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External Validation of an AI-Based Caries Detection Model on Photographs

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Objectives Artificial intelligence (AI)-based models have been increasingly used to automatically analyse photographs of teeth. The aim of this ex vivo diagnostic study was to externally validate a freely accessible AI-based model for caries detection, classification, localization and segmentation using an independent image dataset. It was hypothesized that there would be no differences in diagnostic performance between these data and previously published internal validation data.

Methods For the independent dataset, a total of 718 dental images representing different stages of caries (N=535) and noncarious teeth (N=183) were retrieved from the internet. The photographs were first evaluated by dentists, and they served as a reference standard. Next, an AI-based model was used to analyse the photographs. Diagnostic performance was statistically determined using cross-tabulations to calculate the accuracy (ACC), sensitivity (SE), specificity (SP) and area under the curve (AUC).

Results An overall ACC of 92.0% was achieved for caries detection, with an ACC of 85.5-95.6%, SE 42.9-93.3%, SP 82.1-99.4% and an AUC 0.702-0.909 for the different caries classes. Furthermore, the correctness of caries localization and segmentation was assessed. Herein, 97.0% of the cases were accurately localized. Fully and partially correct segmentation was achieved in 52.9% and 44.0% of the cases, respectively.

Conclusions Despite the promising diagnostic performance of the AI-based model for caries detection and classification, compared to previously published internal validation data, the performance scores decreased. Future studies would be needed to investigate the validity, reliability and practicability of AI-based models using dental photographs from different image sources and/or patient groups.