Influence of Cone-beam Computed Tomography on Endodontic Retreatment Strategies among General Dental Practitioners and Endodontists

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Abstract

Introduction: Treatment options for endodontic failure include nonsurgical or surgical endodontic retreatment, intentional replantation, and extraction with or without replacement of the tooth. The aim of the present study was to determine the impact of cone-beam computed tomographic (CBCT) imaging on clinical decision making among general dental practitioners and endodontists after failed root canal treatment. A second objective was to assess the self-reported level of difficulty in making a treatment choice before and after viewing a preoperative CBCT scan. **Methods:** Eight patients with endodontically treated teeth diagnosed as symptomatic apical periodontitis, acute apical abscess, or chronic apical abscess were selected. In the first session, the examiners were given the details of each case, including any relevant radiographs, and were asked to choose 1 of the proposed treatment alternatives and assess the difficulty of making a decision. One month later, the examiners reviewed randomly the same 8 cases with the additional information from the CBCT data. **Results:** The examiners altered their treatment plan after viewing the CBCT scan in 49.8% of the cases. A significant difference in the treatment plan between the 2 imaging modalities was recorded for endodontists and general practitioners ($P < .05$). After CBCT evaluation, neither group altered their self-reported level of difficulty when choosing a treatment plan ($P = .0524$). The extraction option rose significantly to 20% after viewing the CBCT scan ($P < .05$). **Conclusions:** CBCT imaging directly influences endodontic retreatment strategies among general dental practitioners and endodontists. *(J Endod 2017;■:1–5)*

Key Words

Cone-beam computed tomographic imaging, decision making, endodontists, general dental practitioners, retreatment strategies

Significance

A CBCT scan should only be considered in cases of abnormal findings on PA radiography and/or moderate to high difficulty. Our findings show that endodontic retreatment strategies may be directly influenced by information gained from a CBCT scan.

Clinical decision making to reach the most suitable treatment choice is a complex process that involves consideration of the best available evidence, case-specific clinical judgment, and patient preferences (1). However, treatment decisions are usually made with some degree of uncertainty. Treatment decisions can vary widely among general dental practitioners and dental specialists (1–3) and are dependent on level training, clinical experience, attitudes and values of persons involved, and economic resources (4).

Several studies have shown that success rates of primary nonsurgical root canal treatment generally approach 90% (5–7). Given the anatomic complexity of root canal systems, intricate and resilient pathogenic microbial communities, inherent limitations of chemomechanical instrumentation and obturation methods, and leakage of permanent restorations, complete elimination of bacteria from the root canal systems is not achievable (8, 9). Therefore, it is inevitable that some initial root canal treatments fail.

Clinicians are often faced with 3 treatment modalities for teeth with periapical disease: nonsurgical retreatment, endodontic surgery, or extraction and replacement with an implant-supported crown (10). Long-term survival rates for restored single-tooth implants and teeth with nonsurgical root canal treatment are remarkably similar (11–14). Over the past decade, considerable advances have been made not only in single-tooth implants but also in surgical endodontic treatment. Recent meta-analyses indicate that modern endodontic microsurgery is more successful than traditional endodontic surgery (15, 16). Tsesis et al (17) evaluated the outcome of contemporary periapical microsurgery and concluded that there was a 91.6% success rate 1 year postoperatively. Another possible treatment option in certain cases of endodontic failure is intentional replantation. A recent study on intentional replantation using contemporary materials showed an 88% mean survival rate (18). Thus, the decision to perform endodontic or implant treatment should not be based only on treatment outcome (11).

Conventional periapical (PA) radiography has been used for many years as a diagnostic aid in endodontics. However, it is well established that PA radiographs are not as accurate as cone-beam computed tomographic (CBCT) imaging in detecting the

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presence of periapical pathology (19, 20). The amount of information gained from PA radiographs is limited by the fact that the 3-dimensional (3D) anatomy of the area being radiographed is compressed into a 2-dimensional (2D) image (20). This problem may be overcome by using small-volume CBCT imaging techniques, which can generate 3D images of individual teeth and the surrounding tissues. Therefore, endodontic treatment planning based on conventional 2D PA radiographs alone may be inadequate in some cases. This is corroborated by Ee et al (21), Mota de Almeida et al (22), and Rodríguez et al (23); the examiners altered their treatment plan after viewing the CBCT image in 62.2%, 43%, and 27.3% of the cases, respectively.

To date, neither the value of CBCT imaging in endodontic retreatment decisions nor the difficulty in decision making has been investigated. The aim of the present study was to determine the influence of CBCT imaging on treatment options chosen by general dental practitioners and endodontists after failed root canal treatment and to assess the self-reported level of difficulty in making a treatment choice before and after viewing a preoperative CBCT scan.

Material and Methods

Study Participants

To obtain the most representative population, we selected 120 male and female clinicians who varied in age and clinical experience. These examiners comprised 80 general dental practitioners and 40 endodontists. The general practitioner group included clinicians who had not received postgraduate training in endodontics or any advanced general dentistry programs or courses that included endodontics beyond their basic undergraduate training. The endodontist group included clinicians who had completed a 2-year postgraduate endodontics program (as a minimum requirement) and who had a private practice limited to this field. The experience of both groups ranged between 2 and 20 years. These 2 groups were chosen to represent those dentists who were most likely to be involved in decision making in similar cases as well as to vary clinical training and experience.

Case Selection

Eight cases from the archives of the Department of Operative Dentistry and Endodontics (Universitat Internacional de Catalunya, Barcelona, Spain) were randomly selected from a list of patients who received a CBCT scan in order to complete their diagnosis. The cases in question represented a wide range of teeth affected by post-treatment apical periodontitis with the presence of clinical signs and/or symptoms.

The inclusion criteria were as follows: endodontically treated teeth with a range of clinical situations diagnosed as symptomatic apical periodontitis, acute apical abscess, or chronic apical abscess and teeth with definitive and adequate coronal restorations (without coronal leakage). The exclusion criteria were the following: endodontically treated teeth diagnosed as asymptomatic apical periodontitis, periodontal support less than two thirds of the root length, evidence of a crown or root fracture, and secondary caries or inadequate coronal restorations.

Each case included at least 2 clinical photographs, 2 parallax digital PA radiographs, and a bitewing radiograph (in the case of posterior teeth) taken with Carestream RVG 6100 (Carestream Health, Rochester, NY) and a small-volume CBCT scan taken with Planmeca 3Ds (Planmeca Oy, Helsinki, Finland). The smallest possible field of view was used (5 × 8 cm). Each case was shown on a Keynote presentation slide (Apple, Cupertino, CA). The cases were accompanied by their respective clinical histories, including the patients' age and sex, symptoms, and clinical signs. This information was intended to simulate the patients' first visit to a dentist. The relevant information was labeled on each radiograph and CBCT scan. All patient-identifying information was removed from the image files.

Procedure

To standardize the terminology used, the examiners were gathered in small groups and briefed on the treatment alternatives. Individual data relating to each participant were recorded. Clinical case observations were performed in 2 separate sessions: first for the PA radiographs and second for CBCT images. Images from each modality were viewed only once by each participant. The first evaluation presented all the information of each case, except for the CBCT scan. The 8 cases were presented randomly, and the examiners' decisions were recorded.

For each case, the examiners were requested to perform the following:

1. Choose 1 of the following proposed treatment alternatives (1–3 = retain the tooth and 4 = extract the tooth)
   i. Nonsurgical retreatment
   ii. Apical surgery
   iii. Intentional replantation
   iv. Extraction
2. Rate the decision-making difficulty on a scale from 1 to 5 (1 and 2 = easy decision, 3 = moderate decision, and 4 and 5 = difficult decision)

Four weeks after the first evaluation, the examiners reviewed the same 8 cases with the additional information of the CBCT scans. The cases were presented randomly. Each examiner was able to adjust and scroll through the volumes freely in their own time. The examiners selected the most appropriate treatment plan and the level of decision-making difficulty for the 8 CBCT scans, as was done with the PA radiographs.

Data Analysis and Treatment Plan Comparison

The treatment plan chosen according to both imaging modalities was compared to determine whether there was any significant difference. The examiners' choice of treatment after viewing the PA radiographs and CBCT scans was compared by the main researchers (F.A. and G.R.). Statistical analysis was performed using Microsoft Excel (Microsoft Corp, Redmond, WA) 2008 software and SPSS software (IBM, Armonk, NY).

A chi-square test was run to determine whether there was a significant difference in treatment planning between PA radiographs and the additional information from the CBCT scans.

Results

Eight treatment plans based on the PA radiographs were compared with the 8 treatment plans based on the PA radiographs and the CBCT images. As summarized in Table 1, the results show a significant change in the treatment options between the 2 imaging modalities for all the examiners ($P < .05$). The examiners altered their treatment plan after viewing the CBCT imaging in 49.8% of the cases. A significant difference in the treatment plan between the PA group and the PA/CBCT scan group was also recorded for endodontists and general practitioners ($P < .05$) (Fig. 1). The general practitioners altered their treatment plan in 52.2%

TABLE 1. Clinical Decision-making Choices before and after Cone-beam Computed Tomographic (CBCT) Examination

	1	2	3	4	Total
Before CBCT imaging	482	238	128	112	960
After CBCT imaging	392	216	170	192	960