IMPACT OF INITIAL PERIODONTAL THERAPY ON PERIODONTAL STATUS IN TYPE 2 DIABETES MELLITUS PATIENTS IN CORRELATION WITH GLYCOSYLATED HEMOGLOBIN (HBA1C) LEVELS

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DOI 10.69559/issn.2233-1794.2025.14.1.3

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ABSTRACT

The purpose of this study was to examine the effect of initial periodontal therapy on the periodontal status of patients with type 2 diabetes mellitus, in correlation with glycosylated hemoglobin (HbA1c) levels. A total of 60 patients diagnosed with type 2 diabetes mellitus and periodontal disease underwent initial periodontal therapy. Relevant data on HbA1c laboratory test results and periodontal parameters were recorded at baseline and again three months later. Statistical analysis was performed using the SPSS software package (version 13.0; SPSS Inc., Chicago, IL, USA). To compare periodontal indices between the initial and follow-up examinations, the General Linear Model – Repeated Measures (GLM-RM) was used. Additional variables that could potentially influence the outcome (therapeutic option, HbA1c levels, and presence of diabetes mellitus) were included as covariates. Descriptive statistics are presented as absolute values (n), relative values (%), and as means with standard deviations or interquartile ranges. Comparisons between variables were conducted using the paired t-test or the Wilcoxon test, depending on the distribution of the data.

Based on our study, it can be concluded that initial periodontal therapy in patients with type 2 diabetes mellitus, when analyzed in correlation with HbA1c levels, resulted in a reduction in clinical periodontal inflammatory parameters. The duration of type 2 diabetes mellitus and HbA1c levels did not have a statistically significant effect on the periodontal indices monitored in this study.

Keywords: Periodontitis, Initial Periodontal Therapy, Type 2 Diabetes Mellitus, Glycosylated Hemoglobin (HbA1c)

Introduction

Diabetes mellitus (DM) is a highly prevalent metabolic disease characterized by a chronic and progressive course. Persistent hyperglycemia leads to complications affecting tissues, organs, and numerous systems [1]. There are two main types of diabetes mellitus. Type 1 is caused by the destruction of pancreatic beta cells, autoimmune or idiopathic diseases, and is more common in younger individuals. Type 2 accounts for approximately 90% of all cases and presents as a spectrum ranging from predominant insulin resistance with relative insulin deficiency to predominant insulin secretory deficiency, with or without insulin resistance. Glycosylated hemoglobin (HbA1c) is one of the most important parameters for retrospective glycemic control. The HbA1c value represents the average blood glucose level over the past eight to twelve weeks. According to the World Health Organization (WHO), an HbA1c value of up to 7% is considered normal. Any value above this threshold is considered a relevant parameter for confirming the diagnosis of diabetes mellitus [2].

Periodontitis is an inflammatory disease that affects the supporting structures of the teeth and develops due to the influence of microorganisms present in dental plaque. Anaerobic microorganisms and their byproducts play the most significant role in the development and progression of periodontal diseases [3,4]. Periodontitis arises as a pathological reaction of the periodontal tissues to external (local) irritants, and this response is influenced by the systemic condition of the body. One of the most common systemic diseases that affect the development, prevalence, and progression of periodontal diseases is diabetes mellitus. Periodontal disease is reported as the sixth complication of diabetes mellitus [5]. Research provides evidence of a bidirectional, mutually detrimental correlation between diabetes mellitus and periodontal disease. This negative correlation has been demonstrated in studies conducted worldwide, under various conditions, and using diverse methodologies. Several researchers support the view that poor glycemic control contributes to the deterioration of periodontal health. The severity of periodontal changes is influenced by both the level of glycemic control and the duration of diabetes mellitus [6,7].

Periodontal therapy involves procedures for the mechanical removal of the causes of periodontal inflammatory diseases. All principles of periodontal therapy can be grouped into two main concepts: initial therapy (causal and corrective) and surgical therapy (supportive and access).

Initial periodontal therapy aims to eliminate supra- and subgingival plaque and to create conditions that prevent plaque accumulation on tooth surfaces, thereby reducing the risk of relapse and disease progression [8,9].

The initial treatment is followed by several months of supportive therapy, which requires patient cooperation, regular check-ups, and monitoring of periodontal pocket regeneration [10].

The purpose of the study was to examine the effect of initial periodontal therapy on the periodontal status of patients with type 2 diabetes mellitus, in correlation with glycosylated hemoglobin (HbA1c) levels. HbA1c values were recorded at the first visit and again three months later. The following indices were used to assess periodontal status: Plaque Index (PI), Papilla Bleeding Index (PBI), and the Community Periodontal Index of Treatment Needs (CPITN). These indices were recorded at the first visit and again three months later.

Method and materials

The study included 60 patients diagnosed with type 2 DM and periodontal disease, of both sexes, aged between 18 and 70 years.

Patients presented for examination at the Department/Clinic for Oral Medicine and Periodontology, Faculty of Dentistry, Dental Clinical Center in Sarajevo.

All patients with type 2 DM had their glycosylated hemoglobin (HbA1c) levels recorded at the initial examination and again after three months as part of their regular diabetes treatment.

After taking their medical history, a clinical periodontal examination was performed, including the following indices: PI, PBI, and CPITN.

Patients diagnosed with type 2 DM and periodontal disease underwent initial periodontal therapy. All data were recorded in a form specifically designed for this study, both at the initial examination and at the three-month follow-up.

Statistical design

Statistical analysis was performed using the SPSS software package (version 13.0; SPSS Inc., Chicago, IL, USA).

During the clinical periodontal examination, at both the initial and follow-up examinations, an individual index was assessed for each tooth, scored numerically from 0 (no pathological substrate) to grades 1–4, depending on the size and extent of the pathological substrate. A total pathological index was then calculated for each participant, separately for each of the four quadrants (Q1, Q2, Q3, and Q4).

To compare these periodontal indices between the initial and follow-up examinations, a General Linear Model – Repeated Measures (GLM-RM) was used. Additional variables that could potentially influence the outcome (therapeutic option, HbA1c levels, and presence of diabetes mellitus) were included as covariates. Descriptive statistics are presented as absolute values (n), relative values (%), and as means with standard deviations or interquartile ranges. Comparisons between variables were conducted using the paired t-test or the Wilcoxon test, depending on the distribution of the data.

Results

The study included 60 subjects of both sexes: 29 men (48.3%) and 31 women (51.7%). The average age of the men was 64.8±5.6 years, while the average age of the women was 61.0±9.3 years. The difference

Table 1. Mean, minimum, and maximum PI values at baseline and after initial therapy

Plaque Index	N	Min.	Max.	25th percentile	Median	75th percentile
Q1 – Examination 1	60	0	10.0	1.2	2.0	5.0
Q1 – Examination 2	60	0	4.0	0	0	1.0
Q2 – Examination 1	60	0	12.0	1.0	2.5	5.0
Q2 – Examination 2	60	0	6.0	0	0	1.0
Q3 – Examination 1	60	1.0	15.0	4.0	6.0	8.0
Q3 – Examination 2	60	0	7.0	0	2.0	3.0
Q4 – Examination 1	60	0	18.0	4.0	5.0	8.0
Q4 – Examination 2	60	0	7.0	0	2.0	3.0

Table 2. Mean, minimum, and maximum PBI values at baseline and after initial therapy

Papillary Bleeding Index	N	Min.	Max.	25th percentile	Median	75th percentile
Q1 – Examination 1	60	0	12.0	1.0	4.0	6.7
Q1 – Examination 2	60	0	8.0	0	0	2.0
Q2 – Examination 1	60	0	15.0	1.0	3.0	6.0
Q2 – Examination 2	60	0	5.0	0	0	1.7
Q3 – Examination 1	60	1.0	15.0	4.0	6.0	8.0
Q3 – Examination 2	60	0	7.0	0	1.0	2.0
Q4 – Examination 1	60	0	18.0	3.0	6.0	8.0
Q4 – Examination 2	60	0	8.0	0	2.0	2.0

in age was not statistically significant (p=0.06).

The mean HbA1c (%) was 7.00 (6.20–8.17)% at baseline and 6.85 (6.10–8.02)% at the follow-up examination three months later. The difference was not statistically significant (p=0.085). The average duration of diabetes mellitus among participants was 2 years (1–3 years).

Tables 1, 2, and 3 show the mean values, medians, and percentiles of periodontal indices at baseline and at the three-month follow-up. Tables 4, 5, and 6 present the indices monitored after initial periodontal therapy, analyzed in correlation with HbA1c values and the duration of type 2 DM, reported separately by quadrant.

Table 3. Mean, minimum, and maximum CPITN values at baseline and after initial therapy

CPITN	N	Min.	Max.	25th percentile	Median	75th percentile
Q1 – Examination 1	60	0	18.0	3.0	7.5	11.7
Q1 – Examination 2	60	0	10.0	.0	2.0	4.0
Q2 – Examination 1	60	0	19.0	2.2	7.0	11.0
Q2 – Examination 2	60	0	12.0	.0	1.0	3.0
Q3 – Examination 1	60	2.0	19.0	8.0	10.0	13.7
Q3 – Examination 2	60	0	12.0	.0	2.0	6.0
Q4 – Examination 1	60	0	21.0	6.0	9.5	12.0
Q4 – Examination 2	60	0	14.0	.0	2.0	5.50

Table 4. PI differences between two examinations, after initial periodontal therapy in correlation with glycosylated hemoglobin (HbA1c) levels and type 2 DM duration, by quadrants (Q1–Q4)

GLM-RM	Q1 Quadrant			Q2 Quadrant		
Variables	F	p	Partial η²	F	p	Partial η²
Index (1–2 measurement)	11.513	0.001	0.135	7.278	0.009	0.115
DM duration (years)	2.469	.122	0.031	.009	0.923	.0001
HbA1c (%)	0.196	.660	0.001	2.469	0.122	0.042
Initial therapy	0.135	.715	0.002	.196	0.660	0.003
	Q4 Quadrant			Q3 Quadrant		
Variables	F	p	Partial η²	F	p	Partial η²
Index (1–2 measurement)	6.362	.015	.102	5.272	0.025	0.086
DM duration (years)	1.156	.287	.020	2.323	0.133	0.040
HbA1c (%)	.174	.678	.003	.153	0.697	0.003
Initial therapy	2.722	.105	.046	3.985	0.051	0.066

F- represents the ratio of the variance between groups to the variance within groups.
p- represents the probability, and if it is greater than 0.06, it indicates statistical significance.

Analysis of variance revealed a statistically significant difference in PI values in the Q1 quadrant between the first and second visits, $F(1, 56) = 11.51$; $p = 0.001$, and in the Q2 quadrant between the first and second visits, $F(1, 56) = 7.27$; $p = 0.009$, with a large effect size. Analysis of variance revealed a statistically significant difference in PI values in the Q3 quadrant between the first and second visits, $F(1, 56) = 5.27$; $p = 0.025$. Analysis of variance revealed a statistically significant difference in PI values in the Q4 quadrant between the first and second visits, $F(1,56) = 6.36$; $p = 0.015$, with a medium effect size ($partial\ \eta^2 = 0.102$). The duration of diabetes and HbA1c values at the first examination had no significant effect ($p > 0.05$), while initial therapy showed borderline significance ($p = 0.051$).

Table 5. PBI differences between two examinations, after initial periodontal therapy in correlation with glycosylated hemoglobin (HbA1c) levels and type 2 DM duration, by quadrants (Q1–Q4)

GLM-RM	Q1 Quadrant			Q2 Quadrant		
Variables	F	p	Partial η^2	F	p	Partial η^2
Index (1–2 measurement)	1.275	0.264	0.022	2.362	0.130	0.040
DM duration (years)	0.785	0.379	0.014	0.038	0.845	0.001
HbA1c (%)	0.629	0.431	0.011	0.207	0.651	0.004
Initial therapy	0.083	0.774	0.001	0.636	0.429	0.011
	Q4 Quadrant			Q3 Quadrant		
Variables	F	p	Partial η^2	F	p	Partial η^2
Index (1–2 measurement)	5.572	0.022	0.090	4.226	0.044	0.070
DM duration (years)	1.086	0.302	0.019	2.451	0.123	0.042
HbA1c (%)	0.066	0.798	0.001	0.543	0.464	0.010
Initial therapy	1.303	0.259	0.023	1.471	0.230	0.026

F- represents the ratio of the variance between groups to the variance within groups.
p- represents the probability, and if it is greater than 0.06, it indicates statistical significance.

Analysis of variance did not reveal a statistically significant difference in PBI values in quadrants Q1 and Q2 between the first and second visits ($p > 0.05$).
Analysis of variance revealed a statistically significant difference in PBI values in the Q3 quadrant between the first and second visits, $F(1, 56) = 4.22$; $p = 0.044$, and in the Q4 quadrant between the first and second visits, $F(1, 56) = 5.57$; $p = 0.022$, with a medium effect size. PBI values were significantly lower at the second examination. Additionally, the duration of diabetes (in years), HbA1c values at the first examination, and initial therapy did not have a significant effect on the change in PBI values ($p > 0.05$).

Table 6. CPITN differences between two examinations, after initial periodontal therapy in correlation with glycosylated hemoglobin (HbA1c) levels and type 2 DM duration, by quadrants (Q1–Q4)

GLM-RM	Q1 Quadrant			Q2 Quadrant		
Variables	F	p	Partial η^2	F	p	Partial η^2
Index (1–2 measurement)	2.490	0.120	0.043	4.796	0.033	0.079
DM duration (years)	0.025	0.875	0.0001	0.132	0.717	0.002.
HbA1c (%)	0.053	0.819	0.001	0.394	0.533	0007
Initial therapy	0.008	0.929	0.000	0.614	0.437	0.011
	Q4 Quadrant			Q3 Quadrant		
Variables	F	p	Partial η^2	F	p	Partial η^2
Index (1–2 measurement)	4.033	0.049	0.067	5.747	0.020	0.093
DM duration (years)	1.508	0.225	0.026	1.882	0.176	0.033
HbA1c (%)	0.021	0.884	0.000	.033	0.857	0.001
Initial therapy	5.828	0.019	0.094	8.295	0.006	0.129

F- represents the ratio of the variance between groups to the variance within groups.
p- represents the probability, and if it is greater than 0.06, it indicates statistical significance.

Analysis of variance did not reveal a statistically significant difference in CPITN values in the Q1 quadrant between the first and second visits ($p = 0.120$). In the Q2 quadrant, a statistically significant difference was found between the first and second visits, $F(1, 56) = 4.79$; $p = 0.033$, with a medium effect size (partial $\eta^2 = 0.067$). CPITN values were significantly lower at the second examination. In the Q3 quadrant, analysis of variance showed a statistically significant difference between the first and second visits, $F(1, 56) = 5.74$; $p = 0.020$. In the Q4 quadrant, a statistically significant difference in CPITN values was also recorded, $F(1, 56) = 4.03$; $p = 0.049$, with a medium effect size. CPITN values were significantly lower at the second examination. The duration of diabetes (in years), HbA1c values at the first examination, and the initial therapy applied did not show a significant impact on changes in CPITN values ($p > 0.05$).

Discussion

The results of this study highlight the importance of initial periodontal therapy in reducing inflammatory periodontal parameters. In contrast, HbA1c levels and the duration of type 2 DM were not found to be statistically significantly associated with these parameters.

Preshaw et al. confirmed the interaction between the duration of type 2 DM and HbA1c levels in relation to severe periodontitis. At baseline, severe periodontitis was associated with an increased risk of poor glycemic control (HbA1c > 9.0%), suggesting that long-term, uncontrolled periodontitis may hinder effective diabetes management [11].

In our study, the mean HbA1c value was 7.00% (6.20–8.17) at the initial examination and 6.85% (6.10–8.02) at the three-month follow-up. The observed difference was not statistically significant (p = 0.085). The mean duration of type 2 DM was 2 years (1–3 years).

Although HbA1c levels decreased after three months, our results did not show a statistically significant effect on changes in periodontal parameters, which may be attributed to the short duration of type 2 DM in our patient cohort. Teeuw et al. confirmed a reduction in HbA1c levels in patients with treated periodontitis compared to those with untreated periodontitis. This finding is consistent with our study, in which the mean HbA1c value decreased from 7.00% to 6.85%; however, the observed difference was not statistically significant (p = 0.085) [12].

In our study, statistically significant differences were observed in PI values during the follow-up measurement. Analysis of variance revealed a significant difference between the first and second visits, $F(1, 56) = 7.27$; $p = 0.009$, with a large effect size (partial $\eta^2 = 0.115$). The PI at the second examination was significantly lower. The CPITN index was $F(1, 56) = 4.03$; $p = 0.049$, with a medium effect size ($p = 0.049$), while being significantly lower at the second visit. Similarly, Sho et al. investigated the impact of initial periodontal therapy on periodontal status, noting that the control group received antibiotic therapy. The periodontal parameters monitored showed improvement, as did HbA1c levels [13].

Initial periodontal therapy led to a significant reduction in periodontal inflammation but had no statistically significant effect on parameters used to diagnose metabolic syndrome (MetS). This finding was confirmed by Fernanda et al. and is consistent with our results [14].

Treatment of periodontal disease improves glucose control and reduces inflammatory markers. Improvement in periodontal health in patients with type 2 DM can be achieved through enhanced oral health education and regular dental check-ups. The primary approach to treating periodontal infection involves the removal of the pathogenic biofilm. Our findings are consistent with those of Mathew et al. [15].

Analysis of variance revealed a statistically significant difference in PBI values between the first and follow-up examinations, $F(1, 56) = 4.22$; $p = 0.044$, with a medium effect size. The bleeding index was significantly lower at the second examination. The duration of type 2 DM, HbA1c levels, and initial therapy did not have a significant effect on the reduction of PBI values between the first and follow-up examinations ($p > 0.05$).

Rajashri et al. monitored clinical parameters, including PBI and HbA1c values, at 3 and 6 months after initial periodontal therapy. Their results demonstrated a statistically significant decrease in metabolic parameters following the therapy [16].

Our study, along with those of other authors, has confirmed that initial periodontal therapy in patients with type 2 DM leads not only to improvements in clinical periodontal inflammatory parameters but also to reductions in HbA1c levels, an important marker of metabolic control [17–22]. Given the interrelationship between type 2 DM and periodontal disease, regular check-ups with periodontologists and endocrinologists are essential [23].

Conclusions

Based on our study, it can be concluded that initial periodontal therapy in patients with type 2 DM, in correlation with HbA1c levels, significantly reduced clinical inflammatory parameters of the periodontium. However, the duration of type 2 DM and HbA1c levels, in combination with initial periodontal therapy, did not have a statistically significant effect on the periodontal indices monitored in this study. Given that patients with type 2 DM are at increased risk for the development and progression of periodontal disease, regular dental check-ups and diligent oral hygiene maintenance are essential.

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