A Comparison of 2- and 3-dimensional Healing Assessment after Endodontic Surgery Using Cone-beam Computed Tomographic Volumes or Periapical Radiographs

Tom Schloss, DMD, MSc,[*†] *David Sonntag, DMD, PhD,*[‡] *Meetu R. Kohli, BS, DMD,*[†] *and Frank C. Setzer, DMD, PhD, MS*[†]

Abstract

Introduction: The aim of this study was to compare the assessment of healing after endodontic microsurgery using 2-dimensional (2D) periapical films versus 3-dimensional (3D) cone-beam computed tomographic (CBCT) imaging. **Methods:** The healing of 51 teeth from 44 patients was evaluated using Molven's criteria (2D) and modified PENN 3D criteria. The absolute area (2D) and volume (3D) changes of apical lesions preoperatively and at follow-up were calculated by segmentation using OsiriX software (Pixmeo, Bernex, Switzerland) and ITK-Snap (free software). **Results:** There was a significant difference between the mean preoperative lesion volumes of 95.34 mm^3 (n = 51, standard deviation [SD] ±196.28 mm^3) versus 6.48 mm^3 (n = 51, SD ±17.70 mm^3) at follow-up ($P < .05$). The mean volume reduction was 83.7%. Preoperatively, mean lesion areas on periapical films were 13.55 mm^2 (n = 51, SD ±18.80 mm^2) and 1.83 mm^2 (n = 51, SD ±.68 mm^2) at follow-up ($P < .05$). According to Molven's criteria, 40 teeth were classified as complete healing, 7 as incomplete healing, and 4 as uncertain healing. Based on the modified PENN 3D criteria, 33 teeth were classified as complete healing, 14 as limited healing, 1 as uncertain healing, and 3 as unsatisfactory healing. The variation in the distribution of the 2D and 3D healing classifications was significantly different ($P < .05$). Periapical healing statuses incomplete healing or uncertain healing according to Molven's criteria could be clearly classified using 3D criteria. **Conclusions:** CBCT analysis allowed a more precise evaluation of periapical lesions and healing of endodontic microsurgery than periapical films. Significant differences existed between the 2 methods. Over the observation period, the mean periapical lesion sizes significantly decreased in volume. Given the correct indications, the use of CBCT imaging may be a valuable tool for the evaluation of healing of endodontic surgery. *(J Endod 2017;43:1072–1079)*

Key Words

Apicoectomy, cone-beam computed tomography, endodontic, healing, microsurgery, outcome, root-end surgery, success

Significance

CBCT evaluation allowed for a precise volumetric analysis of preoperative periapical lesions and the assessment of healing after endodontic microsurgery. Healing classification in 3D (CBCT) analysis was significantly different from 2D (periapical radiography) analysis.

Endodontic microsurgery uses high-magnification, ultrasonic root-end preparation and biocompatible root-end filling materials. Success rates in the range of 90% have been reported for endodontic lesions (1, 2). Most original studies used Molven's criteria for the assessment of healing after endodontic surgery, including potential clinical symptoms and radiographic healing based on periapical radiographs.

Cone-beam computed tomographic (CBCT) imaging is a widely accepted tool for diagnostic evaluation in dentistry. However, its main limitation is radiation exposure. Indications in endodontics include the detection of periapical lesions, fractures, or perforations; the evaluation of complex root anatomy, existing root fillings, and the location of separated instruments; surgical treatment planning; and the diagnosis of traumatic injuries to teeth or the alveolar bone (3, 4). In surgical treatment planning, CBCT imaging is helpful to assess the extent and location of apical periodontitis; the bone thickness over pathologic defects; and the proximity to anatomic structures such as the mental nerve, sinus cavity, or adjacent teeth.

Studies have shown that CBCT imaging is superior for the detection of apical periodontitis when compared with periapical radiographs (5–7). The risk-benefit ratio in terms of radiation exposure outweighs the use of CBCT imaging for regular follow-ups after endodontic procedures unless the stage of healing is difficult to discern. Few studies compared 2-dimensional (2D) and 3-dimensional (3D) healing for primary endodontic treatment (8, 9) or endodontic surgery (10–12). No investigation compared the outcome assessment for endodontic microsurgery

From the *Private Practice, Nuremberg, Germany; †Department of Endodontics, School of Dental Medicine, University of Pennsylvania, Philadelphia, Pennsylvania; and ‡Poliklinik fuer Zahnerhaltung, Parodontologie und Endodontologie, Heinrich-Heine-Universitaet Duesseldorf, Duesseldorf, Germany.

Address requests for reprints to Dr Frank C. Setzer, School of Dental Medicine, University of Pennsylvania, 240 S 40th Street, Philadelphia, PA 19104. E-mail address: fsetzer@upenn.edu

0099-2399/$ - see front matter

http://dx.doi.org/10.1016/j.joen.2017.02.007