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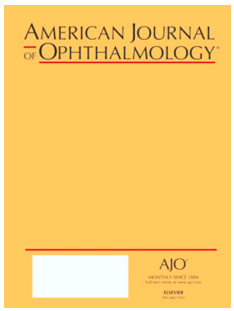

Use of a Neural Net to Model the Impact of Optical Coherence Tomography Abnormalities on Vision in Age-Related Macular Degeneration

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Abstract

Purpose: To develop a neural network for the estimation of visual acuity from optical coherence tomography (OCT) images of patients with neovascular age related macular degeneration and to demonstrate its use to model the impact of specific controlled OCT changes on vision.

Design: Artificial Intelligence (neural network) study.

Methods: We assessed 1400 OCT scans of patients with neovascular age related macular degeneration (AMD). 15 physical features for each eligible OCT as well as patient age were used as input data and corresponding recorded visual acuity as the target data to train, validate and test a supervised neural network. We then applied this network to model the impact on acuity of defined OCT changes in subretinal fluid, subretinal hyperreflective material and loss of external limiting membrane integrity.

Results: 1,210 eligible OCT scans were analysed resulting in 1210 data points which were each 16 dimensional. A ten layer feed-forward neural network with one hidden layer of 10 neurons was trained to predict acuity and demonstrated a root mean square error of 8.2 letters for predicted compared to actual visual acuity and a mean regression coefficient of 0.85. A virtual model using this network demonstrated the relationship of visual acuity to specific, programmed changes in OCT characteristics. When external limiting membrane (ELM) is intact, there is a shallow decline in acuity with increasing sub-retinal fluid but a much steeper decline with equivalent increasing sub-retinal hyperreflective material. When ELM is not intact, all visual acuities are reduced. Increasing subretinal hyperreflective material or subretinal fluid in this circumstance reduces vision further still, but with a smaller gradient than when ELM is intact.

Conclusions: The supervised machine learning neural network developed is able to generate an estimated visual acuity value from OCT images in a population of patients with AMD. These findings should be of clinical and research interest in macular degeneration, for example in estimating visual prognosis or highlighting the importance of developing treatments targeting more visually destructive pathologies.