Three-dimensional analysis of the pulp cavity on surface models of molar teeth, using X-ray micro-computed tomography

The purpose of this study was to investigate the scanning and segmentation precision of surface models of molars for the detection of small volumes, such as the reduced pulp cavity; formation of mineral deposits; detection of narrow root canals and to improve the clinical and morphological understanding of the number of root canals and their configuration.

Methods. Eighteen human molars were scanned using X-ray micro-computed tomography. The reconstruction of the surface models had a precision of <1 voxel, using three-dimensional software and quantitative color mapping. In order to relate the measurements to changes over time the size of the pulp chambers was classified in two well-defined groups.

Results. The mineral deposits were more evenly distributed in small pulp chambers than in large, but complete root canal calcification was never observed. No difference was observed in the material with respect to the presence of intra-radicular connections. In upper molars, a second mesiobuccal canal (mb2) frequency of 91% was found. The difference in length between the first mesiobuccal canal (mb1) and mb2 was <1 mm. The number of root canals could be related to the number of root cones.

Conclusion. In summary, three-dimensional surface models were made with a high precision; an increased accumulation of mineral deposits was noted in molars with small pulp chambers and combined with the consistent pattern of intra-radicular connections, the potential endodontic treatment complexity is underlined in such cases. Finally, an improved understanding of root canal prevalence was reached, when merging well-defined definitions on root morphology and clinical classification systems.

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