Computer-Aided Diagnosis of Furcation Involvement with 3-D CBCT Imaging

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Objectives: Generally, cone beam computed tomography (CBCT) provides better diagnosis of furcation involvement (furcation defect) than 2-D intraoral radiographs. However, diagnosing furcation involvement through CBCT can be difficult and time-consuming for inexperienced clinicians. A computer-aided diagnostic system can aid clinicians to detect and classify furcation involvement by identifying the key features and patterns on CBCT images in real time. Therefore, this study aimed to establish a workflow to develop a diagnostic model for furcation involvement.

Methods: Development of a computer-aided diagnostic system was begun by identifying 25 furcation involvements on CBCT of 15 periodontitis patients. Full mouth series of intraoral radiographic images were first reviewed, then compared with corresponding CBCT images to exclude potential false positive findings on CBCT. Furcation involvements were annotated by using the three-dimensional (3D) imaging software ITK-SNAP (version 3.8.0), designed to segment structures in 3D medical images. First, manual delineation of the region of interest was performed in 2 to 10 sectioned images depending on the defect size then semi-automatic segmentation was used to annotate defects in 3D. One examiner (dental student) performed these furcation involvement annotations and then the other examiner (periodontics faculty) confirmed them. These annotated images were used to develop the deep learning-based diagnostic system.

Results: As this was the beginning of an extensive long-term project, a deep learning model prototype was unable to be developed due to the small number of annotated objects. The average time of identifying and annotating a furcation involvement on each CBCT was 19.96±2.64 minutes. A workflow was created to allow this project to be continued efficiently.

Conclusion: An efficient workflow was established to allow researchers to continue developing the deep learning-based diagnosis model of furcation involvement. At least several hundred more annotated CBCT images will be needed to development an accurate deep learning model.

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