

Type 2 Diabetes Mellitus and the Prevalence of Apical Periodontitis and Endodontic Treatment in an Adult Brazilian Population

Patrícia S. Marotta, MSc,* Tatiana V. Fontes, MSc,* Luciana Armada, PhD,* Kenio C. Lima, PhD,[†] Isabela N. Rôças, PhD,* and José F. Siqueira, Jr, PhD*

Abstract

Introduction: This cross-sectional study evaluated the prevalence of apical periodontitis (AP) and endodontic treatment in type 2 diabetic individuals as compared with nondiabetics from an adult Brazilian population. **Methods:** Full-mouth radiographs from 30 type 2 diabetic and 60 age- and sex-matched nondiabetic individuals were examined, and the presence of AP lesions in untreated and root canal-treated teeth was recorded. The number of teeth and the prevalence of root canal treatment were also evaluated. **Results:** AP was significantly more present in teeth from diabetic individuals (98/652, 15%) than in nondiabetic controls (162/1,368, 12%) ($P = .05$). A separate analysis of untreated and treated teeth revealed that significance was mostly because of the prevalence of AP in untreated teeth, which was 10% in diabetics and 7% in nondiabetics ($P = .03$). No significant difference between diabetics and nondiabetics was observed for the other parameters under study, including the prevalence of AP in root canal-treated teeth, the number of teeth in the oral cavity, the number of treated teeth per individual, the number of individuals with at least 1 AP lesion or 1 root canal treatment, and the number of teeth with AP per individual ($P > .05$). **Conclusions:** AP was significantly more prevalent in untreated teeth from type 2 diabetics. This suggests that diabetes may serve as a disease modifier of AP in the sense that individuals with diabetes can be more prone to develop primary disease. However, findings do not confirm that diabetes may influence the response to root canal treatment because treated teeth had no increased prevalence of AP when compared with controls. (*J Endod* 2012;38:297–300)

Key Words

Apical periodontitis, diabetes mellitus, endodontic treatment

Diabetes mellitus is a disorder characterized by hyperglycemia and can manifest itself as types 1 and 2. Type 1 diabetes accounts for approximately 5% to 10% of all cases of diabetes and is related to a deficiency in the amount of insulin produced caused by self-immune, toxic, or viral destruction of β cells of the islets of Langerhans of the pancreas. Type 2 diabetes accounts for approximately 85% to 90% of the cases and is related to impaired cellular sensitivity to insulin (insulin resistance affecting glucose uptake) (1). In type 2, insulin levels may be normal or reduced; however, a deep deficiency of this hormone does not occur. The resistance of target tissues to insulin occurs because of a decrease in the number of insulin receptors available in the target cells or because of a deficiency in the post-receptor signaling, thereby promoting abnormal intracellular molecular events (2). Both types of diabetes are associated with high levels of systemic inflammation markers and increased susceptibility to infection and its systemic consequences. Moreover, diabetic patients may display compromised healing (3).

Diabetes has been regarded as a possible disease modifier in the oral cavity (4, 5). For instance, prevalence, severity, and the progression of marginal periodontitis have been shown to be increased in diabetic subjects (6, 7). Diabetes has also been suggested to influence the development, course, and response to the treatment of apical periodontitis (AP). Studies in rodents have shown that induced AP lesions were larger in size in type 1 diabetic animals than in nondiabetic controls (8, 9). The rate of flare-ups has been reported to be about twice as high in diabetics than in nondiabetic individuals (10, 11). A poorer treatment outcome of teeth with preoperative AP has been observed for diabetics as compared with nondiabetics (11). Diabetes has been considered as a risk factor for the extraction of root canal-treated teeth (12). Type 2 diabetes mellitus has been found to be significantly associated with the increased prevalence of AP (13). However, a study observed no significant increased prevalence of AP in diabetics as compared with controls (14).

There are not many studies in the literature evaluating the association of diabetes type 2 with the prevalence of AP and root canal treatment. Following a research line of disease modifiers in endodontics and based on suggestive evidence of diabetes acting as one of these factors, this cross-sectional study was performed to evaluate the prevalence

From the *Department of Endodontics, Faculty of Dentistry, Estácio de Sá University, Rio de Janeiro, Rio de Janeiro; and [†]Department of Preventive Dentistry, Federal University of Rio Grande do Norte, Natal, Rio Grande do Norte, Brazil.

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Address requests for reprints to Dr José F. Siqueira, Jr, Faculty of Dentistry, Estácio de Sá University, Av Alfredo Baltazar da Silveira, 580/Cobertura, Rio de Janeiro, RJ, Brazil 22790-710. E-mail address: jf_siqueira@yahoo.com
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of AP and endodontic treatment in type 2 diabetic individuals as compared with nondiabetics from an adult Brazilian population.

Materials and Methods

Individuals seeking routine dental care and attending the School of Dentistry of the Estácio de Sá University for the first time were selected to take part in this study. The study group was composed of 30 type 2 diabetic individuals (18 women and 12 men), with ages ranging from 40 to 69 years (mean, 58.2 ± 8.2 years). Controls were age and sex matched with diabetics so that there were 2 nondiabetic individuals for each diabetic patient. Ages for the 60 control individuals ranged from 41 to 70 years (mean, 58.3 ± 8.0 years). The protocol for this study was approved by the Ethics Committee of the Estácio de Sá University.

Full-mouth periapical and panoramic radiographs from these individuals were digitized and independently analyzed on a computer screen by 2 experienced endodontists. The kappa coefficient was used at the end of the evaluation to analyze agreement between the 2 evaluators as for the presence/absence of AP ($\kappa = 0.84$). Discrepant cases were resolved by joint discussion.

The periradicular status was evaluated according to Strindberg's criteria (15). A periradicular healthy condition was judged when the contour and width of the periodontal ligament space were normal or the periodontal ligament contour was widened mainly around excess filling. The appearance of the surrounding bone was normal. Diseased teeth presented any discernible apical radiolucency (15, 16). The root with the worst condition was taken to represent the status of multirooted teeth.

Radiographs were also examined for the number of teeth present and the prevalence of root canal treatment. As for the latter, root canal-treated teeth were categorized according to the radiographic qualities of the root canal filling following criteria described previously (17, 18). Root canal treatment was ranked as adequate when all canals were obturated with no voids in the filling mass and the apical terminus of the filling was 0 to 2 mm short of the radiographic apex. In multirooted teeth with similar periradicular status for all roots, the root with the worst treatment quality was used. Coronal restoration was ranked as adequate when it was a permanent restoration that appeared radiographically intact with no detectable signs of overhangs, open margins, or recurrent caries.

Data were statistically analyzed to evaluate the significance in the differences between type 2 diabetic individuals and controls using the Wilcoxon signed rank and McNemar tests when the individual was the unit of analysis, whereas the chi-square test with Yates correction was used when tooth was the unit of analysis.

Results

Number of Teeth and Prevalence of Root Canal Treatment

The average number of teeth per individual in the diabetic group was 21.7, whereas in the control group it was 22.8 (Table 1). This difference was not statistically significant ($P > .05$). Of the diabetics, 77% displayed 1 or more teeth with root canal treatment, with an

TABLE 1. The Mean Number of Teeth in Diabetic and Nondiabetic Individuals (mean number ± standard deviation)

	Type 2 diabetics	Nondiabetics
Overall	21.7 (±6.2)	22.8 (±5.7)
Teeth with RCT	2.8 (±3.4)	3.4 (±3.0)
Teeth with no RCT	18.9 (±6.9)	19.4 (±6.5)

RCT, root canal treatment.

average of 2.8 root canal-treated teeth per patient. Of the nondiabetic subjects, 87% presented endodontic treatment in at least 1 tooth, with an average of 3.4 treated teeth per individual. No significant differences were observed either for the number of subjects with at least 1 treated canal or for the number of root canal-treated teeth per individual ($P > .05$).

Percentage of Individuals with AP and Number of Teeth with AP per Individual

Overall, 80% of the diabetic individuals exhibited 1 or more AP lesions, with an average of 3.3 diseased teeth per patient. In the control group, AP occurred in 87% of the individuals, with an average of 2.7 lesions per subject. No significant differences were found either for the percentage of individuals with at least 1 diseased tooth or for the number of teeth with AP per subject ($P > .05$).

Percentage of Individuals with Post-treatment AP and Number of Teeth with Post-treatment AP per Individual

In the diabetes group, 53% of the individuals presented at least 1 root canal-treated tooth associated with post-treatment AP, with an average of 1.3 per patient. In the control group, 55% of the individuals exhibited at least 1 root canal-treated tooth with post-treatment disease, with a similar average of 1.3 per subject. The results were not significantly different either for the percentage of individuals or for the number of root canal-treated teeth with disease per subject ($P > .05$).

Prevalence of AP

The overall prevalence of AP was evaluated using the whole number of teeth investigated (Table 2). This analysis showed that 98 of 652 (15%) of the teeth from diabetic individuals displayed AP lesions, whereas the correspondent values in nondiabetic individuals were 162 of 1,368 (12%). This difference was statistically significant, with a P value at the level of significance ($P = .05$). When analyzing separately the prevalence of AP either in untreated or in treated teeth, it became clear that the significant difference was mostly because of the prevalence of AP in untreated teeth, which was 10% in diabetics and 7% in nondiabetics ($P = .03$). Of the root canal-treated teeth from

TABLE 2. Prevalence of AP Lesions in Diabetic and Nondiabetic Individuals

	Type 2 diabetics (%)	Nondiabetics (%)	<i>P</i> value
Total number of teeth	652	1,368	
With AP	98 (15)	162 (12)	.05
No AP	554 (85)	1,206 (88)	
Number of teeth with RCT	85	206	
With AP	39 (46)	78 (38)	.25
No AP	46 (54)	128 (62)	
Number of teeth with no RCT	567	1,162	
With AP	59 (10)	84 (7)	.03
No AP	508 (90)	1,078 (93)	
Number of teeth with adequate root canal treatment	35	62	
With AP	13 (37)	14 (23)	.2
No AP	22 (63)	48 (77)	
Number of teeth with both adequate RCT and adequate CR	17	40	
With AP	6 (35)	11 (27.5)	.59
No AP	11 (65%)	29 (72.5%)	

CR, coronal restoration; RCT, root canal treatment.

diabetic individuals, 46% were associated with AP, whereas 38% from nondiabetics evinced disease. However, this difference was nonsignificant ($P > .05$). The number of teeth with adequate endodontic treatment in the diabetes group corresponded to 41% of the treated teeth, 37% of which displayed AP lesions. In the control group, teeth with adequate endodontic treatment corresponded to 30% of the treated teeth, 23% of which had AP. This difference was not significant either ($P > .05$). As for teeth with both adequate endodontic treatment and adequate coronal restoration, 35% of those from diabetics and 27.5% from nondiabetics were associated with AP, a difference that was not significant either ($P > .05$).

Discussion

Because there are so far few studies in the literature reporting on diabetes as a disease modifier in endodontics, this cross-sectional study was conducted to investigate the prevalence of AP and endodontic treatment in type 2 diabetic individuals. A cross-sectional design was used because of the advantage of allowing the inclusion of a large number of individuals. Even so, the number of diabetic individuals gathered was not so large but was comparable with previous studies on this same issue (13, 14, 19). Matching individuals by sex and age was performed with the purpose of reducing the interference of these variables and possible risk factors additional to the study. However, one of the limitations of cross-sectional studies is the fact that the mean time since completion of endodontic treatment is unknown. In an attempt to circumvent possible biases, all the individuals participating in the study were attending for the first time in the dental school and basically pertained to the same socioeconomic status (relatively low incomes).

The overall prevalence of AP was significantly higher in teeth from type 2 diabetics when compared with nondiabetics. When teeth were analyzed separately according to the presence/absence of root canal treatment, it was evident that the higher prevalence of AP was mostly associated with untreated teeth. Therefore, our findings showed that AP is more frequent in untreated teeth from diabetics as compared with nondiabetics. This is in agreement with a previous report showing a higher prevalence of AP in teeth from diabetics (13).

Even though the prevalence of AP was higher in teeth from diabetics, no significant differences were found when the analysis involved either the number of patients with at least 1 AP lesion or the mean number of lesions per individual. This is in contrast to 2 previous Spanish studies (13, 19), which also found significant differences for these 2 analyses. Nevertheless, one should have in mind that both analyses have limitations. In the former (individuals with at least 1 diseased tooth), the total number of teeth with disease per individual is not taken into account. In the latter (the number of lesions per individual), the total number of teeth per individual is not considered. In addition to incorporating all these factors, the prevalence analysis also used a much larger sample size (number of teeth) that permitted even an observed difference of only 3% between the groups to be statistically significant.

The prevalence of AP in root canal–treated teeth may be suggestive of the success rate of the treatment although data should be viewed with care because of the cross-sectional nature of the study. In this study, even though treated teeth from controls had a higher percentage of cases with no lesion (62% “success”) when compared with diabetics (54% “success”), this difference was not significant. A lack of significance was also observed for differences observed when only adequately treated canals were evaluated (77% “success” in controls vs 63% “success” in diabetics). Similarly, no significant differences were found for the 2 groups when comparing either the number of individuals with

1 or more treated teeth with post-treatment AP or the number of treated teeth with disease per subject. These findings corroborate those from the Spanish studies (13, 19) but are in disagreement with a previous study that included both types 1 and 2 diabetic patients and found a significant correlation between type 2 diabetic patients and the presence of post-treatment AP (14). Also, Fouad and Burleson (11), in a retrospective study, concluded that patients with diabetes displayed a reduced success rate in endodontic treatments of teeth with preoperative AP. Methodological differences among the studies may have accounted for these differences. Based on our findings, it appears that diabetes may not influence the response to treatment. Because of inconsistency among findings in the literature, studies with well-controlled variables using matched pairs of patients/controls and especially using a larger sample size are necessary to help illuminate this issue.

The prevalence of root canal treatment in this type of study usually serves as a surrogate for pulpal disease. The present findings are in consonance with Segura-Egea et al (13), who found no significant differences between the percentages of diabetic and nondiabetic individuals with at least 1 treated canal as well as between the number of endodontically treated teeth per subject. Another previous study also showed no significant difference between the presence of root canal–treated teeth and diabetes (14). It is worth pointing out that this factor involves other variables, such as the accessibility of patients to dental care. As reported earlier, we tried to avoid this bias by including only individuals belonging to a similar socioeconomic status and attending the dental school for the first time.

Other variables may have influenced the results, such as the time of diabetes, which is a variable not controlled in this and in most of the previous studies. The time of diabetes has been shown to be associated with changes in the presentation of AP in humans. Falk et al (20) included in their study long- and short-duration insulin-dependent diabetics and reported no significant association with the mean number of endodontically treated teeth and AP lesions. However, women with long-duration diabetes had more root canal–treated teeth with AP than women with short-duration diabetes and nondiabetic women. In individuals with a prolonged state of hyperglycemia, proteins (including collagen) become irreversibly glycosylated to form advanced glycation end-products (AGE) (1). An altered host response to infection occurs in diabetic individuals and may be related to the accumulation of AGEs and interaction with their receptors in tissues. The accumulation of AGEs can lead to an exacerbated inflammatory response, with consequently higher bone resorptive and reduced bone formation activities (3, 21).

Some authors claimed that diabetic individuals may have more tooth loss in comparison to nondiabetics as a consequence of increased incidence and seriousness of caries and aggressive forms of periodontal disease (10, 13, 19, 22). However, the present study did not find a significant difference regarding the mean number of teeth per subject between groups, which is in consonance with Falk et al (20).

In conclusion, AP was significantly more prevalent in teeth from type 2 diabetic individuals. This higher prevalence was observed specifically for untreated teeth. These findings suggest that diabetes can serve as a disease modifier of apical periodontitis in the sense that individuals with diabetes may be more prone to develop primary AP. However, our findings do not confirm that diabetes may influence the response to root canal treatment because treated teeth from diabetics had no significantly increased prevalence of disease when compared with controls. Because of the inconsistencies in data available from the literature and considering the limitations of cross-sectional studies, further studies, especially using a prospective design, are required to elucidate some issues and confirm others.

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The authors deny any conflicts of interest related to this study.

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