Materials and Methods: The study was approved by the local ethical committee. Thirty-nine noncavitated teeth were collected from 11 patients who had parts of the upper or lower jaws excised to remove a cyst or neoplasm. Before surgery, radiographs of the involved teeth were taken by using the digital imaging system Digora Optime (Soredex, Helsinki, Finland). The teeth were then sectioned for histologic validation of the lesions. Four Chinese and 4 American dentists and 5 American senior dental students evaluated all of the radiographs according to a 5-category scale. Receiver operating characteristic (ROC) analysis was performed. Repeated-measure analysis of variance (ANOVA) was employed for statistical analysis.

Results: There were no significant differences among the Chinese and American dentists and the American senior dental students ($P = .472$). Interobserver ($P = .67$) and intraobserver ($P = .24$) variances were not significant.

Discussion: Dental education background is not an influencing factor on the accuracy of diagnosis of approximal caries based on digital radiographs.

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HUMAN MANDIBULAR BONE DENSITY DISTRIBUTION: IMAGE ANALYSIS AND BONE REMODELING SIMULATION

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Background: Bone density distribution affects the short-term and long-term success of dental treatments. Currently, there is no quantitative method to analyze bone density distribution in alveolar bone.

Objective: In this study, the bone density distribution in human mandibles was obtained from quantitative analysis on medical images and was also modeled by using biomechanics simulations.

Materials and Methods: Cone beam computed tomography (CBCT) images from 33 patients were obtained from dental clinics. The CBCT scanner was calibrated by using our self-made phantoms to convert gray-scale to mineral density. The CBCT images of multiple human mandibles were analyzed. Finite element models were used to simulate the effects of normal chewing and bite force on bone density distribution. A strain energy density−based bone remodeling algorithm was used in the simulations.

Results: For the same materials in phantoms, there was no significant difference in gray scale in different locations inside the regions of interest, despite the known drawbacks of CBCT. At the chosen effective energy level, the gray scale in CBCT images had high linearity with attenuation coefficients for all materials in the phantoms. The averaged trend in mandibular bone density distribution was obtained. It was higher near the root of the tooth and lower away from the tooth, especially near the lingual arc of the jaw. The numerical simulation results showed a similar trend in bone density distribution under chewing force.

Discussion: The gray scale in CBCT images from the 1 CBCT scanner used in this study had linearity and spatial consistency inside certain regions of interest. The bone density distribution obtained from image analysis had good agreement with that obtained from bone remodeling simulations based on biomechanics analysis. The results may provide detailed information on dental anatomy and can also build the foundation for future improvements in dental treatments using image-based biomechanics analysis.

OSTEOPOROSIS PRESCREENING USING DENTAL PANORAMIC RADIOGRAPHY WITH DEEP LEARNING

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Background: Known as the most common bone pathosis, osteoporosis affects millions of people every year. Clinical diagnostic methods for osteoporosis are expensive and, therefore, have limited availability in population prescreening. Recently, studies have shown that dental panoramic radiography (DPR) can provide information of bone density changes and have potential to be used in trabecular bone structure analysis.

Objective: The aim of this study was to investigate the potential of using deep neural networks on DPR images for osteoporosis prescreening.

Materials and Methods: We collected 108 DPR images from 108 patients (52 patients with osteoporosis and 56 normal individuals). We designed a deep learning algorithm for osteoporosis prescreening. The algorithm uses a multitask scheme to transfer the network pretrained on ImageNet to our data set and improves accuracy in osteoporosis prescreening.

Results: The leave-one-out cross-validation showed that the highest overall accuracy of osteoporosis prescreening to be 92%, demonstrating its significant advantage over previous methods.

Discussion: The study findings showed that using deep neural networks can significantly improve the accuracy of prescreening for osteoporosis, based on 108 DPR images.

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