

Influence of Endodontic Treatment and Coronal Restoration on Status of Periapical Tissues: A Cone-beam Computed Tomographic Study

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Abstract

Introduction: This cross-sectional study determined the prevalence of apical radiolucency in 1290 root canal-treated teeth and the correlation between endodontic treatment quality and the presence of coronal restorations with apical radiolucency using cone-beam computed tomographic imaging. **Methods:** Cone-beam computed tomographic scans were analyzed, and teeth were classified as healthy or diseased according to the periapical status. Other factors were also evaluated for their association with the apical diagnosis including sex, quality of endodontic treatment, presence of coronal restorations and posts, and apical level of filling. **Results:** Of the treated teeth, 48.83% were classified as healthy. Only 55.11% of the teeth had endodontic treatment rated as adequate. The quality of endodontic treatment and the presence of coronal restoration were statistically correlated with the presence or absence of an apical radiolucency ($P < .0001$). Combined data revealed that teeth with both adequate endodontic treatment and the presence of coronal restoration showed significantly better apical status than the other combinations ($P < .001$). Canals filled up to 0–2 mm short of the apex had a significantly higher number of teeth rated as healthy compared with overfilled or underfilled cases ($P = .001$). The presence of a post was not found to be a statistical significant factor ($P = .81$). **Conclusions:** Data showed a relatively high prevalence of apical radiolucencies in root canal-treated teeth. The quality of the endodontic treatment, the presence of coronal restoration, and apical extent of the root canal filling were significantly associated with healthy apical tissues. (*J Endod* 2015;41:1614–1618)

Key Words

Apical radiolucency, cone-beam computed tomography, coronal restoration, cross-sectional studies, root canal therapy

Cross-sectional studies performed in several countries revealed the prevalence of apical radiolucency in root endodontically treated teeth to be relatively high, ranging from 35%–60% (1–12). Ray and Trope (13) examined the radiographs of 1010 endodontically treated teeth and observed the presence of periapical pathology in 39.97% of the cases, showing a strong correlation among the technical quality of endodontic treatment and coronal restoration and apical radiolucency. These statistics are in contrast to the outcome of endodontic treatment obtained in follow-up clinical studies (ie, 90%–95%) (14–16).

Most cross-sectional studies evaluating the apical status of endodontically treated teeth have been performed using 2-dimensional (2D) periapical radiographs (2–9) or panoramic radiographs (10–12). However, current literature has shown the limited diagnostic value of 2D periapical radiographs, especially for determination of the quality of treatment as well as its limitation in the detection of apical radiolucency (17). Cone-beam computed tomographic (CBCT) imaging has the potential to circumvent most of the limitations of 2D radiographs, and its high sensitivity for the detection of bone changes has comparatively disclosed a higher prevalence of apical radiolucency than radiographs (18, 19). A recent clinical study showed a 14 times increase in the periapical radiolucency rate when teeth were assessed with CBCT imaging when compared with periapical radiographs (20).

To the best of our knowledge, there are no studies evaluating the correlation between qualities of endodontic treatment with apical radiolucency using CBCT scanning. The aim of the present study was to assess the prevalence of apical radiolucency in endodontically treated teeth and its correlation to several clinical variables.

Materials and Methods

Study Population

The sample for this cross-sectional prospective study consisted of 434 adult patients who were referred to the oral and maxillofacial radiology department in 2008 requiring 3-dimensional CBCT scanning as part of their dental examination, diagnosis, and treat-

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<http://dx.doi.org/10.1016/j.joen.2015.07.008>

ment planning. The local ethics committee approved this study. All root canal–treated teeth from these patients were included in the study.

The CBCT images were taken using the i-CAT system (Imaging Sciences International, Hatfield, PA) operated at 120 kVp and 7 mA, with an exposure time of 26.9 seconds and a voxel size of 200 μm . All scans were taken following the manufacturer's recommended protocol. According to the examination requirements, a field of view of 80 \times 80 mm was used. All CBCT exposures were performed with the minimum exposure necessary for adequate image quality by an experienced licensed radiologist. The ALARA (as low as reasonably achievable) protocol was strictly followed, exposing patients to the least amount of radiation while still gaining the most useful information for proper diagnosis.

Evaluation Criteria and Radiographic Analysis

From the 434 scanned patients, 1290 teeth were included in this study. The quality of the root canal filling and the presence of coronal restorations were evaluated using i-CAT software (3.1.62; i-CAT Xoran Technologies Inc, Ann Arbor, MI) using a Dell Precision T5400 workstation (Dell, Round Rock, TX) with a 32-inch Dell LCD screen with a resolution of 1280 \times 1024 pixels. The contrast and brightness of the images were adjusted using the image processing tool in the software to ensure optimal visualization.

Before the evaluation and scoring, an oral radiologist and an endodontist were trained and calibrated based on the criteria and variants established. The calibration included reviewing a random set of 100 endodontically treated teeth. A PowerPoint (Microsoft, Redmond, WA) presentation was created. Slides were presented in random order

so that consecutive slides never showed imaging from the same case unless this occurred by chance. Radiographic evaluation was conducted in a dark room. For each slide in the presentation, the reviewers were asked to identify the presence or absence of an apical radiolucency associated with the apical portion of the root 0.5 mm or greater or approximately twice the width of the periodontal ligament space on 1 or more root(s). Interevaluator agreement during the calibration session resulted in a high kappa score (0.87).

Reviewers evaluated all images simultaneously to reach a consensus for the interpretation of the radiographic findings. All teeth were analyzed using all spatial planes (sagittal, axial, and coronal) (2).

Endodontic treatment was considered adequate when all root canals were filled properly, without voids and root canal fillings ending within 0–2 mm short of the radiographic apex. The treatment was considered inappropriate when the root canal fillings ended more than 2 mm short of the radiographic apex or were overfilled. Root canals with voids, inadequate density, unfilled canals, and/or poor condensation were also considered inadequate. In multirrooted teeth, the scoring was based on the root with the worst treatment quality.

The extent of apical filling was assessed and classified into 3 groups according to the apical extension of the filling: 0–2 mm short, >2 mm short, and beyond the radiographic apex.

Coronal restoration was classified as present or absent. The presence or absence of posts was also recorded.

An apical radiolucency was defined as a radiolucency associated with the periapical portion of the root 0.5 mm or greater or approximately twice the width of the periodontal ligament space on 1 or more root(s) and disruption of the lamina dura on at least 1 of 2

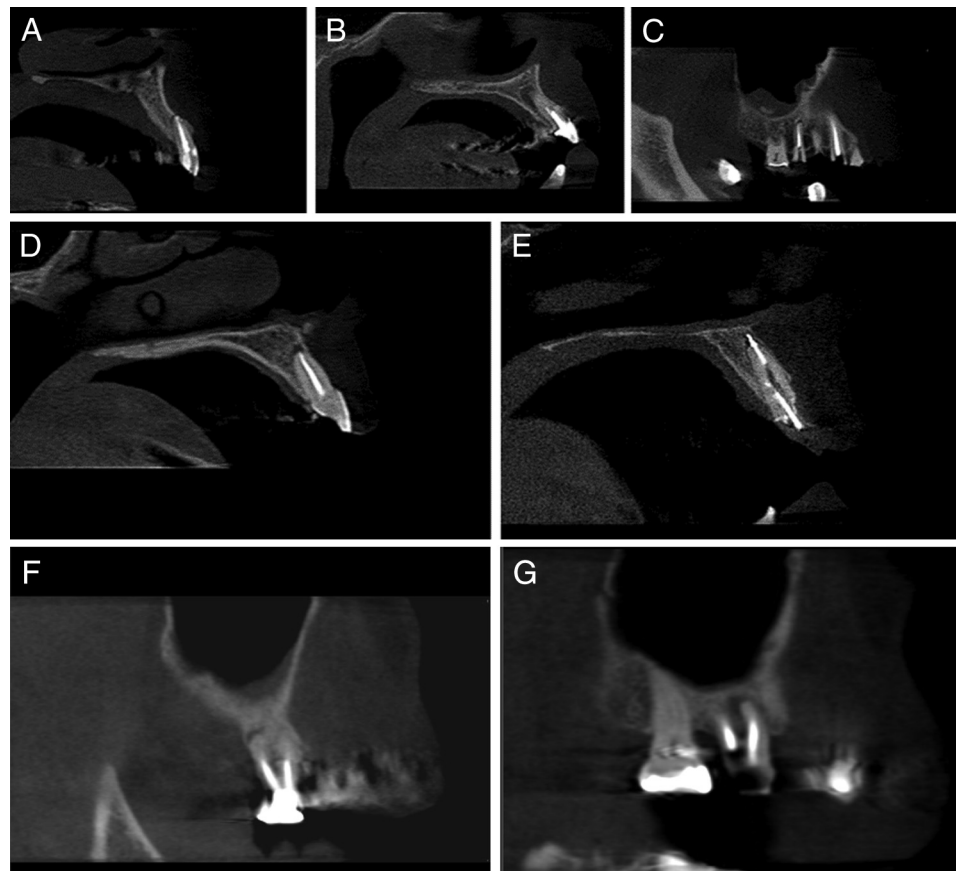


Figure 1. (A) Endodontic treatment appropriate, (B) endodontic treatment filling more than 2 mm short of the radiographic foramen, (C) absent coronal restoration, (D) apical radiolucency, (E) overfilling, and (F and G) multirrooted teeth ranked according to the root with the worst evaluation.

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