Intraradicular Appearances Affect Radiographic Interpretation of the Periapical Area

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Abstract

Introduction: No research exists evaluating the influences of specific variables such as obturation length, radiodensity, or the presence of voids on interpretation of periradicular area. The purpose of this study was to evaluate the effects of obturation length, radiodensity, and the presence of voids on the radiographic interpretations of periapical areas. **Methods:** In a Web-based survey, 3 test image groups of variable obturation lengths, radiodensities, and numbers of voids were presented to observers for evaluation of the periapical areas. Intracanal areas of the images were altered by using Adobe Photoshop to create 3 test image groups. Each observer reviewed 2 control images and 1 image from each test image group. Responses were recorded in a 5-point Likert-type scale. Within each test image group, the periapical areas were identical. Kruskal-Wallis, Mann-Whitney *U*, and Cliff's delta statistical tests were used to analyze results. **Results:** A total of 748 observer responses were analyzed. Significant differences ($P \leq .01$) in the median Likert-type scale responses were identified between the following paired groups: 3 mm short and 1 mm short, 3 mm short and flush, lower radiodensity and higher radiodensity, lower radiodensity and intermediate radiodensity, no voids and several voids, and several voids and single void. Effect sizes ranged from 0.19 to 0.41. **Conclusions:** Significant differences were noted within all 3 test image groups: length, radiodensity, and presence of voids. Length of obturation had the largest effect on interpretation of the periapical area, with the 3 mm short radiographic obturation length image interpreted less favorably. *(J Endod 2017;■:1–6)*

Key Words

Dentistry, endodontic, interpretation, obturation, periapical, radiograph

Significance

Significant differences were noted in radiographic interpretations with differences in obturation length, radiodensity, and presence of voids. Length of obturation had the largest effect on interpretation of the periapical area, with shorter radiographic obturation lengths interpreted less favorably.

The role of radiographs in endodontics includes diagnosis and periapical outcome assessment. Assessment of endodontic obturation is accomplished solely from radiographs by evaluating length, taper, and radiodensity (1). Interpretation of a radiograph involves a cognitive process beyond visual perception. Radiographic interpretation is therefore an imperfect process influenced by human perceptual and cognitive biases (2).

Limited research in dentistry has explored the relationships between the radiographic appearances of obturated roots and assessments of periapical areas. Frazier (3), Strong et al (4), Morgental et al (5), and other data (J.F.H., unpublished data, 2017) all demonstrated that intraradicular areas can affect interpretations of the periapical area. The images in their studies included a variety of coronal and intraradicular radiographic findings. However, to date, no research has evaluated the effects of specific variables such as obturation length, radiodensity, or the presence of voids on interpretations of periradicular areas. The purpose of this research was to explore the impacts of specific obturation characteristics on interpretations of periapical areas. The null hypothesis was that no difference in the interpretations of periapical areas would exist between the variable obturation lengths, radiodensities, or the numbers of voids.

Materials and Methods

This study was performed in accordance with a protocol approved by the Institutional Review Board of Saint Louis University (IRB #27426). The general methodology of this study followed that of Strong et al (4) by using an online survey tool for participant endodontists to interpret the periapical areas of digital radiographic periapical images. A list of e-mail addresses was compiled for a total of 4049 potential participants. The e-mail addresses were randomized by using the Microsoft Excel (2010 Microsoft, Redmond, WA) "RAND()" function. After creating a randomized list, the first 1350 addresses on the list were assigned to Survey Group A, the second 1350 addresses were assigned to Survey Group B, and the last 1349 addresses were assigned to Survey Group C.

Five digital periapical radiographic images were selected for use in the study by a Delphi panel of 3 endodontists. All patient identifiers were removed from images. Two of these images served as control images, with an obvious "abnormal" periapical appearance and an obvious "normal" periapical appearance. The remaining 3 images were test images with ambiguous periapical appearances. The test images were cropped

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to include only a single tooth with clearly visible crown, root, and periapical areas. The test images were digitally modified by using Adobe Photoshop CS6 (Adobe Photoshop, San Jose, CA) to create 3 versions of each test image totaling 9 individual test images. Each test image group had 3 images with identical periapical areas and differing obturation lengths, radiodensities, and numbers of voids. In addition, a radiographic image of an adequate crown was "Photoshopped" into each test image to standardize any effects the coronal restoration may have on the interpretation.

Images were altered as follows: Test Image Group 1: obturation flush with radiographic apex, 1 mm short of radiographic apex, and 3 mm short of radiographic apex; Test Image Group 2: obturation with no voids, a single void, and several voids; and Test Image Group 3: obturation with lower radiodensity, intermediate radiodensity, and higher radiodensity (Fig. 1). The periapical area was not altered in any of the images, and each test image group had identical periapical areas. The images were of such quality that they appeared unaltered as determined by the Delphi panel.

Three online surveys were constructed by using an online survey tool (2016 SurveyMonkey, Palo Alto, CA). All survey questions were identical in format, asking participants to "Please evaluate the periapical area(s)" for 5 separate images. Possible responses were included in a

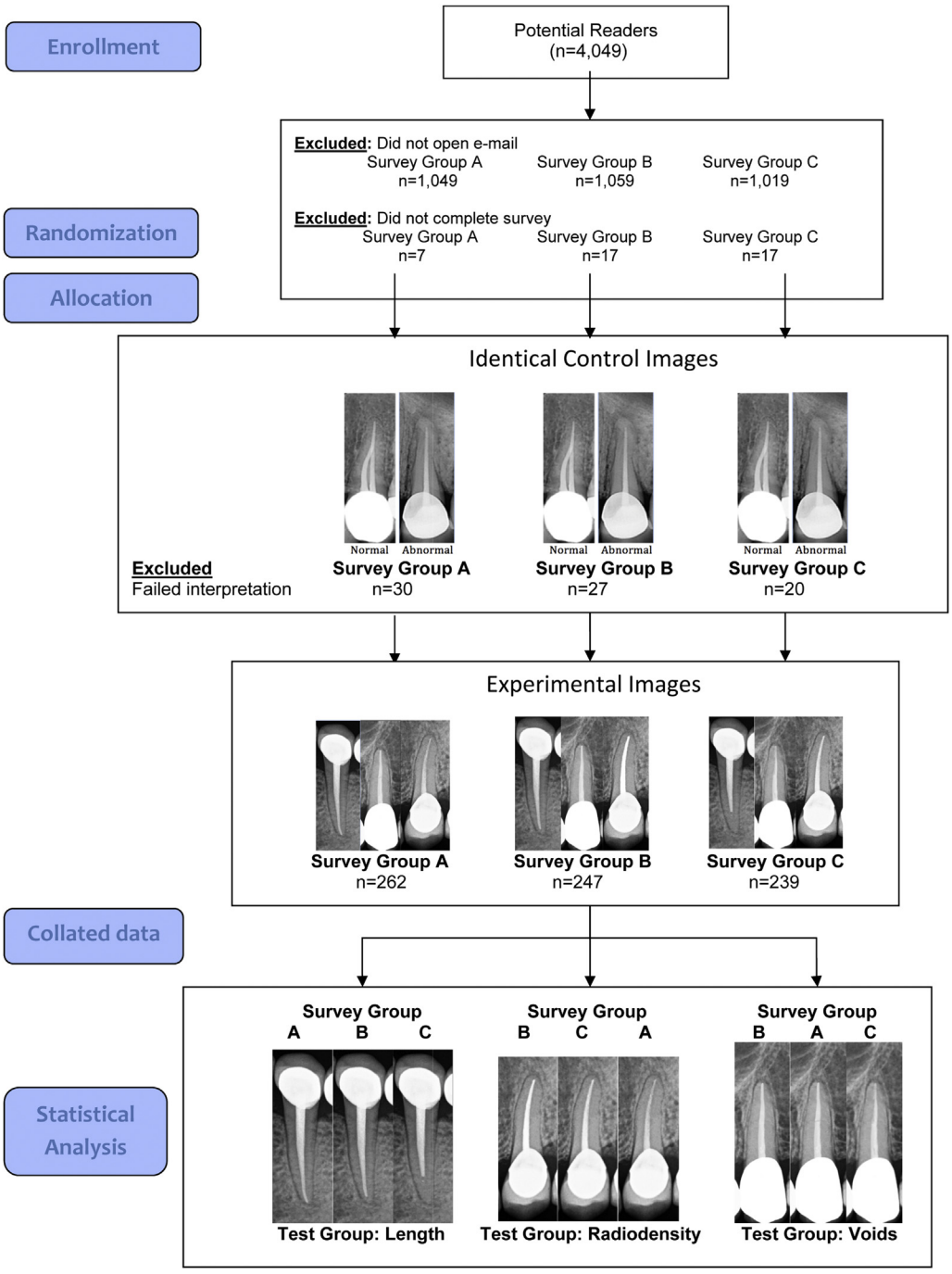

Figure 1. Methodology flow diagram.