Original Paper

Statistical Study of Dental Changes in Patients Diagnosed with Diabetes Mellitus

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ABSTRACT: Dental changes are known to be very diverse in patients diagnosed with diabetes mellitus. The aim of this study is to identify and study the main dental changes in patients diagnosed with diabetes, as well as a statistical comparison of the two types of diabetes (type 1 diabetes and type 2 diabetes). Material and Method: Our study included 107 patients were diagnosed with diabetes mellitus (DM), 48 patients with DM type 1 and 59 patients with DM type 2 participated in the study. Patients aged 19-80 years old were clinically examined by analyzing the following parameters of the remnant teeth, caries, teeth with fillings, teeth with endodontic treatments and teeth with periapical radiotransparency. Results: The group of patients with DM type 1 recorded a high number of carious lesions and several lost dental units compared to the group of patients with DM type 2, where we found numerous periodontal treatments. Conclusions: We did not find a statistically significant difference between DM type 1 and DM type 2 patients with the total number of teeth present. Patients with DM type 1 presented more teeth with carious lesions at the upper jaw, while those with DM type 2 had more carious lesions at the lower jaw. The group of patients with DM type 2 presented more radiological changes of the apical periodontium, both at the upper and lower jaw.

KEYWORDS: *Diabetes, dental lesions, endodontic treatment, periapical radiotransparency*

Introduction

Diabetes mellitus (DM) is a chronic metabolic disorder characterized by hyperglycemia due to insufficient insulin production or poor performance, or both [1,2,3].

Produced in the pancreas, insulin plays a role in some major biological functions, including glucose transport. DM is a chronic inflammatory disease and has a significant impact on public health [4].

Diabetes mellitus is currently considered one of the most common diseases, so it is important to know the most relevant dental changes that occur in these patients and whose development could be influenced by it. The most common type of diabetes is DM type 1 (also known as insulin-dependent), which occurs more frequently in younger patients, and DM type 2 (also known as non-insulin-dependent), considered a chronic disease characterized by high levels of glucose in the blood, resistance of cells to insulin action or poor insulin secretion [5,6,7]. Type 2 DM is more common than type 1 diabetes and accounts for 85 to 90% of all diagnosed cases [8,9,10,11].

Patients with diabetes are affected by changes in general health status, and both types may experience complications that may occur early or late [12].

Oral manifestations of diabetes can be devastating [13] and include gingival and periodontal diseases, dental caries, changes in salivary flow (xerostomy) and changes in salivary constituents, oral infections such as candidiasis, herpes and precancerous lesions, burning mouth syndrome, poor healing oral wounds, increased periapical and periodontal pathologies [12,14,15,16,17,18].

Risk factors such as obesity or overweight, physical inactivity, poor oral hygiene, hypercaloric food values and habits influence the progression of the disorder [19].

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Material and Methods

The participating patients were selected from patients diagnosed with diabetes in the Department of Diabetes of the County Emergency Clinical Hospital of Craiova who addressed the Endodontics Department of the University of Medicine and Pharmacy of Craiova to assess the dental condition and establish the individual treatment needs. The study was conducted between. June 2017 to July 2018. The study received ethical approval by the Ethics Committee of the University of Medicine and Pharmacy of Craiova. Written informed consent was obtained from each participant. The objectives and steps of oral clinical examination were explained for the participants. All participants were informed about their dental diagnosis and referred for appropriate dental treatment as needed. Upon signing the informed consent of participation, the patients were examined.

Inclusion criteria: Patients aged over 18, Patients are diagnosed with diabetes mellitus (1 type or 2 type) Dental patients, Patients who agreed to participate in the study. Exclusion Criteria: Age under 18 years of age, Pregnant patients, Bimaxillary totally edentulous patients. Each patient under study completed a personal record that included the diagnosis of diabetes, the type of diabetes from the observation record of the clinic or the anamnesis.

Depending on the type of DM, patients were grouped into two groups: the group of patients with type 1 DM and the group of patients with type 2 DM. We analyzed the number of remnant teeth by dividing both batches in 4 subdivisions: under 20 teeth, between 20 and 24 teeth, between 24 and 29 teeth, between 30 and 32 teeth.

For each patient we recorded the following parameters: the number of remnant teeth, the number of teeth with simple and complicated dental lesions, the number of teeth with long-lasting fillings. We compared for each arcade in each patient group the following parameters: the number of remnant teeth, the number of dental caries and the number of dental fillings, dividing each batch into three subdivisions: between 0-5 teeth, between 6-10 teeth and over 10 teeth.

To evaluate dental condition, it was recommended that each patient perform a panoramic radiography, assessing the existence and correctness of endodontic treatments, as well as their evolution. For this purpose, we divided the patients according to the type of diabetes in 6 subdivisions: cases with correct endodontic treatments in the upper jaw, cases with correct endodontic treatments in the mandible, cases with incorrect endodontic treatments at the upper jaw, cases with incorrect endodontic treatments in the mandible and respectively, cases with periapical radiolucencies in the upper jaw and cases with periapical radiolucencies in the mandible.

According to the European Endodontic Society (ESE) [20] endodontic treatment is considered correct if the root filling is a radiopaque and homogeneous whole length of the root or 2mm shorter [20]. We evaluated periapical lesions using the PAI index introduced by Orstavik in 1986 [21].

Data collection, clinical dental examination and panoramic x-ray examination were performed by the two Endodontology specialists. The informations obtained were recorded on appropriate forms for this purpose.

Statistical analysis was performed using Microsoft Excel (Microsoft Corp., Redmond, WA, USA), together with the XLSTAT add-on for MS Excel (Addinsoft SARL, Paris, France) and IBM SPSS Statistics 20.0 (IBM Corporation, Armonk, NY, USA) for processing the data.

We used the Chi-Square test to evaluate the association between qualitative variables (p values lower than α=5% were considered statistically significant).

Results

Of the 107 patients, 48 patients were diagnosed with DM type 1 and 59 with DM type 2. Of these, three patients had an edentulous dental arch, two patients had the edentulous mandible (type 1 and 2) and one patient had the edentulous upper jaw (type 1).

Patients aged 19-80 years old were clinically examined by analyzing the following parameters: number of the remnant teeth, number of dental caries, number of teeth with dental fillings, number of teeth with endodontic treatments and number of teeth with periapical radiotransparency.

As it is shown in Table 1, we analyzed the number of remnant teeth by dividing both batches in 4 subdivisions: under 20 teeth, between 20 and 24 teeth, between 24 and 29 teeth, between 30 and 32 teeth.

We found that patients with type 2 DM had more remnant teeth, analyzing both the total number of remnant teeth and each arcade (Table 1).

Table 1. Distribution of the number of teeth in each group of patients

Number of remnant teeth	<20	20-24	24-29	30-32	Total	
DM 1	15 (31.25%)	12 (25.00%)	14 (29.17%)	7 (14.58%)	48 (100.00%)	
DM 2	20 (33.90%)	17 (28.81%)	12 (20.34%)	10 (16.95%)	59 (100.00%)	
Total	41 (25.63%)	42 (26.25%)	52 (32.50%)	25 (15.63%)	160 (100.00%)	
				p Chi square	*0.767*	*NS*

As shown in Table 2, we compared each arcade in each patient group with the following parameters: the number of remnant teeth, the number of dental caries and the number of dental fillings, dividing each batch into three subdivisions: between 0-5 teeth, between 6-10 teeth and over 10 teeth.

After examining the remnant teeth, we assessed the existence of simple and complicated dental lesions, in which case we found that patients with DM type 1 had more teeth with carious lesions at the upper jaw, while patients with DM type 2 had carious lesions more numerous at the mandible (Table 2).

Analyzing the existence of dental treatments, we found that both the upper jaw and mandibular arch, patients with DM type 2 showed numerous coronary lasting fillings (Table 2).

Table 2. The distribution of the remnant teeth with carious lesions and dental fillings on both arches on each batch

	Group	0-5	6-10	>10	*p Chi square*
Number of upper jaw remnant teeth	DM 1 (48 cases)	3 (6.25%)	14 (29.17%)	31 (64.58%)	0.751
	DM 2 (59 cases)	5 (8.47%)	20 (33.90%)	34 (57.63%)	NS
Number of mandibular remnant teeth	DM 1 (48 cases)	4 (8.33%)	13 (27.08%)	31 (64.58%)	0.923
	DM 2 (59 cases)	5 (8.47%)	14 (23.73%)	40 (67.80%)	NS
Number of caries at the upper jaw	DM 1 (48 cases)	37 (77.08%)	8 (16.67%)	3 (6.25%)	0.080
	DM 2 (59 cases)	53 (89.83%)	6 (10.17%)	0 (0.00%)	NS
Number of mandibular caries	DM 1 (48 cases)	38 (79.17%)	10 (20.83%)	0 (0.00%)	0.003
	DM 2 (59 cases)	56 (94.92%)	1 (1.69%)	2 (3.39%)	S
Number of dental fillings at the upper jaw	DM 1 (48 cases)	37 (77.08%)	9 (18.75%)	2 (4.17%)	0.004
	DM 2 (59 cases)	27 (45.76%)	28 (47.46%)	4 (6.78%)	S
Number of mandibular dental fillings	DM 1 (48 cases)	39 (81.25%)	9 (18.75%)	0 (0.00%)	0.0013
	DM 2 (59 cases)	28 (47.46%)	29 (49.15%)	2 (3.39%)	S

In Table 3, we compared each dental arc from each batch: cases with correct endodontic treatments, cases with incorrect endodontic treatments and cases with periapical radiolucencies.

Regarding the effectiveness of the endodontic treatments, analyzing the panoramic x-rays, we observed that in the patients with type 2 DM there were several endodontic treatments correctly performed both at the upper jaw and the mandible (Tabel 3).

Table 3. The situation of root treatments

	DM 1 (48 cases)	DM 2 (59 cases)	*p Chi square*
Cases of upper jaw teeth with correct endodontic treatments	10 (20.83%)	21 (35.59%)	0.094 NS
Cases of teeth with correct endodontic treatments at the mandible	5 (10.42%)	12 (20.34%)	0.163 NS
Cases of upper jaw teeth with incorrect endodontic treatments	13 (27.08%)	30 (50.85%)	0.013 S
Cases of mandibular teeth with incorrect endodontic treatments	11 (22.92%)	21 (35.59%)	0.154 NS
Cases of upper jaw teeth with periapical radiolucencies	25 (52.08%)	38 (64.41%)	0.198 NS
Cases of mandibular teeth with periapical radiolucencies	25 (52.08%)	37 (62.71%)	0.268 S

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By comparing the two groups, we found that the group of patients with Type 2 DM had a higher number of incorrect endodontic treatments on both arches compared to patients diagnosed with DM 1 (Table 3).

Regarding the total number of remnant teeth, in our study, we did not find a statistically significant difference between patients with type 1 DM and those with type 2 DM ($p=0.776>0.05$).

We did not find statistically significant differences between DM type 1 and DM type 2 patients on the number of remnant teeth, neither at the upper jaw. ($p=0.751>0.05$) nor mandible ($p=0.923>0,05$).

We found a statistically significant difference between patients with type 1 DM and those with type 2 DM in the number of teeth carious at the mandible ($p=0.003<0.05$) (Fig.1) but not at the upper jaw ($p=0.080>0.05$).

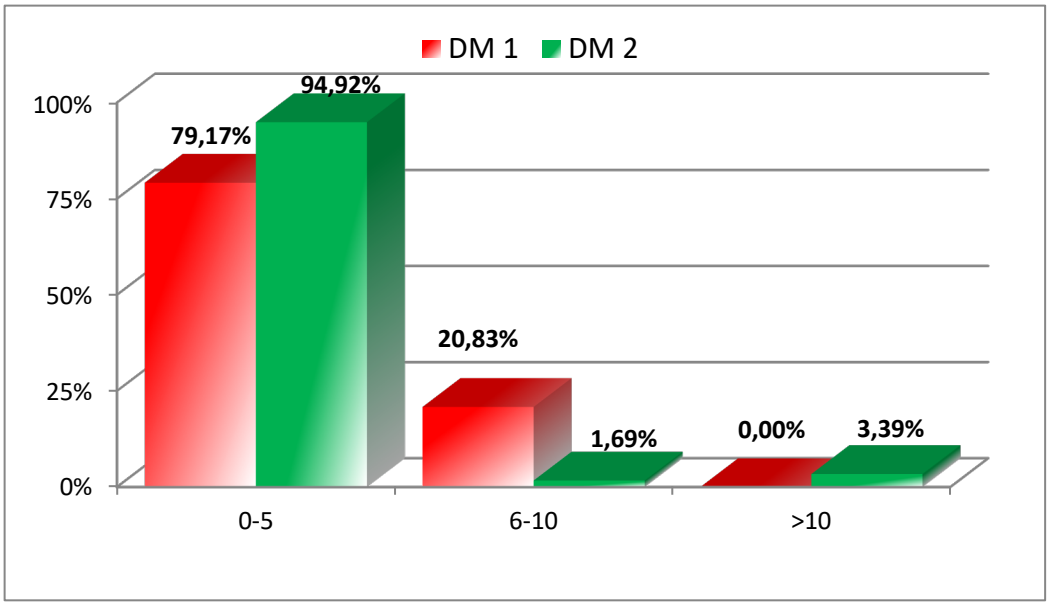

Fig.1. Diagram of dental caries at the mandible. 0-5=teeth with 1 up to 5 dental caries; 6-10=teeth with 6 up to 10 dental caries; >10=teeth with more than 10 dental caries

We also found statistically significant differences between DM type 1 and DM type 2 patients who had fillings at the upper jaw ($p=0.004>0.05$) (Fig.2) and the mandible ($p=0.0013>0.05$) (Fig.3).

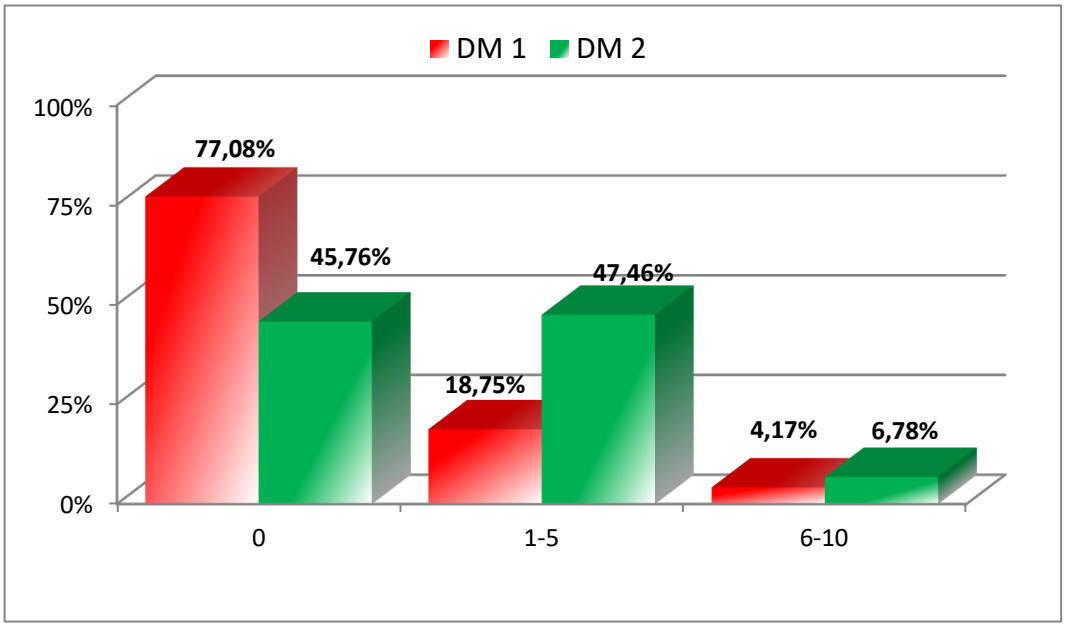

Fig.2. Diagram of teeth with dental fillings at the upper jaw. 0=without dental fillings; 1-5=teeth with 1 up to 5 dental fillings; 6-10=teeth with 6 up to 10 dental fillings

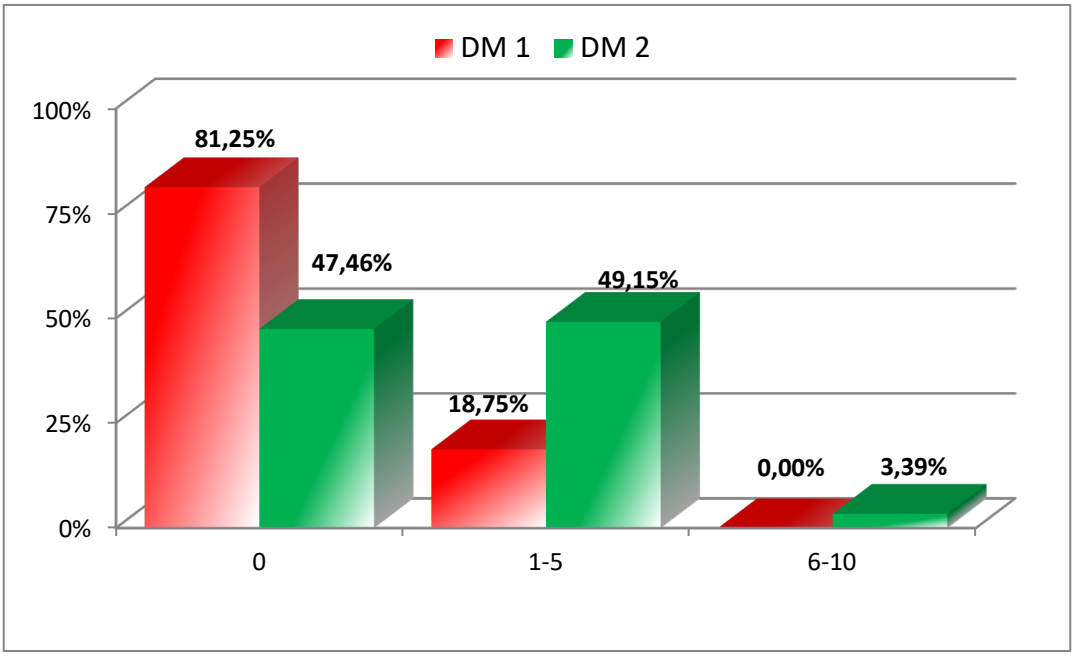

Fig.3. Diagram of teeth with dental fillings at the mandible. 0=without dental fillings; 1-5=teeth with 1 up to 5 dental fillings; 6-10=teeth with 6 up to 10 dental fillings

In our study, we found no significant difference between patients with diabetes type 1 and type 2 diabetes on the number of teeth with correct endodontic treatments nor upper jaw (*p=0.094>0.05*) nor the mandible (*p=0.163>0.05*).

We found a statistically significant difference between DM type 1 and DM type 2 patients with respect to the number of teeth with incorrect root fillings at the upper jaw (Fig.4) *(p=0.013> 0.05),* but not the mandible *(p=0.154>0.05).*

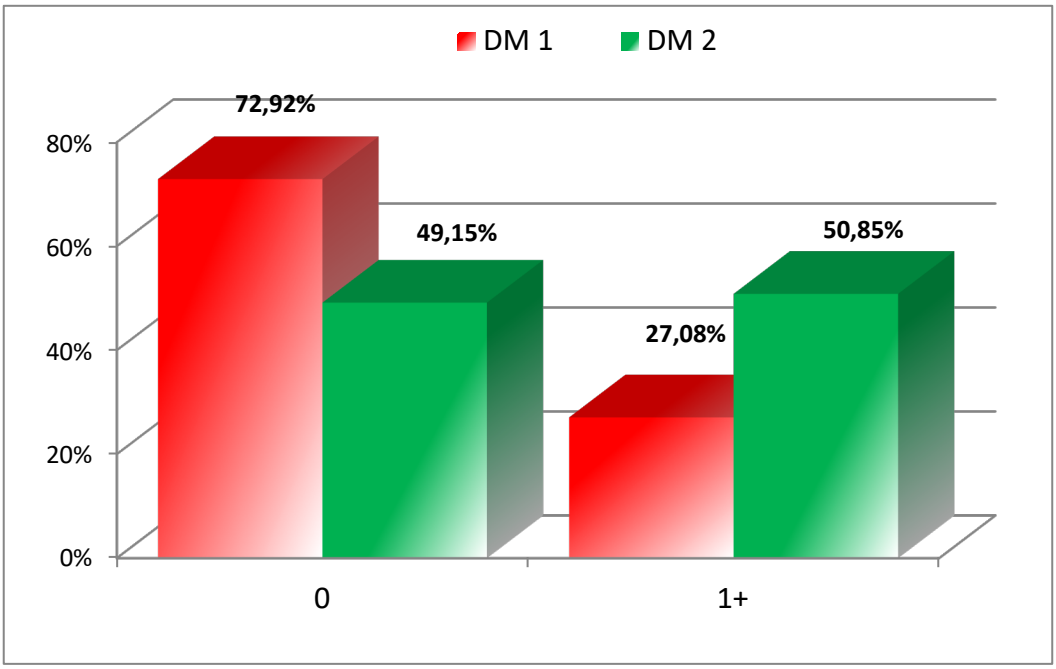

Fig.4. Diagram of teeth with incorrect endodontic treatments at the upper jaw. 0=without incorrect endodontic treatments; 1+=with incorrect endodontic treatments

We did not find a statistically significant difference between DM Type 1 and DM Type 2 patients in terms of the number of periapical radiotransparency teeth at the upper jaw *(p=0.189>0.05)*, nor of the mandible *(p=0.0286>0.05).*

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Discussion

The study performed by Arrieta-Blanco JJ et al, in 2003 [22], a group of 144 patients, of whom 70 individuals were diagnosed with diabetes, and 74 individuals constituting the control group, found statistically significant differences in the prevalence of dental caries of the type of diabetes.

The conclusions of this study were that patients with DM type 1 had a greater number of carious lesions (2.74), a result similar to that obtained by us, but only on the upper jaw arcade.

Unlike the results of our study, where the group of patients with DM type 2 had a greater number of fillings, Arrieta-Blanco JJ et al. [22] achieved different results, finding that patients with type 1 DM had more fillings (3.70) than those with Type 2 DM (1.65 and 1.58, respectively) ($p<0.05$).

On the other hand, patients with Type 2 DM showed a statistically higher number of lost teeth than those who had Type 1 DM (13.95/5.11) ($p<0.05$), resulting in contradiction with the one we obtained, so that the group of patients with DM type 1 recorded the most numerous lost dental units.

Arrieta-Blanco JJ et al., in 2003 [22], found statistically significant differences in the number of caries, the number of teeth lost, and the number of teeth with fillings in the various age groups of the diabetic and control population.

They found only a statistically significant difference in the number of dental absences only when they reported globally ($p<0.01$).

Other studies found an increased incidence of caries and fillings in type 1 DM patients compared to DM type 2 patients and, also they have found a higher number of teeth extracted in DM type 2 patients compared to patients with DM type 1.

In the study conducted by Cuković-Bagić I, (2004) [23], patients with type 2 DM had significantly more extracted teeth (18.2) than those with type 1 DM (14.2: $p<0.001$).

However, low carbohydrate diets in diabetics should, theoretically, reduce the prevalence of caries [24,25,26].

A review of literature shows that there is no clear association between diabetes and dental caries, but several studies have reported a rich history of dental caries in people with diabetes [27,28].

The number of caries, the number of lost teeth and / or the number of fillings can also be influenced by the type of diabetes. In this regard, our study found a greater number of caries lesions in Type 1 DM, a result that agrees with that of Lamey et al. (1990) [29].

However, there is no accordance between the results of our study and that of Lamey et al. [29] on the large number of fillings in type 1 diabetics ($p <0.05$) and the number of absent teeth, which was significantly higher in type 2 diabetics ($p<0.01$), as shown by the research by these researchers.

Kapp et al. (2007) [30], studying the association between diabetes and tooth loss in a group of the population who performed an annual dental visit to the US reported that people with diabetes had a significantly higher prevalence of teeth loss.

Furthermore, the authors reported an association between diabetic disease and tooth loss, especially among young people.

Bole et al. (2010) [31] found that the history of diabetes was a significant risk factor for the increase in dental loss in postmenopausal women in Buffalo, New York.

While several studies in different countries reported the existence of an association between tooth loss and an edentulous in patients with diabetes [32-37], other studies have found only a slight association and not significant [18, 38-39].

Diabetic patients diagnosed with metabolic changes were considered to be at an additional risk of developing dental caries [40] and severe periodontitis that ultimately led to the loss of teeth [41].

Falk et al. (1989) [42] conducted a clinical and radiological investigation that showed a higher prevalence of periapical lesions in type 1 diabetics.

Ueta et al. (1993) [43] studied the prevalence of DM in odontogenic infection, reporting that patients with DM had a disproportionate percentage of high infection pulp or periodontal clinically severe (24% of all cases), but had a much smaller percentage of infection moderate (2.3%), concluding that DM was a predisposing condition for endodontic infections.

In their study of 50 patients, López-López et al. (2011) [44] described that adult patients with type 2 diabetes are significantly more sensitive to apical periodontitis and thus require endodontic treatment.

Conclusions

Regarding the total number of remnant teeth, in our study, we did not find a statistically significant difference between patients with Type 1 DM and those with Type 2 DM.

Patients with Type 1 DM had more teeth with carious lesions in the upper jaw, while patients with type 2 DM had more carious lesions in the mandible.

Regarding the evolution of endodontic treatments, as well as their degree of effectiveness, in the case of the group of our study, we cannot say that DM is a predisposing factor in the occurrence of evolutionary complications, even in the case of the correct treatments, because a proper assessment would have been necessary additional imaging investigations (retroalveolar x-ray and CBCT).

The group of patients with Type 2 DM had several radiological changes of the apical periodontium, both in the upper and lower jaw.

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