Applying Convolutional Neural Networks for Radiographic Identification of Teeth

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Objectives: Full mouth series (FMS) is the clinical gold standard for dental diagnosis, but organization of the radiograph set occupies valuable clinical time. This study focused on tooth classification from periapical (PA) films to facilitate mounting of FMS by a Convolutional Neural Network (CNN).

Experimental Methods: 425 patients from UT Health School of Dentistry at Houston with standardized FMS radiographs were included in the study, yielding a total of 6,438 standardized PAs.
Each PA was labeled by clinicians by tooth type (incisor, canine, or molar), and tooth number using the Universal Numbering System. The CNN model, ResNet 50, was created for classification of tooth type and tooth numbering. After data augmentation, 265,440 images were created and used for data training and testing. 80% of the collected data was used for CNN training and 20% for testing. To confirm the test results from the CNNs, a 5-fold-cross-validation was applied.

Results: After applying the 5-fold-cross-validation, the accuracy for tooth type classification was above 94% across all folds. The mean accuracy for molars, premolars, canines, and incisors are 99%, 99%, 95%, and 99% respectively. After applying the 5-fold-cross-validation to test the accuracy of tooth numbering, a mean accuracy of 95% was achieved.

Conclusion: The overall high accuracy of CNNs in both this study along with the other studies referenced for recognizing teeth number and type are promising for facilitation of FMS mounting in the dental setting. CNNs have a bright future in helping clinicians with these repetitive activities involving large amounts of data and improving efficiency of dental appointments.

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