Development of Periapical Lesions in Endodontically Treated Teeth with and without Periodontal Involvement: A Retrospective Cohort Study

Xavier-Fructuós Ruiz, DDS, Fernando Duran-Sindreu, DDS, PhD,* Hagay Shemesh, DMD, PhD,† Marc García Font, DDS, PhD,* Marta Vallés, DDS, PhD,* Miguel Roig Cayón, DDS, PhD,* and Juan Gonzalo Olivieri, DDS, PhD**

Abstract

Introduction: The purpose of this study was to investigate the incidence of apical periodontitis (AP) in endodontically treated teeth with and without periodontal involvement. **Methods:** The records of 602 patients with 775 root canal–treated teeth were initially examined. Only teeth with adequate root canal filling, adequate coronal restoration, and no AP (periapical index = 1) were selected for further investigation. A total of 194 teeth were included in this cohort study. Age, sex, history of diabetes mellitus, smoking, hypertension, and immunodeficiency disorders were recorded. Two groups were made according to the periodontal status of the patients. The control group included periodontally healthy patients and the periodontal group patients with periodontal disease receiving nonsurgical periodontal treatment. After an observation period of at least 2 years, the incidence of AP was scored using the periapical index. The relationship between patients' variables and AP was conducted using the Cohen kappa test, the chi-square test, odds ratio (OR), and logistic regression analysis. **Results:** Newly emerged AP was found in 14% of periodontally involved teeth and in 3% of nonperiodontal involved teeth ($P < .05$, OR = 5.19, 95% confidence interval). The periodontal condition and hypertension were the only significant factors associated with the presence of AP in the follow-up after univariate logistic regression. Adjusting for hypertension, multivariate logistic regressions showed that periodontal status remained significant (OR = 5.25, 95% CI, $P < .05$). **Conclusions:** The risk of developing AP in endodontically treated teeth is 5.19 times higher for patients with periodontal disease compared with patients without periodontal disease. *(J Endod 2017;■:1–4)*

Key Words

Periodical periodontitis, prevalence, radiographic evaluation, risk factors, root canal obturation, root canal treatment

Significance

Periodontal disease even with adequate periodontal treatment is associated with an increase in the development of apical periodontitis in endodontically treated teeth. Periodontal patients are 5 times more likely to develop apical periodontitis compared with periodontally sane subjects.

Apical periodontitis (AP) is defined as an inflammatory process mainly based on infection by intraradicular microorganisms (1). Several cross-sectional studies have shown the prevalence of AP and its associated predicting factors. It has been reported that AP is a prevalent condition (2). AP prevalence rates in Spanish populations comprise 34%–61% of individuals, 2%–9% of teeth, and 30%–65% of root-filled teeth (3, 4).

Systemic diseases (5), general oral health (6), low socioeconomic status (7), inadequate root fillings, inadequate coronal restoration (8), and presence of carious lesions (9) were shown as possible risk factors related to the presence of AP.

The main problem of cross-sectional studies is the impossibility to distinguish between factors that influence the development of AP and factors related to the healing process because timing information is not recorded. Longitudinal studies can address these limitations by assessing information of the same subjects over a period of time.

Some studies have evaluated the effect of endodontic infection on periodontal status (10, 11). They showed that root canal–treated teeth with AP showed a worse periodontal condition than those cases without AP. Conversely, the evidence of the effect of periodontal disease as a risk factor for the development of AP is scarce (12).

When periodontal disease is treated, cementum surrounding the root could be damaged or lost during scaling and root planing (13). Therefore, dentin tubules could become exposed to the surface. A tooth with an adequate root canal filling and coronal restoration that does not show an apical lesion on the radiograph could develop a lesion in patients with a periodontal disease through penetration of bacteria through the exposed dentinal tubules on the external root surface (12).

From the *Department of Restorative Dentistry and Endodontics, Universitat Internacional de Catalunya, Barcelona, Spain; and †Department of Endodontology, Academic Centre for Dentistry Amsterdam, Amsterdam, The Netherlands.

Address requests for reprints to Dr Juan Gonzalo Olivieri, Dentistry Faculty, Universitat Internacional de Catalunya, C/Josep Trueta s/n 08195, Sant Cugat del Vallès, Spain. E-mail address: jgolivieri@uic.es

0099-2399/$ - see front matter

http://dx.doi.org/10.1016/j.joen.2017.03.037

The purpose of this study was to evaluate the development of AP in endodontically treated teeth of patients undergoing nonsurgical periodontal treatment and in the maintenance phase at the time of the recall/control compared with patients without periodontal disease. The null hypothesis was that there are no significant differences in the development of AP in endodontically treated teeth in periodontally healthy patients compared with patients with periodontal disease.

Materials and Methods

The Institutional Ethics in Research Committee (Universitat Internacional de Catalunya, Barcelona, Spain) approved the study design with the code END-ECL-2015-02. This *in vivo* investigation was conducted as a passive retrospective cohort study on a consecutive referral Spanish population.

Sample Size Calculation

Statistical calculation of the sample size between 2 variables, the presence/absence of periodontal disease and periapical index (PAI) scores ($\leq$2 or >2), was performed. Assuming an alpha risk of 0.05, a beta risk of 0.05, and a power of 95%, the sample size needed to obtain statistical differences per group resulted in 82.

Patient Population Selection

Patients were selected from a consecutive referral list at the University Clinic (Clínica Universitaria de Odontología, Universitat Internacional de Catalunya, Sant Cugat del Vallés, España) from January 2009 to December 2011 (first evaluation). The database consisted of 602 patients (775 root canal–treated teeth). Of these 775 teeth, only those meeting the inclusion criteria were included in the study.

The inclusion criteria were as follows:

1. Teeth free of periapical disease, classified as PAI score 1, by a calibrated endodontist neither involved in the study nor in the clinical treatment of the patient. The periapical status of endodontically treated teeth was determined according to the PAI score proposed by Ørstavik et al (14).
2. Teeth with an adequate root canal treatment defined as all root canals sealed with no voids radiographically visible ending 0–2 mm short of the radiographic apex (15).
3. Teeth with an acceptable coronal restoration evaluated according to the radiologic coronal score. Only teeth with intact restoration without signs of leakage were selected (15).
4. Patients older than 18 years.
5. Teeth exhibiting in the x-ray more than 4 mm radiopaque bone between the crestal bone and the radiographic apex.
6. Patients not undergoing periodontal surgical treatment.
7. Only 1 tooth per patient was included.

Of the initially evaluated 775 root canal–treated teeth, 205 met the inclusion criteria. Five hundred seventy teeth were excluded for the following reasons: 291 teeth had PAI $\geq$2 during the first evaluation, 397 teeth had inadequate root filling, 286 had inadequate coronal restoration, 5 teeth underwent periodontal surgical treatment, 3 teeth were from patients younger than 18 years, 2 teeth presented concurrent endodontic and periodontal diseases with communication, and 16 teeth were from patients from whom another tooth was already included in the study.

Two groups of patients were formed according to the periodontal status, which was evaluated according to the periodontal bone loss (PBL) classification (16). Two calibrated periodontists who were neither involved in the study nor in the clinical treatment of the patients scored the PBL in bitewings and periapical radiographs on the first evaluation. Each radiograph was evaluated twice for each evaluator in sessions separated by 1 month in order to measure the intraexaminer agreement.

The PBL classification includes the following 4 categories:

1. Normal: the normal situation of the alveolar crest is assumed to be 2 mm under the cementoenamel junction
2. Mild: <25% bone loss
3. Moderate: 25%–50% bone loss
4. Severe: >50% bone loss

Group 1 was composed of teeth in patients without periodontal disease (normal PBL). Group 2 was composed of teeth in patients with periodontal disease (mild, moderate, and severe PBL) who received nonsurgical periodontal treatment.

A minimum of a 2-year observation period was chosen for the teeth included in this study. In group 1, 11 teeth were lost to follow-up because of a shorter than 2 year-observation period. In group 2, no losses to follow-up were reported.

The following dependent variables were recorded: age, sex (0 = female, 1 = male), smoking habits (0 = absent, 1 = present), diabetes mellitus (0 = absent, 1 = present), hypertension (0 = absent, 1 = present), and immunodeficiency disorders (0 = absent, 1 = present).

Follow-up Radiographic Evaluation

Two calibrated endodontists who were neither involved in the study nor in the clinical treatment evaluated periapical radiographs in the follow-up under the same conditions as in the first evaluation. Each radiograph was evaluated twice for each evaluator in sessions separated by 1 month in order to measure the intraexaminer agreement. Before the investigation was performed, 50 periapical radiographs not included in this study were screened for calibration. Classification of AP was performed as a dichotomic evaluation/variable according to PAI $\leq$2 (absence of AP)/>2 (presence of AP) at the follow-up examination. In cases in which no agreement was reached, a third endodontist was consulted to reach a consensus score.

Statistical Analysis

Values of central tendency and dispersion of the dependent variables were calculated using Statgraphics Centurion XV software (Statpoint Technologies, Inc, Warrenton, VA). Inter- and intraexaminer reliability was verified using the kappa test. The chi-square test and logistic regression analysis were performed to evaluate differences among groups at a significance level of $P < .05$.

Results

For evaluation of periodontal status, the kappa values were 0.9 and 0.85 for intraexaminer and interexaminer, respectively. For PAI score evaluation, the kappa values were 0.81 and 0.77 for intraexaminer and interexaminer, respectively. These findings indicate good to very good agreement (17). Periapical status at the second evaluation was performed in group 1 (mean age = 32.2 $\pm$ 8.7 years) and group 2 (mean age = 57.4 years $\pm$ 13.1 years) (Table 1). The mean follow-up of cases since the first evaluation was 33.3 $\pm$ 6.4 months for group 1 and 37.5 $\pm$ 10.7 months for group 2.

AP (PAI >1) was found in 3 teeth (3%) of nonperiodontal samples and in 13 teeth (14%) of periodontal samples ($P \leq .05$, odds ratio = 5.19, 95% confidence interval). The analysis suggests that the only variables that were significantly related to the development of AP were hypertension and periodontal status (Table 2). Age, sex, smoking habits, diabetes mellitus, and immunodeficiency disorders were not