the efficacy of scaling and root planning associated with the topical application of vitamin E along with the simultaneous control of the effect of variables like time of follow up and patient’s initial status, GEE logistic regression model was used for BOP index while GEE linear regression model was used for PD, CAL and GI. Results were evaluated separately for proximal and radicular surfaces (except for GI).

Results:

<table>
<thead>
<tr>
<th>Understudy Index</th>
<th>Variable</th>
<th>Proximal</th>
<th>Radicular</th>
</tr>
</thead>
<tbody>
<tr>
<td>BOP²</td>
<td>vitamin E compared to the control group</td>
<td>0.001</td>
<td>0.1779</td>
</tr>
<tr>
<td></td>
<td>Week 4 compared to week 2</td>
<td>-0.391</td>
<td>0.3566</td>
</tr>
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<td>BOP at the beginning of Study</td>
<td>1.005</td>
<td>0.3652</td>
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<tr>
<td></td>
<td>vitamin E compared to control group</td>
<td>-0.057</td>
<td>0.103</td>
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<tr>
<td></td>
<td>Week 4 compared to week 2</td>
<td>-0.31</td>
<td>0.0706</td>
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<tr>
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<td>PD at the beginning of Study</td>
<td>0.506</td>
<td>0.0293</td>
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<tr>
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<td>vitamin E compared to control group</td>
<td>-0.284</td>
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<td></td>
<td>Week 4 compared to week 2</td>
<td>-0.401</td>
<td>0.0864</td>
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<td>0.675</td>
<td>0.0414</td>
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<table>
<thead>
<tr>
<th>Understudy Index</th>
<th>Variable</th>
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<th>SE</th>
<th>P value</th>
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<tbody>
<tr>
<td>BOP²</td>
<td>vitamin E compared to control group</td>
<td>0.029</td>
<td>0.0563</td>
<td>0.612</td>
</tr>
<tr>
<td></td>
<td>Week 4 compared to week 2</td>
<td>-0.219</td>
<td>0.1123</td>
<td>0.05</td>
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<tr>
<td></td>
<td>GI at the beginning of Study</td>
<td>0.335</td>
<td>0.0961</td>
<td>0.001</td>
</tr>
</tbody>
</table>

1Binary logistic regression model was used.
2GEE linear logistic regression model was used.
3Standard Error

Also, disease status at the beginning of study had a significant effect on the outcome of treatment. Teeth with a more severe disease at the onset of study had a worse condition in the follow up compared to those with a better initial status.

For the GI, the effect of type of treatment was not significant (0.029, p=0.612).
The effect of time on GI was significant (-0.219, p=0.05). GEE regression model demonstrated that the mean GI decreased by 0.219 at week 4 compared to week 2. The effect of high GI (severity of gingival inflammation) at the onset of study was significant on the course of recovery as well (0.335, p=0.001).

**Discussion:**

Oxygen free radicals produced by the immune cells to confront invading microorganisms are among the destructive factors in the course of periodontal disease and have an adverse effect on the periodontium. To date, several studies have been conducted on the efficacy of topical application of antioxidants. The present study aimed at evaluating the efficacy of using 5% vitamin E dissolved in soybean oil via the tray method for treatment of chronic periodontitis. In a study by Cohen et al., in 1991 plaque index and gingival index were evaluated. In the vitamin E group, the reduction of indexes was not significant (13) which is in accord with our study results. The reason for the lack of efficacy of vitamin E in the two studies seems to be the weak antioxidant effect of vitamin E for treatment of periodontitis. The low dosage may also be responsible for this lack of efficacy.

In another study by HanioKaa et al., in 1994, PI, PD, BOP and CAL were evaluated. In their study reduction of indexes at weeks 3 and 6 compared to the baseline values in the CO-Q10 plus mechanical debridement group was statistically significant. This is in contrast to our study result. However, the effect of time in both studies was significant (14). The mentioned difference between the two studies can be attributed to the method of application of drug in HanioKaa study. They injected the drug into the periodontal pockets using a plastic syringe.

In a study by Chander et al., in 2007 PI, GI and BI were evaluated. In their study, the test groups using lycopene with and without scaling and root planning showed a significant decrease in indexes at weeks 1 and 2 compared to the baseline values. This reduction was greater in the test group of lycopene with scaling and root planning (15). Their study results were not in agreement with those of ours. The difference may be due to the stronger therapeutic effect of lycopene on periodontitis which was able to improve gingivitis even without mechanical debridement.

**Conclusion:**

The present study results demonstrated that the effect of time on improvement of indexes was more significant than the type of treatment. Considering the efficacy of other antioxidants used in the above mentioned studies, application of them in future studies can provide us with more knowledge about their efficacy when used via the tray method since the tray method is easy to use and patients can even use them at home.

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**References:**