Prevalence of Apical Bone Defects and Evaluation of Associated Factors Detected with Cone-beam Computed Tomographic Images

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Abstract

Introduction: Cone-beam computed tomographic (CBCT) imaging has been shown to be accurate for detecting apical bone defects (ABDs). Medium field of view CBCT imaging may provide apical images of the whole oral cavity at a resolution that is sufficient to allow ABDs to be located and measured. The aim of the work presented was to calculate the prevalence of ABDs from CBCT images as well as to assess some associated factors and their measurement. **Methods:** One hundred CBCT data sets with a voxel size of 0.2 mm were analyzed by 2 evaluators according to a standardized reading protocol. The number of maxillary and mandibular teeth, the presence of endodontic treatment, and the presence of ABDs associated with endodontic treatment were identified, and the presence of intraradicular posts was documented. The size of ABDs detected was measured, and they were classified according to the Cone Beam Computed Tomography Periapical Index. **Results:** A total of 2368 teeth and 100 subjects were analyzed. The prevalence of ABDs in subjects was 78%; in 8.6% of the sample teeth, ABDs were present, and 38.2% of endodontically treated maxillary molars were affected by it. Endodontic treatment was significantly associated with an increased risk for the presence of an ABD (P = .0001); 40.8% of endodontically treated teeth were associated with an ABD. This rate increased to 85.9% in endodontically treated maxillary molars. Placement of a post was significantly associated with the presence of an ABD (P = .003). The most frequent lesions were those with diameters between 2 and 4 mm (39.2%). **Conclusions:** There are only few studies on the prevalence of ABDs using CBCT analysis. This study in a French population shows a high prevalence of ABDs, especially on endodontically treated molars. The most effective way to exhaustively detect such defects is with CBCT imaging. Moreover, CBCT images show details of the extent of bone loss, thus providing information valuable for the therapeutic decision and details that could help with the prognosis. *(J Endod 2015;41:1043–1047)*

Key Words

Apical bone defect, cone-beam computed tomographic imaging, Cone Beam Computed Tomography Periapical Index, endodontic treatment

Several relationships between general health and periapical infectious pathosis have been shown. First, bacteria found in the presence of apical periodontitis (AP) constitute a risk for people whose health is fragile, such as subjects who have received transplants or are immunocompromised (1). Moreover, AP may interact with overall health. Marotta et al (2) and Segura-Egea et al (3) showed that type 2 diabetes is significantly associated with an increased prevalence of AP in untreated teeth; moreover, in a review, it has been suggested that AP contributes to poorly controlled diabetic metabolic conditions (4). Also, irradiated (5) and osteopenic or osteoporotic (6) bone tissue is associated with a higher frequency of AP. Finally, like tobacco, age, and excess weight, AP is considered a risk factor for cardiovascular diseases by some (7).

In asymptomatic AP, an apical bone defect (ABD) caused by the interplay of bacterial activity and the human immunologic response can clinically only be observed by radiologic examination. Cone-beam computed tomographic (CBCT) imaging has been shown to be more accurate for bone detection than intraoral or panoramic radiographs (8, 9). Also, in endodontics, CBCT imaging has been positively assessed for detecting the number of root canals and the mesiodistal and coronoapical dimensions (10). Approved by endodontic societies, CBCT imaging facilitates diagnosis, influences treatment, and enhances the management of endodontic pathologies (11, 12).

For complete radiographic assessment of the maxillary and mandibular area and dental structures, a large or a medium field of view is needed. Many epidemiologic data sets have been collected from panoramic or periapical status radiographs, but the role of CBCT imaging in epidemiologic cross-sectional analysis is still poorly explored (13).

Therefore, the aim of this retrospective study was to determine the prevalence of ABDs and to assess their volume and associated factors in a French population using CBCT imaging.

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Materials and Methods

Subjects and Radiographic Techniques

Existing CBCT imaging records used in this study were chosen from the database of a private radiologic practice. All of them were initially read by the radiologist before dental treatment. To respect ethics and local radiation protection guidelines, no patient underwent CBCT imaging specifically for the study.

All CBCT scans were taken between January 2012 and June 2013 using a Kodak 9500 3D system (Carestream Health, Marne-la-Vallée, France) at 10 mA and 90 kV, a medium field of view of 9 × 15 cm, and a 0.2-mm voxel size.

One hundred six anonymous existing CBCT scans were selected at random. They had been acquired for implant planning, orthodontics, assessment of marginal bone levels, or endodontic diagnosis; no scan was specifically prescribed for the present study.

Exclusion criteria were subjects younger than 18 years of age or edentulous subjects; CBCT scans were excluded in which root apices and cortical bone were not completely visualized. Third molars and root tips were also excluded from the analysis.

Radiographic Observations

One hundred Digital Imaging for Communication in Medicine data sets constituted the final sample. Raw data from scans were captured by 2 observers (F.L. and M.G.G.) using CS 3D Imaging Software (update 3.3.9, Carestream Health). The CBCT scans were viewed with no change of settings on a 22-inch monitor with a resolution of 1920 × 1080 pixels (Fig. 1). Two weeks later, observer 1 performed a second evaluation to determine reliability (see later).

Examiners used the same protocol for all multiplanar views (axial, sagittal, and coronal). The following information was tabulated for each patient: sex, age, total number of teeth, number of teeth with evidence of root canal treatment (RCT), and apical bone destruction. For each tooth, posts and the CBCT periapical index (CBCTPAI) using reference material from Estrela et al (14) were tabulated. The CBCTPAI was determined by the largest lesion extension (Fig. 2). A 6-point (0–5) scoring system was used with 2 additional variables; along with these numbers, the presence of sinus membrane thickening was tabulated for maxillary premolars and molars. For multirooted teeth, the worst CBCTPAI noted was used to describe its conditions when there were multiple lesions.

Statistical Analysis

Inter- and intraexaminer agreement was determined on Stata9 software (StataCorp, College Station, TX) using the Cohen kappa test after a trial period during which both examiners read a subset of 20 CBCT scans. The relationship between periapical bone destruction and the presence or absence of RCT was first analyzed using the chi-square test. The association of the presence of ABDs in 1 or more root canal–treated teeth with patient- (age and sex) and tooth-related factors (number of teeth, presence and number of posts, and number of RCTs per jaw) was assessed with a logistic regression analysis.

The same test was used to analyze the association of the presence of ABDs in non–root canal–treated teeth with patient-related (age and sex) and tooth-related factors (number of teeth per arch). The relationship of the number of ABDs in endodontically treated teeth and patient- and tooth-related factors was then assessed with a linear regression analysis. For this purpose, both logistic and linear regressions were calculated using a stepwise method with a probability of 0.05 for entry and 0.10 for removal of the independent variables.

Results

For the presence of ABDs, the kappa value for the interexaminer agreement tested for examiner 1 was 0.87, and the interexaminer agreement after training was 0.75, which can be considered good to very good agreement.

Descriptive Data

One hundred CBCT scans were included from 53 female and 47 male subjects with an average age of 47.1 years (standard deviation = 15.82 years). A total of 2368 teeth were analyzed (1244 teeth for female subjects and 1124 teeth for male subjects). Table 1 summarizes the age and sex distribution of the sample.

Of the 2368 teeth included in the sample, 431 (254 maxillary and 177 mandibular teeth) (Fig. 3) had received endodontic treatment (18.2%), and 188 of those (115 maxillary and 73 mandibular) had received posts (7.9%).

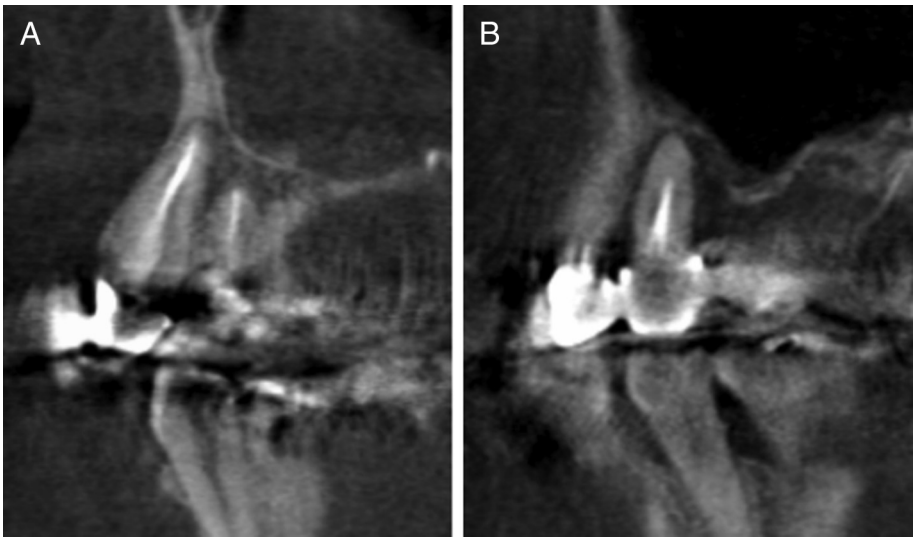

Figure 1. (*A*) Lesion type 1 in CBCTPAI (between 0.5 and 1 mm) at the apex of the upper left maxillary cuspid. (*B*) Sagittal CBCT picture of an endoperiodontal lesion on the upper left second premolar.