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Artificial Intelligence application in detection and classification of orthodontic malocclusions from clinical images

by

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ABSTRACT

TITLE: Artificial Intelligence application in detection and classification of orthodontic malocclusions from clinical images.

Introduction: Orthodontic malocclusions are the 3rd most prevailing oral illness subsequent to dental cavities and diseases of the periodontium. Early diagnosis could intercept developing malocclusions and thus provide a more favourable outcome. Nevertheless, hectic lifestyles, geographical remoteness, provider shortages, and high cost of treatment are common barriers to access care and screening for malocclusion.

Objective: Firstly, to develop a fully automated system using AI application for localizing, detecting, classifying malocclusions simply by assessing intraoral clinical images. Secondly, to assess the reliability and accuracy of the developed system versus 2 clinicians.

Method: This study consists of 1310 intraoral photographs (Left occlusion, Right Occlusion) of 655 subjects. The images were divided into training set, validation set and test set. Considering the influence that the depth of the convolutional neural network has on model accuracy for large-scale image recognition, we used Visual Geometry Group (VGG-16) architecture to classify malocclusions. It has very small 3×3 kernel-sized filters, with 13 convolutional layers and 3 fully connected layers, which is a significant improvement from its prior-art configurations.

Results & Interpretation: The model achieved 98.2786% training accuracy and 86.9806% validation accuracy. The highest Area Under the Curve (AUC) value was 1.0 for class 3R, followed by an AUC value of 0.98 for class 2L and the lowest AUC value was 0.95 for class 1L. Overall, all the six classes (1L, 1R, 2L, 2R, 3L,3R) generally had high accuracy for detection and classification. The model efficiency was re-evaluated with an external dataset (Test set) and the model was able to accurately predict the class that each image belonged to, proving its reliability. The extensive use of intra-oral clinical photographs for screening purpose in malocclusion diagnosis facilitates easy interdepartmental correspondence between various dental specializations to determine need for patient's treatment. The built AI model is in the process of being trained further for 100% accuracy and will validate future referral systems employing AI based algorithms.

Conclusion: The employment of a deep convolutional computational neural network to detect orthodontic malocclusion from intraoral photographs proved itself valid. The developed AI model classified malocclusions from different views of intra-oral images with reasonable accuracy.

KEYWORDS: Artificial Intelligence; Orthodontics; Dentistry; Malocclusion; Machine Learning; Deep Learning; Artificial Neural Networks; Image Recognition.

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