Impact of scaling and root planing on clinical periodontal status and glycemic levels in prediabetic patients

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Abstract: Objective: The aim was to assess the effect of scaling and root planing (SRP) on clinical periodontal parameters and glycemic levels in prediabetic patients. Methods: Fifty prediabetic patients with periodontal disease were included. Demographic data (age, gender, education status, duration of prediabetes, type of treatment adopted for prediabetes management, and oral hygiene maintenance protocols) were recorded using a questionnaire. Patients were randomly divided into two groups (25 patients/group). In Group 1, SRP alone was performed, in Group 2, SRP + oral doxycycline (100 mg) administration. In both groups, fasting blood glucose (FBG) levels and periodontal parameters (plaque index [PI], bleeding on probing [BOP], and probing depth [PD]) were assessed at baseline and after 6 months. Statistical analysis was performed using one-way analysis of variance. Results: Age, gender, and duration and treatment of prediabetes were comparable among patients in Groups 1 and 2. PI, BOP, and PD significantly reduced in both groups than baseline values. Reduction in periodontal parameters among Groups 1 and 2 were comparable. There was no significant reduction in FBG levels among patients in Groups 1 and 2 after 6 months of SRP. Conclusion: SRP was effective in reducing periodontal inflammation in prediabetic patients. FBG levels did not show any significant difference after SRP in both groups.

Keywords: periodontal inflammation, hyperglycemia, scaling and root planing, prediabetic state

Introduction

It is well-acknowledged that periodontal inflammation is worse in patients with poorly controlled diabetes than patients with well-controlled diabetes and systemically healthy non-diabetic individuals [1–5]. Moreover, studies [4, 6–8] have shown that prediabetic patients (patients with impaired glucose tolerance) are also susceptible to periodontal destruction as compared to their systemically healthy controls. It has been proposed that local periodontal infection increases the systemic burden of inflammatory mediators (such as C-reactive protein [CRP]), which in turn aggravate the existing metabolic disorder in hyperglycemic patients [9, 10]. Additionally, increased production and accumulation of advanced glycation endproducts in periodontal tissues raised cellular oxidative stress and production and accumulation of proinflammatory cytokines (such as interleukin (IL)-6, IL-1β, IL-18, matrix metalloproteinase [MMP]-8, and MMP-9) in the serum, saliva, and gingival crevicular fluid of patients with persistent hyperglycemia tend to worsen periodontal inflammation [11–15].

Scaling and root planing (SRP) is a common and non-invasive periodontal therapeutic strategy which has been reported to improve glycemic status in patients with type 2 diabetes mellitus (T2DM) [16–21]. Similar results were reported by Javed et al. [8] in a patient population of prediabetic individuals. However, controversial results have also been inked. In a recent study, Engebretson et al. [22] reported that SRP is ineffective in improving glycemic control in patients with hyperglycemia and moderate to advanced periodontal disease. Likewise, results by Santos et al. [23] also reported that SRP is effective in treating periodontal inflammatory conditions in patients with chronic hyperglycemia, without significant improvements in the glycemic control at 3 and 6 months follow-up.
It has also been shown that SRP alone is ineffective in the complete elimination of pathogenic microbes and their products from periodontal pockets [23]. Therefore, SRP with adjunct antibiotic therapy is usually performed, which helps in the extermination of pathogenic microbes from infected periodontal pockets [24, 25]. In the study by Akalın et al. [24], clinical efficacies of locally delivered and systemically delivered doxycycline were compared as adjuncts to conventional SRP in the treatment of periodontal disease. The results demonstrated that locally delivered or systemically delivered doxycycline when used as adjuncts to SRP are equally effective in the treatment of periodontal disease [24]. It was therefore hypothesized that SRP when performed with adjunct antibiotic therapy is more effective in reducing periodontal inflammation and hyperglycemia as compared to when SRP is used as a sole therapeutic strategy.

With this background, the aim of the present study was to assess the impact of SRP on glycemic levels and clinical periodontal parameters in a prediabetic patient population.

Materials and Methods

**Ethical guidelines**

The study was reviewed and approved by the research ethics review board of College of Dentistry Research Center at King Saud University, Saudi Arabia. The study was performed in accordance with the Helsinki Declaration of 1975 as revised in 2000. Volunteering participants were requested to sign a consent form.

**Inclusion and exclusion criteria**

Patients with medically diagnosed prediabetes (fasting blood glucose [FBG] levels ranging between 100 and 125 mg/dL) were included [26]. Patients with self-reported systemic disease such as type 1 diabetes mellitus and T2DM, HIV infection/acquired immune deficiency syndrome, cardiovascular disorders, epilepsy, hepatic disorders, and renal disorders were excluded. In addition, pregnant patients, patients with a recent history of antibiotic and/or steroid intake, patients with overlapping teeth, edentulous individuals, and tobacco smokers were not sought.

**Study population**

Fifty patients (all male) with medically diagnosed prediabetes volunteered to participate in the present study. These individuals were requested to present their medical records to confirm the diagnosis of prediabetes. In all individuals, prediabetes had been diagnosed in accordance with the criteria proposed by the American Diabetes Association [26].

**Study groups**

All participants (n = 50) were randomly divided into two groups (Group 1 and Group 2) by tossing a coin. In Group 1, 25 prediabetic males underwent full mouth SRP, and in Group 2, 25 prediabetic males underwent full mouth SRP with adjunct doxycycline (100 mg once daily for 15 days) administration.

**Questionnaire**

A trained interviewer collected information regarding age, gender, education status (graduate level), duration of prediabetes, and daily oral hygiene maintenance protocols from prediabetic patients in Group 1 and Group 2.

**Measurement of fasting blood glucose levels**

Among prediabetic patients in Groups 1 and 2, FBG levels were measured at baseline and 6 months after SRP, using a digital glucometer (Accu-Chek Activ, Roche Diagnostics, Mannheim, Germany).

**Measurement of periodontal parameters**

Full-mouth plaque index (PI) [27], bleeding on probing (BOP) [28], and probing depth (PD) were gauged to the nearest millimeter (mm) using a graded probe (Hu-Friedy, Chicago, IL. USA) [2, 29] and were measured at six sites (mesiobuccal, midbuccal, distobuccal, distolingual/palatal, midlingual/palatal, and mesiolingual/palatal) on all maxillary and mandibular teeth. Fractured teeth with embedded roots and bilateral maxillary and mandibular third molars were excluded. Individuals with PD ≥5 mm in more than 30% sites were categorized as having periodontal disease.

**Statistical analysis**

Statistical analysis was performed using a computer software (SPSS, Version 18, Chicago, IL. USA). With inclusion of 25 patients per group (assuming a standard deviation of 1.0%), the study power was estimated to be 85% at a two-sided significance level of 0.05. Intergroup comparisons were performed using the Student t-test whereas, for intragroup comparison, one-way analysis of variance and a paired t-test were used. With a total
sample size of 50 cases (25 individuals per group), the study power was estimated to be 80%.

Results

Characteristics of the study cohort

There was no statistically significant difference in age and duration of prediabetes among individuals in Group 1 (43.6 ± 2.4 years and 5.5 ± 3.8 months, respectively) and Group 2 (47.7 ± 3.2 years and 11.2 ± 0.3 months, respectively). Nearly 23% of the study participants had attained graduate level education (Group 1: 20.7 ± 8.5% and Group 2: 27.6 ± 5.4%). All prediabetic patients had been recommended by their physicians to maintain glycemic levels by dietary control regimes. These results are shown in Table I.

At baseline, 100% individuals in Group 1 and 100% individuals in Group 2 reported to brush their teeth once daily. After 6 months of SRP, 60% individuals in Group 1 and 50% individuals in Group 2 reported to have been performing oral hygiene maintenance regimes twice daily.

Measurement of fasting blood glucose levels and periodontal inflammatory parameters at baseline and after 6 months of scaling and root planing

At baseline, the FBG levels among patients in Group 1 and Group 2 were 120.8 mg/dL and 118.7 mg/dL, respectively. After 6 months of SRP, FBG levels among prediabetic patients in Group 1 and Group 2 were 112.3 mg/dL and 110.4 mg/dL. There was no statistically significant difference in FBG levels between baseline and 6-month follow-up values among patients in Group 1 and Group 2 (Table II).

At baseline, there was no statistically significant difference in PI, BOP, and PD (>4 mm) among individuals in Groups 1 and 2 at baseline and after 6 months of scaling and root planing (Table III).

<table>
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<tr>
<th>Table I</th>
<th>Characteristics of the study cohort</th>
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<tr>
<td>Total participants (n = 50) (mean ± SD)</td>
<td>Group 1 (n = 25) (mean ± SD)</td>
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<tr>
<td>Sex</td>
<td>50 males</td>
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<tr>
<td>Age in years</td>
<td>44.5 ± 3.2</td>
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<tr>
<td>Duration of prediabetes in months</td>
<td>6.5 ± 3.4</td>
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<td>Education status in % (graduate level)</td>
<td>23.3 ± 4.5</td>
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<th>Treatment strategy recommended by physicians for management of prediabetes</th>
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<tr>
<td>Allopathic (%)</td>
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<tr>
<td>Homeopathic (%)</td>
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<tr>
<td>Herbal (%)</td>
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<td>Dietary control (%)</td>
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<td>Others (%)</td>
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<tr>
<th>Table II</th>
<th>Fasting blood glucose levels among individuals in Groups 1 and 2 at baseline and after 6 months of scaling and root planing</th>
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<tr>
<td>Fasting blood glucose levels (in mg/dL)</td>
<td>At baseline</td>
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<tr>
<td>Group 1</td>
<td>120.8</td>
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<td>Group 2</td>
<td>118.7</td>
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<tr>
<th>Table III</th>
<th>Periodontal inflammatory parameters (mean ± SD) periodontal parameters in among prediabetic patients in Groups 1 and 2 at baseline and 6 months after scaling and root planing</th>
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<tr>
<td>Periodontal parameters</td>
<td>Group 1 (SRP only) (n = 25)</td>
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<tr>
<td>Plaque index</td>
<td>54.5 ± 10.2*</td>
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<tr>
<td>Bleeding on probing</td>
<td>45.5 ± 9.6*</td>
</tr>
<tr>
<td>Probing depth</td>
<td>22.4 ± 3.6*</td>
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*P < 0.05

†P < 0.05
Discussion

The 6-month follow-up results obtained from the present investigation showed a significant reduction in periodontal inflammation among prediabetic patients in Group 1 (SRP alone) and Group 2 (SRP with adjunct doxycycline therapy). An explanation in this regard may be derived from the fact that periodontal disease elevates the systemic burden of inflammatory mediators (such as CRP) that aggravate the existing metabolic disorder in patients with chronic hyperglycemia [9, 10], however, SRP reduces the severity of periodontal infection and decreases the systemic burden of inflammatory mediators which in turn reduces the hyperglycemic state in prediabetic patients.

An interesting finding in the present study was that despite reduction in the severity of periodontal inflammation in both groups compared to baseline values, FBG levels in both groups remained unchanged. In the present study, all patients with medically diagnosed prediabetes were recommended by the healthcare providers to control their blood glucose levels via strict dietary maintenance regimens. It is possible that in the time frame between SRP and follow-up, prediabetic patients were unable to maintain a strict dietary control to manage their serum glycemic levels. This is one explanation for the comparable FBG levels, which were seen in prediabetic patients in both groups. It has been reported that poor education is a significant risk factor for hyperglycemia as well as poor periodontal health [2]. It is worth mentioning that oral hygiene instructions were given to all patients (n = 50) during the initial visit (baseline) and ~50% patients in each group reported to have been brushing their teeth twice a day at 6 months of follow-up. Although this factor could have played a role in reducing periodontal inflammation in these patients, it seems that there are additional factors (such as income status) that govern the systemic burden of inflammation and serum glycemic levels. It is well known that a poor socioeconomic status is a risk factor for hyperglycemia [2]. It is tempting to speculate that the poor education and income status of the patients may not have permitted them to follow strict dietary measures in selecting their daily meals. This is another reason for the insignificant difference in glycemic levels among prediabetic patients in both groups.

The present study showed no significant difference in FBG levels at 6-month follow-up among individuals in Group 1 (SRP only) and Group 2 (SRP with adjunct doxycycline therapy). However, it is noteworthy that individuals included in the present study had been diagnosed with prediabetes within the past approximately 10 months (Table I). It is therefore hypothesized that the short duration of prediabetes may have prevented the systemic inflammatory burden from rising drastically. These factors could have defused the role of adjunctive use of doxycycline among individuals in Group 2. Further long-term studies are needed to assess whether or not SRP with adjunct doxycycline therapy improves glycemic status in individuals with a long history of prediabetes.

A limitation of the present study is that the postoperative FBG levels were measured after 6 months of SRP. In the study by Rodrigues et al. [20], there was significant reduction in hyperglycemia among type 2 diabetic patients after 3 months of SRP. It is therefore speculated that there might have been a reduction in glycemic levels among patients included in the present investigation after 3 months of SRP; however, poor glycemic control probably raised the FBG levels thereby showing no significant difference among baseline and follow-up measurements. Another limitation of the present study is that glycemic levels were monitored using FBG levels alone. It is known that measurement of hemoglobin A1c (HbA1c) levels is a reliable and non-fluctuant indirect test for serum glucose management that reflects or correlates with the average blood glucose levels during the past 3 months [26]. Further studies, using HbA1c levels as screening tools for assessing the association between SRP and hyperglycemia are needed.

Conclusion

Within the limits of the present study, it is concluded that NSPT reduces hyperglycemia and periodontal inflammation in patients with prediabetes.* * *

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Authors’ contribution: FAA performed the clinical examinations, performed the statistical analysis and wrote the manuscript. FJ designed the study, wrote the manuscript and revised it prior to submission. All authors had full access to all data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.

Conflict of interest: The authors report no conflicts of interest related to the present study.

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