Original Article

Impact of Air and Manual Scaling on Dental Anxiety and Blood Glucose Level among Diabetic Patients

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ABSTRACT

Aims: The current study aimed at describing the short-term effect of nonsurgical periodontal treatment on dental anxiety and blood glucose level change among diabetic patients. **Materials and Methods:** One hundred and fifty patients with diabetes participated in a cross-sectional study design. All of them were divided into two groups, with 75 patients in each group. The first group was treated with air scaling, whereas the second group was treated with manual scaling. The determination of treatment needs and the evaluation of periodontal health status were achieved by using Community Periodontal Index for Treatment Need (CPITN). The level of dental anxiety was assessed by using Visual Analogue Scale (VAS). The glucose change was calculated by subtracting the glucose level before treatment from the glucose level straight after treatment. **Results:** No significant difference in glucose level was observed between manual scaling and air scaling after treatment (P = 0.076), and the level of glucose was significantly lower after scaling treatment within the treatment groups (P = 0.000). The level of glucose change between the groups was significantly lower for the manual scaling treatment group (P = 0.013), and it was significantly correlated with VAS (P = 0.000). Multiple regression analysis showed a significant association between the treatment groups (P = 0.007). **Conclusions:** Scaling reduced blood glucose and dental anxiety levels in patients with diabetes. Manual scaling was associated with reduced glucose level change less than air scaling after treatment.

Keywords: *Diabetes mellitus, general health, periodontal disease*

Introduction

Diabetes mellitus (DM) is characterized by elevated blood glucose levels, and it is considered as a heterogeneous group of metabolic disorders. Insufficient insulin secretion is the main feature of type 1 DM due to destructive autoimmune processes of the pancreatic β-cells, whereas body resistance to insulin circulation is the main feature of type 2 DM.[1] Retinopathy, nephropathy, neuropathy, and vascular syndromes may be the result of a prolonged hyperglycemic state of diabetes.[2]

Periodontal disease is a chronic inflammatory bacterial infection of the gingival bone that supports the tooth, which is caused by the accumulation of gram-negative anaerobic microorganisms that adhere to the teeth.[3] Periodontitis is common in patients with HIV/AIDS, DM, and cardiovascular disease.[4] DM and periodontal inflammation have a disturbing effect on the health of millions of people worldwide,[5] and individuals with type 2 DM are more likely to be associated with alveolar bone loss.[6] It has been reported that periodontal disease is accompanied by poor glycemic control.[7,8]

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In spite of the fact that many studies have tested dissimilar periodontal protocols for patients with DM, just a few have investigated the viability of these treatments among diabetic and nondiabetic subjects. A few studies have shown that both patients with diabetes and those without diabetes were similar in their short- and long-term responses after surgical and nonsurgical periodontal treatment.[9-13] However, other studies have shown that patients without diabetes responded better than patients with diabetes to periodontal treatment.[14-17]

Scaling and root planing are considered as the gold standard nonsurgical treatment of periodontitis,[18] and they are most commonly used currently for periodontal treatment.[19] Some clinical studies have shown that scaling and root planing efficiently decreases the microbial level in a periodontal pocket and improves the clinical parameters such as bleeding on probing, probing depths, and clinical attachment level.[20] However, scaling and root planing manually can frequently be difficult and time-consuming owing to the root morphology variations when working blindly at deep pocket spots.[20,21] The time required for instrumentation is shorter for ultrasonic equipment than for hand instruments.[20,22,23] The power-driven ultrasonic mechanical instruments were utilized by operators more efficiently to reach difficult spots such as furcation areas more easily,[24] owing to their vibrating mechanism that is capable of removing root surface debris.[25] In addition, ultrasonic scalers comprise a liquid output, which helps in cooling the tool throughout usage.[24] However, a nonsignificant difference was observed when comparing the microbiological and clinical outcomes achieved by ultrasonic equipment with those accomplished by hand instrumentation.[24-26]

Regarding surface roughness, the air scalers smoothened the surfaces slightly less effective than manual scalers.[27,28] This improvement in surface smoothness when using manual scaling could be explained due to the fact of better tactile and proprioceptive senses and to the controlled movement of the operator.[29] In a recent systematic review of literature,[30] it was concluded that the nonsurgical periodontal treatment by using only scaling and root planing improved the glycemic status by about 0.26% for patients with type 2 DM. However, this improvement was only observed after four months of periodontal treatment. Therefore, a shorter period of scaling and root planing could also be considered and investigated. Further, information investigating the association between manual and ultrasonic scaling methods with DM glucose level change after treatment is scarce in the literature. Therefore, this study aimed at investigating the impact of different modalities of treatments, such as manual- and air scaling, on dental anxiety and blood glucose level change among patients with diabetes directly after nonsurgical periodontal therapy and at determining its association with other confounding factors.

Materials and Methods

A total of 150 participants aged between 35 and 55 years were recruited for this study between December 2016 and December 2017. All participants were provided with a consent form before the study and were divided into two groups. The first group consisted of 75 patients with periodontal treatment using air scaling, whereas the second group consisted of 75 patients treated with manual scaling. The ethical standard outlined in the 1964 Helsinki declaration was followed for all participants in the study. The study was approved by the Medical Ethics Committee (protocol 60; 5 November 2017). Further, a consent form was attained from all participants after their endorsement.

The inclusion criteria were as follows: Patients have at least five teeth remaining, diagnosed with periodontitis on any of the remaining teeth with a periodontal pocket depth (PPD) deeper than 4 mm on probing, and type 1 or type 2 DM. Patients' smoking history was recorded; nevertheless, smokers were not excluded from the study. Patients with pregnancy, a history of present or previous cardiovascular disease, and/or medically compromised patients were excluded from the study.

Clinical assessment of calculus, gingival bleeding, and periodontal pockets was done by using CPITN to determine the distribution of periodontal condition before treatment. Blood glucose level was determined by using an Accu-Check Active meter (Roche Diabetes Care). A blood drop taken from each patient was applied to the test field, whereas the test strip was attached to the testing meter according to the manufactural instructions. After completion of treatment, patients were asked to specify their anxiety level on a horizontal VAS line from 0 to 100 mm, where 0 represents "not anxious at all" and 100 represents "extremely anxious."[31]

Blood glucose level was recorded for each patient, at baseline before treatment and after completion of the dental hygiene treatment without the use of local anesthetics. One examiner (HA) performed the measurements for all the patients from each group.

Statistical analysis

Data were analyzed using SPSS with $P < 0.05$ significance level, and they were investigated for normality using the Shapiro–Wilk test. Chi-square,

Mann–Whitney, and Wilcoxon Signed-Ranks tests were used to analyze the difference between the two treatment groups. Correlation between glucose level change and VAS was determined using the Spearman Rank Correlation test. The multivariate regression analysis model was used to determine the association of blood glucose level change after treatment with the scaling groups, gender, smoking, and CPITN variables.

Results

One hundred and fifty patients participated in this study, and they were divided into two groups. The first group consisted of 75 patients (51 males, 24 females), in whom periodontal treatment was done by air scaling; the second group consisted of 75 patients (27 males, 48 females), in whom periodontal treatment was done by manual scaling. There was a significant difference in gender (0.000) and smoking (0.038) between treatment groups, as shown in Table 1. The level of glucose was significantly lower (0.000) after scaling treatment within the groups, whereas no significant difference (0.076) was observed between the groups after treatment. However, the change in glucose level was significantly lower with manual scaling more than air scaling, as illustrated in Table 2. Dental anxiety level was significantly correlated with a change in glucose level (0.000), and an increase of dental anxiety level increased the glucose level change [Table 3]. The multiple regression model was used to determine the association between the change in glucose levels. A significant association was only observed between the treatment groups (air scaling versus manual scaling) (P = 0.007). Manual scaling reduced glucose change by about 11 units less than air scaling [Table 4].

Discussion

Usually, the dental clinician can deal with the patient with diabetes in a way that is reliable with managing a nondiabetic individual.[32] Therefore, patient recruitments in this study included type 1 and 2 DM participants with periodontal disease. Regarding patients' gender, no association was observed between gender and patients' glucose level change. This was in accordance with a previous study by Bakhshandeh *et al.*, in which no gender difference was observed in the oral health indices in patients with diabetes.[33] Smokers and nonsmokers do not appear to influence glucose levels in patients with diabetes.[34,35] Similarly, in this study it was observed that most of the patients were nonsmokers; however, smoking as a variable was not found to be associated with glucose level change.

The short-term effect of periodontitis on diabetes status was not previously considered. Therefore, the association between the short-term effect of blood glucose level change and nonsurgical periodontal treatment was considered in the current study instead of the long-term (one to three months) follow-up after an intervention.

The periodontal condition of patients with diabetes supports the necessity to create a complete oral health advancement program for patients with diabetes.[33] Scaling as a nonsurgical periodontal therapy is considered an important part of the treatment of periodontal disease.[36] In 1982, the CPITN was proposed and it was a rapidly accepted instrument that

Table 1: Demographic data, according to the treatment groups (Air Scaling and Manual Scaling)

		Air scaling (N = 75) n (%)	Manual scaling (N = 75) n (%)	P-value
Gender	Male	51 (68)	27 (36)	0.000*,†
	Female	24 (32)	48 (64)	
Smoking	Smoker	31 (41)	19 (25)	0.038*,§
	Non-Smoker	44 (59)	56 (75)	

*Significance at $P < 0.05$ using †Chi-square test, §Mann–Whitney test.

n = number of individuals; P = probability value

Table 2: Glucose and glucose level change between and within groups (air scaling and manual scaling)

		Air scaling (N = 75); mean (SD)	Manual scaling (n = 75); mean (SD)	P-value
Glucose	Before	127.8 (31)§	112.1 (30)§	0.000*,†
	After	110 (29)§	105.6 (33)§	0.076†
Glucose Level Change		-17.8 (27)	-6.5 (14)	0.013*,†

The same superscript § within groups indicated a significant difference (P<0.05) using Wilcoxon signed-ranks t-test.

n = number of individuals; P = probability value

*Significance at $P < 0.05$ using †Mann–Whitney test.

Table 3: Correlation between glucose level change and VAS

		VAS, mean (SD) 17.6 (8)
Glucose level change	Correlation coefficient	0.756
Mean (SD)	P-value	0.000*,§
−12.2 (22.2)	N	150

VAS = Visual Analogue Scale; n = number of individuals; P = probability value

*Correlation is significant at the 0.01 level (2-tailed), using §Spearman Rank Correlation test

Table 4: Multivariate regression analysis to detect the association of the change in glucose level before and after treatment with scaling groups, gender, smoking, and CPITN as predictable variables

Variable	Change in glucose	
	Coefficient (SE)[¦]	*P*-value
Intercept	−14.001 (8.913)	0.118
Scaling_Groups[†]	11.100 (4.068)	0.007*
Gender[‡]	4.331 (5.034)	0.391
Smoking[§]	−4.181 (5.118)	0.415
CPITN	−2.228 (3.518)	0.527
R^2	0.074	

provided the scientific community with a huge amount of epidemiological data.[37]

Despite the different scaling techniques utilized in this study, results showed reduced blood glucose levels after treatment for both groups. This could be explained due to a better patient's perception of the treatment offered,[38] as there is a correlation between anxiety and patients with DM.[39,40] Anxiety as an emotional factor needs to be addressed in patients with DM for a better quality of life.[41] It is generally perceived that stress may have a negative effect on the health of patients with DM and especially on type 2 DM. The experience of stress is related to the release of counterregulatory hormones and energy mobilization, which frequently result in increased blood glucose levels.[42,43] Moreover, the improvement of blood glucose levels was found to be significantly associated with stress management in patients with type 2 DM.[44]

In this study, we investigated the association between glucose change before and after treatment and other confounding factors such as scaling groups, gender, smoking, and CPITN using a linear regression analysis model. The manual scaling group as a predictor in this study reduced glucose level change more than the air scaling group. Previous studies concluded that utilizing ultrasonic technique needs a reduced treatment time than the manual technique, and the former was believed to enhance patients' perception.[20,22,23] However, the results of this study showed that the manual scaling reduced glucose level in patients with DM less than air scaling. Different periodontal procedures in patients manifested different fear of pain and anxiety.[45] In the present study, it is possible that the scaling of the dental surface might stimulate free nerve endings in some oral tissues such as the gingiva, tooth pulp, and periodontal ligament.[46] The ultrasonic instrument is used commonly in periodontal treatment due to its facilitator properties as a mechanical device. However, as normal human sense sounds are at a level between 20 Hz and 20,000 Hz, sounds that exceed this frequency, such as ultrasonic scalers and air turbine, resulted in possible complications to patients exposed to ultrasound.[47] On the other hand, an air scaler is a vibrating machine; the vibrational force is considered as its main principal feature of work, which is not controlled, and it varies depending on the operator's experience.[28] However, better tactile and proprioceptive senses were observed when using a manual scaler.[29]

Inequality of gender distribution between treatment groups is considered as one of the limitations of this study. Similarly, it was also observed that most of the patients were nonsmokers in both groups. However, the regression model revealed that there was no association found between gender, smoking, and glucose level change. Future studies could control predictable variables by increasing the number of participants.

Conclusion

Within the limitation of this study, it was concluded that scaling generally reduced blood glucose and dental anxiety levels in patients with diabetes after treatment. However, manual scaling was associated with reduced blood glucose level change less than air scaling. Gender, age, and CPITN showed no association with glucose level change.

Future scope/clinical significance

Our article creates a paradigm for future studies to encourage researchers to focus on this area. The information investigating the association between manual and ultrasonic scaling methods with glucose level change in patients with type 2 DM after periodontal treatment is scarce in the literature.

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Conflicts of interest

Nil.

Authors' contributions

Alyamama M. Alwan: conceived the idea, collected the data, drafted the manuscript, revised the manuscript, edited the manuscript, and approved the final version to be published. Hussein A. Mousa: conceived the idea, collected the data, drafted the manuscript, and approved the final version to be published. Haider J. Talib: conceived the idea, collected the data, drafted the manuscript, and approved the final version to be published. Tameem K. Jassim: performed the

statistical analysis, drafted the manuscript, revised the manuscript, edited the manuscript, and approved the final version to be published.

Ethical policy and institutional review board statement

The ethical standard outlined in the 1964 Helsinki declaration was followed for all participants in the study.

Patient declaration of consent

A consent form was obtained from all participants after their endorsement.

Data availability statement

The data set used in the current study is available (option as appropriate): (a) Repository name; (b) name of the public domain resources; (c) data availability within the article or its supplementary materials; (d) available on request from (contact name/email id); (e) dataset can be made available after the embargo period due to commercial restrictions.

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