Periapical and Endodontic Status of Type 2 Diabetic Patients in Catalonia, Spain: A Cross-sectional Study

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Abstract

Introduction: The aim of this study was to investigate radiographically the prevalence of apical periodontitis (AP) and endodontic treatment in a sample of adult type II diabetic patients and control subjects. Methods: In a cross-sectional section, the radiographic records of 50 adult patients reporting a history of well-controlled type 2 diabetes mellitus (DM) (study group) and 50 age- and sex-matched subjects who reported no history of DM (control group) were examined. Periapical status of all teeth was assessed using the periapical index score. Results: The average number of teeth per patient in the diabetic and control groups was 21.9 and 24.6 teeth, respectively (P = .012). AP in one or more teeth was found in 37 diabetic patients (74%) and in 21 control subjects (42%) (odds ratio = 3.9, P = .002). One or more root-filled teeth were found in 35 (70%) and 25 (50%) of diabetic and control subjects, respectively (odds ratio = 2.3, P = .043). Among diabetic patients with root-filled teeth, 16 (46%) had AP affecting at least one treated tooth. Among controls with root-filled teeth, 6 (24%) had AP affecting at least one treated tooth (P > .05). Adjusting for teeth number, multivariate logistic regression analysis showed that periapical status (odds ratio = 3.3, P = .0071) and the number of root-filled teeth (odds ratio = 1.7; P = .0035) were significantly associated with diabetes status. Conclusions: The results showed that in adult patients, type 2 DM is significantly associated with an increased prevalence of AP and endodontic treatment. (J Endod 2011;37:598–601)

Key Words

Apical periodontitis, diabetes mellitus, endodontics

Diabetes mellitus (DM) is a group of complex multisystem metabolic disorders caused by a deficiency in insulin secretion caused by pancreatic β-cell dysfunction and/or insulin resistance in liver and muscle. Diabetes affects more than 9% of the adult population and has a dramatic impact on the health care system through high morbidity and mortality among affected individuals (1).

DM alters many functions of the immune system and is associated with delayed healing and compromised immune responses (2). This predisposes to chronic inflammation, progressive tissue breakdown, and diminished tissue repair capacity (3). Evidence has consistently indicated that DM is a risk factor for increased severity of gingivitis and periodontitis (4), and aggressive forms of periodontal disease have been associated with increased serum glucose levels (5).

Chronic apical periodontitis (AP) is the inflammation and destruction of apical periodontium that is of pulpal origin, appears as a periapical radiolucence area, and does not produce clinical symptoms (6). Periapical lesions consecutive to AP result from a periapical inflammatory response provoked by polymicrobial irritants from root canals. Despite numerous differences between chronic inflammatory disease of periodontal and endodontic origins, there are notable similarities (7) including the following: (1) both diseases are chronic infections affecting oral tissues, (2) both conditions share a common microbiota that often is associated with gram-negative anaerobic bacteria (8), and (3) elevated systemic cytokines and inflammatory mediators levels have been observed in conjunction with both disease processes (9). Thus, there is a biologic basis to suppose that DM could be associated with a higher prevalence of periapical lesions or a higher rate of endodontic treatment. Some studies have investigated this hypothesis (10) finding a greater prevalence of periapical lesions in type 1 diabetics (11), and reporting that in cases of poorly controlled DM periapical radiolucencies tend to develop during treatment (12, 13). Ueta et al (14) reported a disproportionately high percentage of clinically severe pulp or periodontal infections in patients with DM, and Bender and Bender (15) found a high rate of asymptomatic tooth infections in diabetics exhibiting poor glycaemia levels of an unclear cause. Fouad and Burleson (16) showed that patients with diabetes have a reduced likelihood of success of endodontic treatment in cases with preoperative periapical lesions. Segura-Egea et al (17) found a higher prevalence of AP in type 2 diabetic patients. However, Britto et al (18) found no significant differences in the prevalence of AP between diabetics and controls but reported that men with type 2 diabetes who had endodontic treatments were more likely to have residual lesions after treatment. The aim of the present study was to investigate radiographically the prevalence of AP and endodontic treatment in a sample of type II diabetic patients and control subjects of Catalonia, Spain.

Materials and Methods

Among the patients looking for routine dental care at the University of Barcelona, Faculty of Dentistry, 50 subjects, 20 men and 30 women, reporting a history of well-controlled type 2 DM (HbA1c = 6.6 ± 0.6) ranging from 44 to 83 years old (60.7 ± 10.3 years) diagnosed according to the criteria of The Expert Committee on the Diagnosis and Classification of Diabetes Mellitus (19) were included in the study group. An additional 50 age- and sex-matched patients, 22 men and 28 women, ranging from 36 to

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Address requests for reprints to Dr Juan José Segura-Egea, Facultad de Odontología, Universidad de Sevilla, 41009-Sevilla, Spain. E-mail address: segurajj@us.es 0099-2399/$ - see front matter Copyright © 2011 American Association of Endodontists. doi:10.1016/j.joen.2011.01.002
79 years (61.6 ± 10.4 years) (P > .05) who reported no history of diabetes and normal glucose tolerance served as control subjects. The total sample consisted of 100 patients, 42 men and 58 women, aged 61.1 ± 10.3 years. The scientific committee of the Faculty of Dentistry approved the study, and all the patients gave written informed consent.

Periapical and endodontic status were diagnosed on the basis of examination of digital panoramic radiographs of the jaws. Two trained radiographic technicians using a digital orthopantomograph machine (Promax, Planmeca, class 1, type B, 80 KHz; Planmeca, Helsinki, Finland) took the panoramic radiographs.

All teeth, excluding third molars, were recorded. Teeth were categorized as root filled teeth if they had been filled with a radiopaque material in the root canal(s). The following information was recorded on a structured form for each subject: (1) the number of teeth present, (2) the number and location of teeth without root fillings (untreated teeth) having identifiable periapical lesions, (3) the number and location of root-filled teeth, and (4) the number and location of root filled teeth having identifiable periapical lesions. The periapical status was assessed using the periapical index (PAI) (20) as described previously (21, 22). Briefly, before evaluation, the observers participated in a calibration course for the PAI system, which consisted of 100 radiographic images of teeth, some root filled and some not. Each tooth was assigned to one of the PAI scores by using visual references for the five categories within the scale (15, 17). After scoring the teeth, the results were compared with a “gold standard atlas,” and a Cohen kappa was calculated (0.74). Reproducibility was evaluated by the repeat scoring of 50 patients 2 months after the first examination. These patients were randomly selected. Before the second evaluation of the radiographs, the observer was recalibrated in the PAI system by scoring the 100 standard images. The intraobserver agreement test on PAI scores on the 50 patients produced a Cohen kappa of 0.76. A score greater than 2 (PAI ≥3) was considered to be a sign of periapical pathology. The worst score of all roots was taken to represent the PAI score for multirooted teeth.

Raw data were entered into Excel (Microsoft Corporation, Redmond, WA). All analyses were performed in an SPSS environment (Version 11; SPSS, Inc, Chicago, IL). The Student t test, chi-square test, and logistic regression analysis were used to determine the significance of differences between groups. Data are reported as the mean ± standard deviation.

Results

The average number of teeth per patient was 21.9 ± 6.4 and 24.6 ± 3.8 teeth in the diabetic and control groups, respectively (P = .012). AP in one or more teeth was found in 37 diabetic patients (74%) and in 21 control subjects (42%) (odds ratio = 3.9; 95% confidence interval [CI], 1.7-9.2; P = .002) (Table 1). The average number of teeth with AP was 0.9 ± 0.9 and 0.7 ± 0.6 teeth in the diabetic and control subjects, respectively (P > .05). One or more root-filled teeth were found in 35 (70%) and 25 (50%) of diabetic and control subjects, respectively (OR = 2.3, 95% CI, 1.0-5.3; P = .043). Among diabetic patients with root-filled teeth, 16 (46%) had AP affecting at least one treated tooth. Among controls with root-filled teeth, six (24%) had AP affecting at least one treated tooth (P > .05, OR = 2.7).

Univariate logistic regressions were run with age, sex (0 = female, 1 = male), teeth number, AP (0 = absent, 1 = present), number of teeth with AP, root-filled teeth (0 = absent, 1 = present), number of root-filled teeth, root-filled teeth with AP (0 = absent, 1 = present), and number of root-filled teeth with AP as explanatory variables one at a time and “diabetic status,” dichotomized (0 = absent, 1 = present), as the dependent variable (Table 2). The analysis suggested that both periapical and endodontic status were significantly associated with diabetic status. Adjusting for teeth number, multivariate logistic regression analysis showed that periapical status (OR = 3.3; 95% CI, 1.4-8.0; P = .0071) and number of root-filled teeth (OR = 1.7; 95% CI, 1.2-2.4; P = .0035) remained significant.

Discussion

This cross-sectional study aimed to investigate the periapical and endodontic status in type 2 diabetic patients compared with the control subjects. The results reveal a significantly higher prevalence of AP and endodontic treatment in type 2 diabetics.

The subjects studied were adults attending for the first time the dental service of the Faculty of Dentistry of Barcelona, Catalonia, Spain. The recruitment of the subjects was the same as those used by others (16, 18, 17). Both the study and the control groups consisted of more women than men; however, epidemiological studies reported that sex had no effect on the presence of AP or the frequency of endodontic treatment (20, 23). There was not a significant difference in age between both groups.

Panoramic radiographs and the PAI score (20) were used to assess the presence of AP. Other epidemiological studies have also used panoramic radiographs and the PAI scoring system to evaluate the periapical status (24–28). Periapical areas of all the teeth, excluding only third molars, were radiographically evaluated. Thus, the results reproduce the periapical status of the subjects. Other authors, in similar studies, have excluded teeth with absent or defective coronal restorations, teeth with their periradicular tissues near radiolucent anatomic structures, or root-filled teeth with inadequate root canal treatment (18). These exclusions necessarily alter the results and do not allow us to know the real periapical status of the subjects.

The average number of teeth was significantly lower in diabetic patients (21.9 ± 6.4 and) than in control subjects (24.6 ± 3.8). This finding is in accordance with numerous reports documenting, quite convincingly, that DM, especially when poorly controlled, is associated with significant tooth loss because of the increased incidence and severity of caries and the aggressive forms of periodontal disease associated with diabetes (17, 29, 30).

In the present study, diabetic patients showed a higher prevalence of AP (OR = 3.9; 95% CI, 1.7-9.2; P = .002) compared with age- and sex-matched control subjects. Adjusting for teeth number, multivariate logistic regression analysis showed that the association between periapical status and diabetic status remained significant (P = .0071). This result is in accordance with previous reports (12,13,11,14,15,16) and with an earlier investigation that found a comparable OR value in another sample of Spanish adults (17). On the contrary, Britto et al (18), in a similar study design, investigated the prevalence of

### Table 1. The Prevalence of Apical Periodontitis (AP), Root-filled Teeth (RFT), and Root-filled Teeth with AP (RFT-AP) in Diabetic (n = 50) and Control (n = 50) Subjects

<table>
<thead>
<tr>
<th></th>
<th>AP (%)</th>
<th>RFT (%)</th>
<th>RFT-AP (%)</th>
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<tbody>
<tr>
<td>Diabetic</td>
<td>37 (74)</td>
<td>35 (70)</td>
<td>16 (46)</td>
</tr>
<tr>
<td>Control</td>
<td>21 (42)</td>
<td>25 (50)</td>
<td>6 (24)</td>
</tr>
<tr>
<td>Total</td>
<td>58 (58)</td>
<td>60 (60)</td>
<td>22 (37)</td>
</tr>
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RFT-AP are out of all RFTs.

*P < .05.
†P < .001.
‡P < .01.
radiographic periradicular radiolucencies in root-filled teeth and untreated teeth in patients with and without diabetes and found no significant differences in the prevalence of AP between diabetics and controls. However, these investigators excluded teeth with absent or defective coronal restorations, teeth with their periradicular tissues near radiolucent anatomic structures, and root-filled teeth with inadequate root canal treatment. Because of this, their results do not reflect the real periapical status of the subjects studied, and the comparison between both groups cannot produce definite conclusions.

The percentages of subjects having at least one root-filled teeth differed significantly in diabetic (70%) and control (50%) groups (OR = 2.3; 95% CI, 1.0–5.3; P = .043). Moreover, adjusting for teeth number, multivariate logistic regression analysis showed that the number of root-filled teeth was significantly higher in diabetic patients (P = .0032). On the contrary, Britto et al (18) found no association between endodontic root canal treatment per se and diabetic status. The reasons for these findings can be the same as described earlier although they can be also be attributed to better overall dental care in the population of the United States compared with the Spanish population. In addition, a previous study conducted in Spain in a sample of Andalusian adults also found no association between endodontic status and DM (21). This study reported lower percentages of root-filled teeth in diabetics (31%) and controls (42%) compared with those found in the present study. The higher prevalence of endodontic treatment in Catalonian patients was compared with a reduction of only 48% for the high-glucose group. Fouad and Burleson (16) investigated endodontic diagnostic and treatment outcome data in patients with and without diabetes. A multivariate analysis showed that patients with diabetes have increased periodontal disease in root-filled teeth and have a reduced likelihood of success of endodontic treatment in cases with preoperative periradicular lesions. Mindiola et al (33) performed an epidemiological study of a regional population of Native Americans identifying factors affecting the retention of root-filled teeth and to determine frequencies of endodontic care. The results suggested that diabetes contributes to decreased retention of root-filled teeth. Doyle et al (34), in a retrospective study, evaluated whether diabetes was associated with the outcome of patients undergoing nonsurgical root canal treatment, finding a borderline significant association (P = .065). Wang et al (35) analyzed the long-term prognosis of teeth receiving nonsurgical root canal treatment (NSRCT) in patients with DM to elucidate the impact of DM on the risk of tooth extraction after NSRCT. Results showed that DM was a significant risk factor for tooth extraction after NSRCT (P < .01, OR = 1.8). A recent prospective epidemiologic study, using a self-reported history of endodontic therapy, concluded that diabetes was more prevalent among patients with coronary heart disease, with 24 or fewer teeth never having had endodontic treatment (36).

There is evidence from the literature associating DM with a higher prevalence of periapical pathosis and endodontic treatment, greater size of the periapical osteolytic lesions, greater likelihood of asymptomatic periapical infections, and delay/arrest of periapical repair and high prevalence (11–18, 32–36). The data reported in the present study, together with the results of studies conducted so far, are not conclusive but show some differences in the natural history of periapical lesions in the diabetic patient suggesting an association between DM and AP. Prospective epidemiological studies are needed to deepen the relationship between inflammatory disease of endodontic origin and diabetes mellitus.

**Acknowledgments**

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

**References**