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Prevalence of Chronic Apical Periodontitis Among Diabetic Patients Attending an Endodontics Clinic

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ABSTRACT

Introduction: Diabetes mellitus is one of the most common metabolic disorders in Mexico. The hyperglycemic state that characterizes this condition can lead to various alterations in the pulp tissue and may contribute to the establishment of periapical pathologies, particularly chronic apical periodontitis. **Objective:** To determine the prevalence of chronic apical periodontitis in diabetic and non-diabetic patients treated at the reception and diagnosis clinic and the endodontics clinic of the postgraduate and research division, school of dentistry, UNAM, between 2015 and

2020. **Material and Methods:** A descriptive and analytical cross-sectional study was conducted. A total of 190 digital panoramic radiographs and corresponding clinical records were examined. These were obtained through non-probabilistic convenience sampling from the database of the Reception and Diagnostic Clinic and the Endodontics Clinic. The sample included diabetic and non-diabetic patients aged ≥ 40 years. The history of diabetes, the number of teeth with chronic apical periodontitis, the presence of previous root canal treatment, the number of teeth with chronic apical periodontitis associated with prior root canal treatment, and the severity of chronic apical periodontitis were evaluated. The severity was determined using the Periapical Index (PAI) scoring system. **Results:** The overall prevalence of chronic apical periodontitis in the study population was 61.6%. Among these, 16.3% were non-diabetic patients, and 45.3% were diabetic patients. No statistically significant differences were found between the groups (p = 0.240). **Conclusions:** There were no statistically significant differences in the prevalence of chronic apical periodontitis, the severity of lesions according to the Periapical Index, or the presence of chronic apical periodontitis in teeth with previous root canal treatment between diabetic and non-diabetic patients. Future studies are recommended to consider glycemic control at the time of patient registration and the duration of diabetes progression.

Keywords: Diabetes mellitus, endodontics, chronic apical periodontitis, root canal treatment, endodontic treatment, Periapical Index.

INTRODUCTION

Diabetes mellitus (DM) is one of the most common metabolic disorders, and Mexico is among the 10 countries with the highest prevalence worldwide, according to the International Diabetes Federation (IDF)[1]. The total prevalence of diabetes in Mexican adults is 18.3%, which includes both diagnosed (12.6%) and undiagnosed (5.8%) cases[2]. The main characteristic of DM is hyperglycemia; however, the metabolic dysregulation associated with DM leads to secondary pathophysiological changes in various organs, especially the eyes, kidneys, nerves, heart, and blood vessels[3,4].

In the endodontic context, hyperglycemia can cause various alterations in the pulp tissue, mainly due to impaired collateral circulation, which leads to an increased risk of pulp necrosis due to ischemia[5]. In addition, high glucose levels inhibit macrophage function, resulting in an inflammatory state that hinders host cell proliferation and wound healing[6]. This, among other factors, leads to the development of periapical lesions, particularly chronic apical periodontitis (CAP), which is defined as *"the inflammation and destruction of periapical tissue caused by the progression of previous pulp pathologies without resolution. It is present as an apical radiolucent area in the absence of clinical symptoms"* [7].

Previously, the presence of CAP has been evaluated in patients with DM. Although controversial results have been observed in human models, there is evidence of an increased risk of a poor defense response to pathogens in the periapical tissue, as well as a greater predisposition to the persistence of lesions after root canal treatment (RCT)[8]. Therefore, the purpose of this study was to determine the prevalence of CAP in diabetic patients at the endodontics clinic of the División de Estudios de Posgrado e Investigación (DEPeI) at the Facultad de Odontología (FO) of Universidad Nacional Autónoma de México (UNAM) between 2015 and 2020.

MATERIALS AND METHODS

A descriptive and analytical cross-sectional study was conducted, considering the ethical aspects of research involving human subjects and in accordance with the Helsinki principles set forth in the regulations of the General Health Law. The protocol was approved by the Ethics and Research Committee of the FO, UNAM, under number CIE/0102/02/2022. A total of 190 clinical records from the Clínica de Recepción y Diagnóstico (CRED) and the Clínica de Endodoncia were reviewed between 2015 and 2020. The records were selected using non-probabilistic convenience sampling. The inclusion criteria were records that had entries in both clinics (CRED and endodontics clinic), records that corresponded to patients with type 2 diabetes under medical treatment, and records that included people aged 40 years or older. Records of pregnant patients and those patients who did not have an initial panoramic radiograph or who had poor-quality images were excluded.

The variables included in the study were gender (*female/male*), age (*years* old), history of diabetes (type 2 diabetic under medical *treatment/non-diabetic, based on the CRED file*), number of teeth with CAP, presence of previous RCT (*present/absent*), and number of teeth with CAP associated with previous RCT. Periapical status was assessed using the Periapical Index (PAI), which is a scoring system for recording apical periodontitis on radiographs, providing an ordinal scale of 5 scores: 1 (*healthy)*, 2 (*minor changes in periapical bone structure)*, 3 (*changes in periapical bone structure with some mineral loss)*, 4 (*periapical destruction with well-defined radiolucent area)*, and 5 (*severe periodontitis with exacerbated characteristics)*.[5,9,10] The evaluations were performed by one observer (inter-observer Kappa test 0.70). A descriptive analysis was performed for each of the variables involved. To determine the differences between the prevalence of chronic apical periodontitis in diabetic and non-diabetic patients, an X^2 test was performed at a 95% confidence level. The statistical analysis was performed using IBM® SPSS® Statistics software (Version 11; SPSS Inc., Chicago, IL, USA).

RESULTS

A total of 190 files of patients who attended the Endodontics Clinic were reviewed; of these, 57.4% of the population were women and 42.6% were men. The average age of the population was 61.9 ± 10.5. No statistically significant differences were observed for age and gender (p=0.209). Regarding the frequency and distribution of diabetic patients, 76.3% of the population (n=145) had this condition, with women showing the highest prevalence (63.4%) compared to male patients (36.6%) (p=0.002). No statistically significant differences were observed in the age distribution of diabetic patients (p=0.213).

Of the total number of patients attending the Endodontics clinic, 38.4% had healthy periapical areas and 61.6% had some degree of CAP. When we looked at the association between diabetes and PAC, we found that 76.3% of patients with CAP were diabetic and 23.7% were non-diabetic (Table 1). No statistically significant differences were observed in the prevalence of CAP in diabetic patients compared to non-diabetic patients (p=0.240).

Table 1. Relationship between diabetes and chronic apical periodontitis in patients attending the endodontics clinic of the DEPeI, UNAM between 2015 and 2020

	Non-diabetic patients		Diabetic patients		Total	
	n	%	n	%	n	%
HP	14	7.4	59	31.0	73	38.4
CAP	31	16.3	86	45.3	117	61.6
Total	45	23.7	145	76.3	190	100

HP: Healthy periapex, CAP: Chronic apical periodontitis, n: sample, %: percentage *X^2 test= 1.33 p= 0.240.*

In the analysis of the association between diabetes and the degree of CAP injury, it was observed that in non-diabetic patients, the most prevalent CAP injury was PAI 3 (11.6%), followed by PAI 1 and PAI 4 scores (both 4.2%), then PAI 2 (3.2%), and finally PAI 5 (0.5%). Likewise, in the diabetic population, the most prevalent CAP injury was PAI 3 (27.9%), followed by PAI 2 and PAI 4 with 17.9% and 12.1%, respectively; PAI 5 had a prevalence of 5.3%, while PAI 1 was 13.2%. No statistically significant differences were observed in the degree of injury according to the PAI scale (p = 0.350) (Table 2).

Table 2. Relationship between diabetes and the degree of CAP lesion according to the PAI scale in patients attending the endodontics clinic of the DEPeI, UNAM between 2015 and 2020

PAI scale	Non-diabetic patients		Diabetic patients		Total	
	n	%	n	%	n	%
1	8	4.2	25	13.2	33	17.4
2	6	3.2	34	17.9	40	21.1
3	22	11.6	53	27.9	75	39.5
4	8	4.2	23	12.1	31	16.3
5	1	0.5	10	5.3	11	5.8
Total	45	23.7	145	76.3	190	100.0

PAI scale: 1-healthy, 2-minor changes in periapical bone structure, 3-changes in periapical bone structure with some mineral loss, 4-periapical destruction with well-defined radiolucent area, 5-severe periodontitis with exacerbated characteristics. n: sample, %: percentage, X^2 test= 4.37 p= 0.350

In the analysis of the relationship between diabetes and the number of teeth affected by CAP associated with previous RTC, it was observed that, in non-diabetic patients, 15.8% had no affected teeth, 6.8% had one tooth with CAP associated with RCT, and only 1.1% had two affected teeth. In no case were three teeth with this condition observed. In the diabetic population, 59.5% had no teeth affected by CAP associated with RTC, 13.2% had one affected tooth, 3.2% had two teeth with this condition, and 0.5% had three affected teeth. No statistically significant differences were found between the groups (p = 0.350) (Table 3).

Table 3. Relationship between diabetes and number of teeth affected with CAP and previous RCT in patients attending the endodontics clinic of the DEPeI, UNAM between 2015 and 2020

Number of teeth	Non-diabetic patients		Diabetic patients		Total	
	n	%	n	%	n	%
0	30	15.8	113	59.5	143	75.3
1	13	6.8	25	13.2	38	20.0
2	2	1.1	6	3.2	8	4.2
3	0	0.0	1	0.5	1	0.5
Total	45	23.7	145	76.3	190	100.0

CAP: chronic apical periodontitis, RCT: root canal treatment, n: sample, %: percentage, X^2 *test= 3.22 p= 0.350*

DISCUSSION

In Mexico, DM represents one of the main public health problems. *"According to mortality data, in 2020, 1,086,743 deaths were reported, of which 14% (151,019) were due to diabetes mellitus"*[11]. In terms of DM by gender, the present study found that 63.4% of women were diabetic compared to men (36.6%). This is consistent with the 2018 ENSANUT report, which states that diabetes is more common in women (11.4%) than in men (9.1%). García *et al.,*[13] in 2021, point out that this is due to metabolic changes secondary to menopause, which promote obesity, which in turn promotes the onset of DM. The population in this study had a mean age of 61.9 ± 10.5, suggesting that most women would have already experienced the changes related to menopause and estrogen decline[12,13].

In contrast, in 2019, the IDF indicates that, globally, the estimated prevalence of diabetes in women is slightly lower than in men (9.0% vs. 9.6%). However, *"a greater number of deaths are associated with diabetes in women (2.3 million) than in men (1.9 million). This is because diabetes is associated with a wide variety of cardiovascular diseases, which together are the leading cause of morbidity and mortality in people with* diabetes"[14]. The relative risk of these diseases is 25-50% higher in women[13].

Regarding the presence of CAP, it was found that 61.6% of the population showed some degree of CAP in at least one tooth, while 38.4% had no lesions. This is very close to the findings reported in 2015 by Segura-Egea *et al.*[15], who mentioned that, in Spain, the presence of CAP ranges from 34% to 61% of individuals and from 2.8% to 4.2% of teeth. Results equivalent with these figures could be due to the similarity of the populations, since both were obtained from records of patients who attended a university for dental care. It is possible that in both that study and the present study, the socioeconomic status of the populations was low, assuming that educational institutions maintain a recovery fee for the services they offer; that is, the costs are lower than those offered in private services. This is therefore a portion of the population that seeks options for care, and, in many cases, oral health is not usually a priority. This is important not only because it limits the treatment plan but also in terms of the support and follow-up of the treatments performed. In addition, both in the present study and in that of Segura-Egea *et al.*[15], the same scale was used to measure the prevalence of CAP (PAI scale).

In this regard, when analyzing the severity of CAP using the PAI scale, the most common score was 3 (39.5%), followed by 2 (21.1%) and 1 (17.4%). When associating the degree of CAP injury with the presence of diabetes, no significant differences were found between diabetic and non-diabetic patients. Previous studies conducted by López-López *et al*. in 2011[16] and Alsomadi

in 2017[10] used this same scale to determine the presence/absence of CAP based on a score of 3. Both studies reported that diabetic patients showed a higher prevalence of CAP than controls. However, the results were not significant. In other studies, such as that by Segura-Egea *et al*.[17] in 2019, no significant association was found between CAP and DM, and prospective studies are suggested to confirm whether there is a relationship between the two pathologies. Similarly, two systematic reviews of the literature, Tibúrcio-Machado *et al*.[18] in 2017 and Ríos Osorio *et al*.[19] in 2020, indicate that although there is a strong connection between the presence of DM and the persistence and presence of PAC, well-designed clinical research with adequate methodologies is still needed to elucidate the influence of type 2 DM on the evolution of pulp and periapical pathologies.

The results in the current literature are still scarce and incipient, and the evidence for such an association is not yet conclusive. Although this is consistent with the results obtained in the present study, we should acknowledge some limitations given the small number of patients that could be evaluated, such as differences between the number of diabetic and non-diabetic patients. Also, there were some other variables out of our control, such as the duration of illness, glycemic control, and undiagnosed systemic diseases in patients reported as non-diabetic.

On the other hand, Segura-Egea *et al*.[20] in 2016 and Ríos-Osorio *et al*.[19] in 2020 mention that DM is significantly associated with a higher prevalence of CAP in endodontically treated teeth[20,19]. In the present study, data were also collected regarding the prevalence of CAP and previous RTC, and it was found that in 24.7% of cases, there were 1 to 3 affected teeth in the same patient. When associating this condition with DM, it was observed that 6.8% of non-diabetic patients had one affected tooth and 1.1% had two affected teeth. In diabetic patients, one affected tooth was found in 13.2% of cases, two teeth in 3.2% of cases, and three teeth in less than 1%. However, no statistically significant differences were observed between the groups. This contrasts with the results of some studies investigating the possible relationship between DM and the survival of endodontically treated teeth. Three of them, Mindiola *et al*.[21] in 2006, Ng *et al*.[22] in 2011, and Wang *et al*.[23] in 2011, found a significant relationship between diabetes and the extraction of endodontically treated teeth. In addition, a meta-analysis and systematic review, both conducted by Segura-Egea *et al*.[20,17] in 2016 and 2019 respectively, concluded that diabetic patients have a significantly higher prevalence of periapical lesions associated with restored teeth compared to control subjects.

It is important to emphasize that some of the studies showing an increase in periapical lesions in diabetic patients focus primarily on type 1 diabetic patients, who are associated, in most cases, with a greater number of years of disease progression, as well as on patients with uncontrolled blood glucose levels. The present study evaluated type 2 diabetics and included only patients who reported controlled blood glucose levels, a condition that may influence the results.

CONCLUSIONS

In this study, no statistically significant differences were found to suggest a relationship between DM and CAP. It is important to note that in this study, the prevalence of DM was higher in women. For future research, it is recommended to consider the glycemic control of patients at the time of admission and the duration of DM in order to have greater control of patients upon admission to the CRED, such as taking blood pressure and glucose readings, inquiring about the duration of illness, and requesting laboratory tests for patients who are systemically compromised for better diagnosis and prognosis of treatment or for research purposes.

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