Automated detection and discriminative localization of age-related macular degeneration in optical coherence tomography volumes using deep learning

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AUTOMATED DETECTION AND DISCRIMINATIVE LOCALIZATION OF AGE-RELATED MACULAR DEGENERATION IN OPTICAL COHERENCE TOMOGRAPHY VOLUMES USING DEEP LEARNING

Background: Age-related macular degeneration (AMD) is the leading cause of blindness for people in high-income countries. Optical coherence tomography (OCT) is a widely used imaging modality in AMD disease management. Deep learning has revolutionised the field of computer vision and achieves state-of-the-art performance. A major drawback inherent in deep learning algorithms is the lack of interpretability which significantly hinders the cooperation between the expert and the deep learning algorithm, limiting the scope of application of deep learning in clinical practice.
Objectives: Develop an automated method for localising discriminative regions and classifying controls and AMD in OCT volumes using deep learning.
Methods: 1891 OCT scans were extracted from an ophthalmologist practices clinical imaging database and linked to clinical endpoints derived from ICD10 codes in the medical records: Healthy controls (ICD10: 'Z010') and AMD (ICD10: 'H353L', 'H353J' and 'H353K').
The deep learning model consisted of a total of six convolutional layers were the global average pooled output of the last convolutional layer was fed to a fully connected classification layer. For discriminative localization, class activation mapping (CAM) was performed.
Results: The deep learning model achieved an AUC of 95.2% (95% CI: 92.3%-98.1%) on a test set of 197 volumes (115 control, 82 AMD). Visualising the class discriminative regions gives insight into which features are most important for distinguishing between AMD and the control group
Conclusions: The application of CAM provides an insight into the trained deep learning model and which regions are important for discriminating AMD volumes from control volumes. We believe that the insight CAM provides is crucial for establishing trust between the medical expert and the deep learning algorithm.

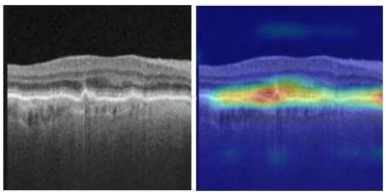

Figure 1 – The left image shows a slice from a patient diagnosed with AMD. The right image shows the discriminative regions used by the deep learning algorithm for predicting AMD.