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Investigation of the DMFT index of type 2 diabetes mellitus patients with a 5-year interval cross sectional study

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Cover Page Footnote

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Investigation of the DMFT index of type 2 diabetes mellitus patients with a 5-year interval cross sectional study

Aim: Type 2 diabetes mellitus (T2DM) is a chronic metabolic disease with insulin deficiency or dysfunction. Notably, T2DM also has clinical and radiological implications in the oral region. This study aims to evaluate the changes in decay, missed, and filled teeth (DMFT) indexes on panoramic radiographs of T2DM patients at the end of a five-year follow-up and compare them with the control group.

Materials and Methods: Two panoramic radiographs taken five years (mean 5.32 ± 0.24) apart from each of the 92 patients (46 T2DM and 46 healthy) were evaluated. The DMFT index was calculated in a total of 184 panoramic radiographs and compared statistically.

Results: When the DMFT index calculated on the first radiographs used in the five-year follow-up of the T2DM patients was compared with the DMFT index five years later, a statistically significant increase was found in the mean values except for D ($p < 0.05$)

Conclusion: T2DM does not affect DMFT. As the DMFT values of both groups increased at the end of five years, it was determined that advanced age exacerbated DMFT. Panoramic radiography can be used in the follow-up of DMFT.

INTRODUCTION

Diabetes mellitus (DM) is one of the most common chronic hormonal diseases in the 21st century, along with severe health problems.¹ DM is characterized by a lack of insulin production or an inadequate insulin response. DM can be classified into two categories: type 1, where there is no insulin production, and type 2, where there is no adequate response to insulin. Type 2 constitutes approximately 90% of DM diseases and mainly affects the adult population.² DM damages multiple organ systems and lowers one's quality of life due to the pathophysiological condition.³ Notably, type 2 diabetes mellitus (T2DM) can also affect the oral cavity directly or indirectly.⁴ The main oral complications of DM include dry mouth, dental caries, periapical lesion, gingivitis, periodontitis, oral candidiasis, burning mouth syndrome, difference in taste, oral lichen planus, geographic tongue, recurrent aphthous stomatitis, susceptibility to infection, and delayed wound healing.⁵ The increase in *Streptococcus mutans* in DM patients, poor oral hygiene, diet, and impaired salivary structure increase the risk of caries.⁶ Several studies in the literature have examined the relationship between dental caries and DM, as well as decay, missed, and filled teeth (DMFT) and DM.⁷⁻¹²

DMFT is an important index used to evaluate and monitor the oral health status of the population.¹³ The use of the DMFT index, which was first defined by Klein and Palme in 1938, is recommended by the World Health Organization (WHO).^{14,15} This index determines the number of DMFTs, with minimum and maximum values ranging from 0 to 28.¹⁶

Panoramic radiography allows for a thorough examination of all dental and anatomical regions in the upper and lower jaw.¹⁷ Panoramic radiographs are frequently used in scans and

epidemiological studies due to their simplicity.¹⁸ Several DMFT studies in the literature have been conducted using panoramic radiography.^{19,20}

This study aims to compare the five-year change in T2DM patients' DMFT values with the control group on two panoramic radiographs of T2DM and control groups taken five years apart.

MATERIALS AND METHODS

This study was approved by the Scientific Research and Publication Ethics Committee of the University (2022/3892).

Study Population

For the study, suitable radiographs were selected among the panoramic radiographs of the patients who applied to the Inonu University Faculty of Dentistry, Department of Oral and Maxillofacial Radiology, for various reasons between 2013 and 2021. Turkish population from the southwest Eastern Anatolia region was evaluated.

In the study, 184 panoramic radiographs of 92 patients in the age range of 33–84 were used. Two panoramic radiographs taken five years (mean 5.32 ± 0.24) apart of each of the 46 patients without any systemic disease (28 females, 18 males) for the control group and 46 T2DM (32 females, 14 males) patients were used.

Patients with only T2DM were identified from the records, among whom those with panoramic radiographs taken at a five-year interval were identified. Patients with panoramic radiographs at five-year intervals without any chronic diseases were determined for the control group. The panoramic-radiography-taking interval for each patient was accepted as a minimum of 5 years 0 days and a maximum of 5 years, 5 months, and 29 days. The mean panoramic-radiography-taking interval was 5.32 ± 0.24 .

Evaluation of Panoramic Radiographs

Panoramic images were obtained using the Planmeca Proline XC (Helsinki, Finland) device with exposure parameters of 18 s, 64–68 kVp, and 5–8 mA. The images were evaluated using the Romexis Software. Panoramic radiographs with insufficient image quality were not included in the study. Patients with another chronic disease accompanying T2DM and edentulous patients on the initial radiograph were excluded from the study. The third molar teeth were not evaluated on the panoramic radiographs.

Panoramic radiographs of the T2DM and control groups were downloaded. The downloaded radiographs were mixed and coded in such a way that the time of imaging and chronic disease conditions were not clear and saved in a folder (ET, BÖ). The DMFT values were evaluated by another investigator who was blinded to the meanings of the codes used in naming the panoramic radiographs in the file (DÇÖ).

The number of decayed teeth (D), missed teeth (M), and filled teeth (F) were determined on panoramic radiography and recorded separately (Figure 1). Radiolucencies disrupting the normal anatomical appearance of the teeth were considered as D. The edentulous spaces of each tooth

were evaluated as M. The presence of a fixed bridge pontic and dental implant in the edentulous spaces was also considered as M. Restored, root canal treatment, and crowned teeth were evaluated as F. The sum of these values was recorded as the DMFT score (DÇÖ). Each determined value was recorded into four groups: T2DM 5 years ago, T2DM 5 years later, control group 5 years ago, and control group 5 years later (ET, BÖ). A statistical comparison was performed in the D, M, F, and DMFT values between the groups.

Statistical Analysis

A Kolmogorov-Smirnov test was performed for the normality of the data distribution. Data with a p-value greater than 0.05 were found to be normally distributed, while those with a small p-value were found to have a non-normal distribution. In the independent groups, the Mann-Whitney U test was used for those who were not normally distributed, and the independent t-test was used for those who were normally distributed ($p < 0.05$). The Wilcoxon test was used for those who were not normally distributed, and the paired t-test was used for those who were normally distributed in the dependent groups ($p < 0.05$). The chi-square test was used to compare the nominal data ($p < 0.05$).

RESULT

In our study, the data of a total of 92 patients, consisting of 46 patients with T2DM and 46 in the control group, were evaluated. The T2DM group consisted of 32 female (69.6%) and 14 male (30.4%) patients, while the control group comprised 28 female (60.9%) and 18 male (39.1%) patients. The T2DM and control groups were compared by gender ratios, and no statistically significant difference was found (Table 1).

The mean age of the patients with T2DM was 55.41 ± 11.86 (min: 33, max: 84), while the mean age of the control group patients was 54.89 ± 11.17 (min: 34, max: 78). There was no statistically significant difference between the groups in terms of age ($p = 0.941$) (Table 2).

At the beginning of the five-year follow-up of the T2DM group, the mean values were 2 ± 1.81 for D, 7.39 ± 5.9 for M, 5 ± 4.8 for F, and 14.5 ± 7.33 for T. At the end of the five-year follow-up of the T2DM group, the mean values were 2 ± 2 for D, 8.69 ± 6.58 for M, 6.56 ± 4.66 for F, and 17.26 ± 7.52 for T. While the change in the mean D values of the T2DM patients after five years was not statistically significant ($p = 0.86$), the increase in the M, F, and T values was statistically significant (Table 3). The mean values of the control group at the beginning of the five-year follow-up were 2.72 ± 2.44 for D, 6.86 ± 5.38 for M, 3.85 ± 3.25 for F, and 13.82 ± 5.99 for T. The mean values in the control group at the end of the five-year follow-up were 2.39 ± 1.86 for D, 8.15 ± 6.38 for M, 5.29 ± 3.48 for F, and 15.95 ± 6.6 for T. While the change in the mean D values of the control group patients at the end of five years was not statistically significant ($p = 0.294$), the increase in the mean M, F, and T values was found to be statistically significant (Table 4).

At the beginning of the five-year follow-up, there was no statistically significant difference between the D, M, F, and T mean values of the T2DM patients and the control group (Table 5). There was no statistically significant difference in the D, M, F, and T mean values between the T2DM patients and the control group at the end of five years (Table 6).

DISCUSSION

Due to the effects of oral health on daily life, the WHO has identified it as one of the most serious public health issues.²¹ For nearly 70 years, the DMFT index has been considered the most important index used in assessing oral and dental health around the world. This index is also very important in epidemiological studies on public health.²² Oral findings, such as periodontal diseases, dental caries, xerostomia, and delayed wound healing, can be expected in DM patients.⁶

Sebring et al. found in their study that the evaluation of the DMFT index, remaining teeth, and root-filled teeth using panoramic radiography was reliable.¹⁹ Boffano et al.²⁰ used panoramic radiography to calculate the DMFT index in their clinical study. In our study, panoramic radiography was determined to be suitable for use in the long-term follow-up of the DMFT index.

Several studies in the literature have stated that diabetes is associated with dental caries.⁷⁻¹⁰ In their study with 60 patients, Latti et al.⁷ found the DMFT index to be higher in patients with DM compared with the non-diabetic control group. In their study with 100 patients, Singh et al.⁸ found the DMFT value to be significantly higher in T2DM patients than in the healthy control group. Malvania et al.⁹ conducted a study with 240 patients and found that the rate of caries in diabetics was 73%, while it was 31% in the non-diabetic control group. In the study conducted with 23,089 patients in the Spanish population, Jacob et al.¹⁰ found the overall caries rate to be 20.6% and highly correlated with diabetes. Sukminingrum et al.²³ found the DMFT index to be 13.52 in T2DM patients (mean age: 53.74) and 9.73 in the control group. There was a significant difference in DMFT indices between these two groups. In the same study, the decay value was also higher in patients with DM.²³ Khan et al.⁶ found in their study with panoramic radiography that the rate of missing teeth was higher in patients with diabetes, and there were more carious lesions and restored teeth in the non-diabetic group. In general, T2DM patients are expected to have more dental caries because of being obese and eating high-calorie, high-carbohydrate foods. Decreased saliva secretion has also been reported to increase the risk of caries.⁷

However, some studies in the literature have reported that there was no relationship between DM and caries in the studies conducted between DM and control groups.^{11,12} Arrieta-Blanco et al.¹¹ compared the mean number of caries in their study conducted with 70 diabetics and 74 non-diabetic individuals and found no difference between the two groups. While the rate was 7.9% in diabetics, it was 6.91 in non-diabetic patients. Bharateesh et al.¹² found the prevalence of caries to be 13.6% in 300 diabetic patients and 13.6% in 300 non-diabetic patients. According to the study, the reasons for the low prevalence of caries in diabetic patients were more protein-based nutrition and less consumption of fermentable carbohydrates.¹² In their study, Buyschaert et al.²⁴ found that the caries rate was lower in the diabetic patient group with well-controlled blood sugar compared with the control group.

In our study, there was no significant difference between the DMFT values in T2DM patients (mean age 55.41) and the control group (mean age: 54.89) in the assessment before the five-year

period. Similar results were found in the evaluation after the five-year period. Based on this result, it was thought that there was no negative situation in terms of oral health in T2DM patients compared with DMFT. However, at the end of the five-year period in the T2DM patients, there was a significant increase in all DMFT values except for the D value. Similar results were obtained in the DMFT values of the control group after a five-year period.

According to a literature review that included studies conducted in Asia, Europe, North America, South America, Australia, and Africa between 2016 and 2020, the rate of caries was reported to be high in many countries.²⁵ In a study conducted in Turkey, the DMFT value was 6.72 in a subpopulation with a mean age of 31.6 years. In the same study, the DMFT value was 9.64 in the 44–56 age group and 10.92 in the 57–69 age group.²⁶ In another study conducted in Turkey, the DMFT value was 16.59 in the 55–64 age group of the subpopulation.²⁷ In our study, the DMFT value was 14.5 in T2DM patients with a mean age of 55.41 years and 17.26 in patients with a mean age of 60.41 after five years. In the control group with a mean age of 54.89, the DMFT value was 13.82, but it became 15.95 five years later, with a mean age of 59.89. Although the DMFT values were numerically higher in the T2DM patients, there was no statistically significant difference. Based on the results of our study, it was thought that the DMFT values increased with age, T2DM did not have an effect, and that it was a social condition.

CONCLUSION

According to the DMFT index, T2DM did not affect oral health in the population over 55 years. At the end of the five-year period, the DMFT index increased in both healthy and T2DM patients. Therefore, it is necessary for dentists to take precautions regarding oral health in older patients. Panoramic radiographs are suitable for use in long-term follow-up of the DMFT index.

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Figure legend

Figure 1: Samples of Before five years panoramics(A1, B1, C1) and after five years panoramics(A2, B2,C2) for evaluation of D (decay) , M (missing) and F(filling) teeth.

Table 1. Examining the gender distribution of the groups

Groups							
	Diabetes mellitus		Control		Total		p-value
Gender	N	%	N	%	N	%	
Female	32	69.6	28	60.9	60	100	0.512
Male	14	30.4	18	39.1	32	22.5	
Total	46	100	46	100	92	100	

N: number of people.

Chi-square test was used for statistical analysis. $p < 0.05$ indicates statistical difference

Table 2. Examining the age distribution of the groups

Age	N	Mean	SS	Min	Max	P-value
Diabetes Mellitus	46	55.41	11.86	33	84	0.941
Control	46	54.89	11.17	34	78	

SS:Standart deviation. n: number of people.

N<0.05 shows statistical difference

Mann Whitney U test was used for statistical analysis

Table 3: Comparison of type 2 diabetes mellitus groups DMFT values between 5 year period before and after

	Diabetes mellitus B ^a			Diabetes mellitus A ^b			P value
	mean	Min-max	sd	mean	Min-max	sd	
D	2	0-7	1.81	2	0-9	2	0.86
M	7.39	0-23	5.9	8.69	0-26	6.58	0.000
F	5	0-18	4.8	6.56	0-18	4.66	0.001
T	14.5	0-28	7.33	17.26	2-28	7.52	0.000

Sd:Standard Deviation.

p<0.05 shows statistical difference

Wilcoxon test was used for statistical analysis.

B^a: Before 5 year period

A^b: After 5 year period

Table 4. Comparison of control groups DMFT values between 5 year period before and after

	Control group B ^a			Control group A ^b			P value
	mean	Min-max	sd	mean	Min-max	sd	
D	2.72	0-12	2.44	2.39	0-7	1.86	0.294
M	6.86	0-27	5.38	8.15	0-27	6.38	0.000
F	3.85	0-11	3.25	5.29	0-13	3.48	0.004
T	13.82	3-28	5.99	15.95	4-28	6.6	0.000

Sd:Standard Deviation.

p<0.05 shows statistical difference

Wilcoxon test was used for statistical analysis.

B^a : Before 5 year period

A^b: After 5 year period

Table 5: Comparison of DMFT values between type 2 diabetes mellitus and control groups before 5 year period.

	Diabetes mellitus B ^a			Control Group B ^a			P value
	mean	Min-max	sd	mean	Min-max	Sd	
D	2	0-7	1.81	2.72	0-12	2.44	0.077
M	7.39	0-23	5.9	6.86	0-27	5.38	0.713
F	5	0-18	4.8	3.85	0-11	3.25	0.64
T	14.5	0-28	7.33	13.82	3-28	5.99	0.636

Sd:Standard Deviation..

p<0.05 shows statistical difference

Mann Whitney U test was used for statistical analysis.

B^a : Before 5 year period

Table 6: Comparison of DMFT values between type 2 diabetes mellitus and control groups after 5 year period.

	Diabetes Mellitus A ^a			Control group A ^a			P value
	mean	Min-max	sd	mean	Min-max	sd	
D	2	0-9	2	2.39	0-7	1.86	0.189
M	8.69	0-26	6.58	8.15	0-27	6.38	0.608
F	6.56	0-18	4.66	5.29	0-13	3.48	0.374
T	17.26	2-28	7.52	15.95	4-28	6.6	0.323

SS:Standard Deviation. N: number of people.

p<0.05 shows statistical difference

Mann Whitney U test was used for statistical analysis.

A^b: After 5 year period

Figure 1

