



## Apical Periodontitis and Endodontic Treatment in Patients with Type II Diabetes Mellitus: Comparative Cross-sectional Survey

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### ABSTRACT

**Aims:** The aims of this study were to investigate the prevalence of apical periodontitis (AP) in diabetes mellitus (DM) patients compared with nondiabetic patients and to examine the effect of glycemic control on the prevalence of AP.

**Materials and methods:** Radiographs of a group of DM patients were compared with those of a matched nondiabetic group to identify AP. The diabetic group was subdivided according to the level of glycemic control into two subgroups: A well-controlled DM and a poorly controlled DM. The periapical index score was used to assess the periapical status. All groups were compared in regard to the presence of AP lesions, the number of endodontically treated teeth (ET), and the percentage of failure of endodontically treated teeth (AP/ET ratio). Statistical Package for the Social Sciences (SPSS version 20.0, Chicago, Illinois, USA) was used for all the analyses;  $p \leq 0.05$  was considered as statistically significant.

**Results:** The prevalence of AP was higher in diabetic group than in the nondiabetic group (13.5 vs 11.9% respectively). Diabetic group had more teeth with endodontic treatment ET compared with nondiabetic group (4.18 vs 1.82% respectively); this difference was statistically significant ( $p = 0.001$ ) along with higher AP/ET ratio (27.7 vs 19.3 respectively). The poorly controlled DM group had a higher prevalence of AP lesions compared with the well-controlled DM group (18.29 vs 9.21 respectively). This difference was statistically significant ( $p = 0.001$ ); they also had a higher percentage of ET (5.55 vs 3.13% respectively) and AP/ET ratio (32.0 vs 21.8% respectively).

**Conclusion:** This survey demonstrates a higher prevalence of AP in DM patients compared with nondiabetic group, with an increased prevalence of persistent chronic AP. Compared with a well-controlled diabetic group, a poor glycemic control may be associated with a higher prevalence of AP and increased rate of endodontic failures.

**Clinical significance:** Counseling diabetic patients, particularly those with poor glycemic control, about the risk of failure of endodontic treatment can be part of planning management, which could include referring diabetic patients who need endodontic treatment for consultant care.

**Keywords:** Apical periodontitis, Cross-sectional survey, Diabetes mellitus, Endodontic treatment, Glycemic control.

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### INTRODUCTION

Diabetes mellitus (DM) is a chronic, complex disease that involves numerous pathophysiological features.<sup>1</sup> It is one of the most prevalent diseases in the adult population. Persistent hyperglycemia is responsible for various types of organ and tissue damage in diabetic patients that results in long-term, systemic, debilitating complications.<sup>2</sup> The relationship between oral health and diabetes has been investigated widely, especially its association with periodontal disease and dental caries.<sup>3-7</sup>

A wide range of chemical and physical factors can induce periradicular inflammation; scientific evidence clearly indicates that apical periodontitis (AP) infections are very prevalent and are caused by microbial factors, which may lead to the progression and perpetuation of different forms and are quite similar to those that cause periodontal disease.<sup>8</sup> However, the literature on the relationship between DM and endodontic diseases is limited in all areas, including the pathophysiology, prevalence, and effect on treatment.

Pulp from patients with DM has a tendency to present with limited dental collateral circulation, an impaired

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immune response, an increased risk of acquiring a pulp infection (especially anaerobic ones) or necrosis, toothache, and an occasional tendency for pulp necrosis caused by ischemia.<sup>9</sup>

Few studies have suggested that DM may serve as a disease modifier of AP in that individuals with diabetes may be more prone to develop the primary disease. However, findings have not yet confirmed that diabetes may influence the response to root canal treatment because treated teeth had no increased prevalence of AP when compared with controls.<sup>10</sup> Few studies have examined the effect of glycemic control on the prevalence of AP.<sup>11</sup>

The aims of this study were to investigate the prevalence of AP in diabetic patients compared with matched nondiabetic patients and to examine the effect of glycemic control on the incidence of AP.

## MATERIALS AND METHODS

The study was performed in cooperation between an endocrinology clinic and consulting Endodontic Clinic at the King Hussein Medical Centre in Amman, Jordan, over a 6-month period (April 2015–September 2015). The study was approved by the Ethics Committee of our hospital, and written informed consent was provided by each participant after an informed consultation session was carried out by one of the residents working in the clinic.

### Sample Recruitment Process

Out of 248 patients interviewed in the endocrine clinic, 142 diabetics agreed to participate in the study, in addition to 3 patients who had been diagnosed with DM from the control group. Therefore, 145 patients were enrolled in group I. At the Family Medicine Clinic, 461 patients were interviewed and invited to participate in the study; 149 agreed, but 3 of them were found to have undiagnosed DM. Thus, 146 nondiabetic patients were

**Table 1:** Demographic and background characteristics of the diabetic and control groups (% and means)

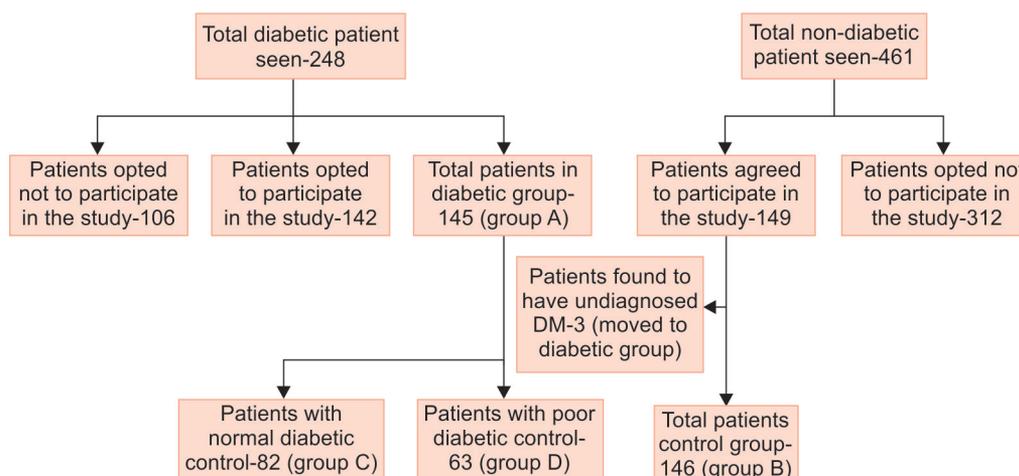
Characteristics	Group I (n = 145)	Group II (n = 146)	p-value
<b>Gender</b>			
Male	48.96	51.37	0.821
Female	51.04	48.63	
Mean±SD	49.6±8.85	51±8.97	0.325 <sup>†</sup>
<b>Income (in JOD<sup>‡</sup>)</b>			
0–200	26	24	0.638
201–400	38	36	
401–600	29	31	
>600	7	9	
<b>Educational status</b>			
Primary	29	23	0.271
High	27	31	
College	22	21	
University	22	25	
Mean years since the last visit to a dentist	5.6±6.12	5.2±6.54	0.835 <sup>†</sup>
<b>Smoking status</b>			
No	73	69	0.683
Yes	27	31	
<b>Hypertension</b>			
No	67	82	0.047
Yes	33	18	
Body mass index	26.19±3.92	25.57±4.40	0.384 <sup>†</sup>

<sup>†</sup>Analysis of variance; <sup>‡</sup>Jordanian Dinar (1.4 USD); SD: Standard deviation

enrolled in group II. Groups I and II (control group) were matched for age, gender, income, education, presence of hypertension, body mass index (BMI), smoking, and the number of years that had elapsed since the patient's last visit to a dentist (Table 1).

Group I was subdivided into two groups; group III included 82 well-controlled DM (glycated hemoglobin [HbA1c] <7%), while group IV contained 63 patients with poorly controlled DM (HbA1c >7%);<sup>12</sup> the recruitment process is illustrated in Flow Chart 1.

**Flow Chart 1:** Recruitment process



### Assessment of Periapical Status

All participants were offered digital panoramic radiographs in the Endodontic Department. Two senior endodontists independently evaluated these anonymous panoramic radiographs. In cases of disagreement, a combined assessment session was held to reach a consensus. The two observers were previously calibrated, and the kappa coefficient was used to analyze the agreement regarding the presence/absence of a periradicular lesion ( $\kappa = 0.91$ ). The periapical index (PAI) score was used to assess the periapical status.<sup>13</sup> A PAI  $\geq 3$  was considered to be a sign of AP. In multirrooted teeth, the worst score of all roots was taken to represent the PAI score for the teeth.

### Statistical Analysis

The Statistical Package for the Social Sciences (SPSS, version 20.0, Chicago, Illinois, USA) was used for all the analyses. A descriptive analysis was performed for sociodemographic features, health-related behaviors, radiographic data, the presence of diabetes, and diabetes control status. The normality of the distribution of continuous variables was tested using the graphic method. We performed a bivariate analysis to compare the presence of a periradicular lesion with several of the studied variables using the Mann–Whitney U-test for continuous data and the chi-squared test or Fisher’s exact test for categorical data. The threshold of statistical significance was set at 5% ( $p \leq 0.05$ ).

## RESULTS

### Diabetic Group I vs Nondiabetic Group II

Diabetics showed a higher number of teeth with AP, although this difference was not statistically significant. Diabetic group had more endodontically treated teeth (ET) compared with nondiabetic group (4.18 vs 1.82% respectively); this difference was statistically significant ( $p = 0.001$ ) along with higher AP/ET ratio (27.7 vs 19.3 respectively) (Table 2).

### Well-controlled DM (Group III) vs Poorly Controlled DM (Group IV)

Poorly controlled diabetic group had more AP lesions compared with the well-controlled diabetics (18.29 vs 9.21

respectively). This difference was statistically significant ( $p = 0.001$ ); poorly controlled DM group also had a higher percentage of ET (5.55 vs 3.13% respectively) and the AP/ET ratio (32.0 vs 21.8% respectively) (Table 3).

## DISCUSSION

Diabetes mellitus is a common metabolic disease with an estimated prevalence of 17.1%.<sup>1</sup> Diabetes is associated with several factors that can cause the following complications: (1) Shunting through the polyol pathway, (2) enhanced oxidative stress, (3) high levels of protein kinase C activation, and (4) enhanced formation of advanced glycation end products. Abnormalities in each of these pathways may affect a number of important cellular and molecular events, which can lead to pathologic changes when combined.<sup>14,15</sup> Despite the high prevalence of DM and the extensive investigations and research on its impact on health of affected individuals that have taken place, few studies have evaluated the possible relationship between DM and endodontic infections.<sup>16-21</sup>

Our study was, therefore, designed to examine the prevalence of endodontic lesions in diabetic patients compared with controlled nondiabetic patients and also to investigate the effect of glycemic control on the progression of the endodontic disease.

The results of our study showed that compared with the control group, AP was more prevalent in diabetic patients regardless of whether their disease was controlled or uncontrolled (13.15 vs 11.9 respectively), although this difference did not reach statistical difference. The prevalence of AP in both groups (diabetics and controls) was higher than the incidence of AP reported in other studies in a general population from other countries.<sup>22-24</sup> On the contrary, the AP prevalence in our control group was comparable to that reported by a Jordanian population study by Al-Omari et al<sup>25</sup> (11.9 vs 11.6% respectively). This difference in the AP prevalence between a Jordanian population and other studies could be explained by the fact that the oral status of Jordanian adults is unsatisfactory in general due to poor oral hygiene, which causes a high incidence of carious teeth, and an overall unsatisfactory quality of fixed dentures.<sup>26</sup> Socioeconomic status may also affect the quality of oral

**Table 2:** Periapical lesions (AP), ET, and the ratio of teeth with AP in ET in diabetic patients (group I) and nondiabetic controls (group II)

	Group I, n = 145 (%)	Group II, n = 146 (%)	p-value
Number of teeth	3111	3127	NS
Teeth with AP	409 (13.15)	372 (11.90)	NS
Teeth with ET	130 (4.18)	57 (1.82)	0.001*
Teeth with AP/ET	36 (27.7)	11 (19.3)	0.02

\*Statistical significance; NS: Not significant

**Table 3:** Periapical lesions (AP), ET, and ratio of teeth with AP in ET in patients with well-controlled diabetes (group III) and in poorly controlled diabetics (group IV)

	Group III, n = 82 (%)	Group IV, n = 63 (%)	p-value
Number of teeth	1759	1352	NS
Teeth with AP	162 (9.21)	247 (18.29)	0.001*
Teeth with ET	55 (3.13)	75 (5.55)	0.03
Teeth with AP/ET	12 (21.8)	24 (32.0)	0.02

\*Statistical significance; NS: Not significant

hygiene. Our group of patients was mainly from a low socioeconomic background, a population where oral health is not always a priority.

The difference in AP between diabetic and nondiabetic patients has been demonstrated in a few studies that showed a higher prevalence of AP in diabetic patients.<sup>27-29</sup>

When controlled diabetic patients were compared with the noncontrolled group, the prevalence of AP was greater than that in the noncontrolled group (18.29 vs 9.21% respectively). This revealed the effect of poor diabetic control on the development of endodontic disease; this consequence of poor control of diabetes was also demonstrated by Sánchez-Domínguez et al,<sup>11</sup> who demonstrated the relationship between glycemic control and periapical disease. Compared with our study, their results revealed a higher prevalence of AP, both in controlled diabetics and noncontrolled diabetics. Other studies have reported a greater prevalence of AP lesions in diabetic patients compared with nondiabetic populations;<sup>10,30</sup> these studies included smaller numbers than our study, and one of them was a retrospective study.

The percentage of ET was 2.3%, which is low compared with the results of some other studies,<sup>22,31-33</sup> in which the range was from 6.8 to 18.5%. This could be a consequence of the survey population being unrepresentative of the whole country and/or due to differences in socioeconomic factors and the provision of dental care services in these various other countries. In contrast, our data were in agreement with a number of previous studies that found the prevalence of teeth that received ET to range between 1.3 and 4.8%.<sup>23,34-36</sup>

The effect of diabetes on the success of ET was demonstrated by the difference in the AP/ET percentages between diabetic and nondiabetic patients (27.7 vs 19.3% respectively). Poor control of diabetes complicates the case more with more lesions in the noncontrolled diabetic group compared with controlled diabetic group (32 vs 21.8% respectively). This negative effect of diabetes on the success of ET can be explained by the results of many published studies, which have highlighted that glucose levels may interfere with the repair process of periapical changes; patients with diabetes who undergo dental procedures (particularly endodontic treatment) showed a poorer ability for wound repair.<sup>16,20,21</sup> Animal studies have indicated that diabetics are more likely to be afflicted with extensive periradicular changes, which may be due to a reduction in their defense capacity against microbial agents.<sup>37</sup> This lowered defense suggests the need for an adequate follow-up in these patients both before and following radicular ET, as many authors have suggested,<sup>38,39</sup> particularly since the majority of these patients (>50%) tend not to attend their follow-up visits.<sup>40</sup>

This study was a cross-sectional design that had some limitations. The data lacked a longitudinal follow-up and were also drawn from a small sample size that does not represent the entire diabetic adult population. However, the chance of researcher bias in our study was reduced compared with a longitudinal study because we used a cross-sectional design. Other limitations of our study included using radiographs as the only mode of diagnosis with increasing probability of incomplete diagnosis. In some cases, periradicular lesions are restricted to cancellous bone, which makes them undetectable on conventional radiographic examination<sup>41</sup> in addition to the fact that periradicular diagnoses are influenced by the quality of the root filling.<sup>42</sup>

## CONCLUSION

This study suggests a higher prevalence of AP in DM patients and increased number of ET. The prognosis for root-filled teeth was worse in diabetics, showing a higher rate of root canal treatment failure with an increased prevalence of persistent chronic AP. High level of HbA1c >7% is associated with higher prevalence of AP, increased number of ET as well as poorer prognosis of endodontic treatment evident by increased AP/ET ratio. Larger, prospective epidemiological multicenter studies will be needed to better determine the relationship between DM and periapical inflammation.

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