Microtomography: a method to assess root canal geometry and changes after endodontic preparation

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INTRODUCTION: Medical imaging has progressed greatly in the last 30 years. In endodontic studies *in vitro*, new technologies and techniques have been explored to assess root canal geometry and anatomical changes after canal preparation. X-ray microtomography is one of these techniques, which allows three-dimensional images of canal geometry to be obtained before and after an endodontic treatment [1]. This non-destructive imaging has been in use for a decade [2,3]. In this preliminary study, the objective is to propose a modified version of methodology described previously by Peters and Paqué [1,3].

METHODS: Two steps were used to obtain root canal images: image acquisition and three-dimensional (3-D) reconstruction.

Acquisition: The specimens (freshly extracted human maxillary molars) were scanned before and after root canal shaping with HeroShaper instruments (Micro-Mega, Besançon, France) following the manufactures' guidelines. Acquisitions were performed using a Skyscan1072 high resolution microtomography scanner (Micro Photonics Inc, Allentown, PA, USA). Each acquisition contained 470 slices with a thickness of 38.57µm.

3-D Reconstruction: Three major steps were involved in this generic task: 1) data filtering; 2) delineation and registration of the 3-D shape of the ROI (regions of interest), and 3) mapping measurements over these shapes. The second step, i.e. 3-D image segmentation and registration, was performed using the Amira commercial software, (Indeed Visual Concepts, Berlin, Germany). The other steps, i.e. filtering and measurement, were carried out through a research platform developed in our laboratory. Anatomical changes were assessed using the mathematical method of cylindrical representation.

RESULTS: Three-dimensional images of the root canal were obtained (Fig. 1), and the anatomical changes (volumes, surfaces areas, etc.) assessed. The volume and surface area, cylindrical representations, and the canal axis for each canal before and after preparation were also calculated (Fig. 2). Curvilinear abscissas were calculated for each canal before and after canal shaping with the endodontic instruments (Fig. 3).

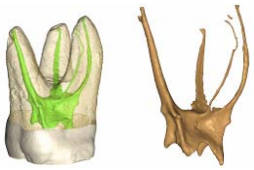

Fig. 1: 3-D dental reconstruction: several tissues (left) vs. pulp structures (right).

Fig.2: 3-D representation of the root canals and canal axes before (brown or red) and after (blue).

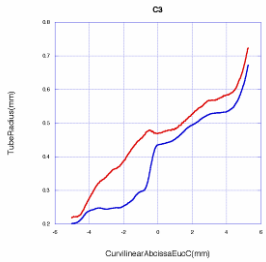

Fig.3: Curvilinear abscissa variation for a canal before (red) and after (blue) preparation.

DISCUSSION & CONCLUSIONS: This methodology seems to be a very adequate *in vitro* endodontic methodology for exploring root canal geometry and assessing anatomical changes. Using a mathematical method, i.e. cylindrical representation, allows the anatomical changes to be better evaluated.

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