Artificial intelligence-based analysis of corneal confocal microscopy images for diagnosing peripheral neuropathy

Aim: This study proposed a novel artificial intelligence-based deep learning algorithm (DLA) to identify if peripheral neuropathy (PN) is present (PN+) or absent (PN-) in participants with diabetes or pre-diabetes using corneal confocal microscopy (CCM) images of the sub-basal nerve plexus.
Methods: CCM images of 279 participants (88 with type 1 diabetes, 141 with type 2 diabetes and 50 with pre-diabetes) in total (149 with PN-, 130 with PN+) were used to train, validate, and test the algorithm using one CCM image per participant. A modified ResNet-50 model was trained to perform binary classification of PN based on Toronto consensus criteria.
Results: The proposed algorithm achieved an area under the curve of 0.95, a sensitivity of 0.91 and a specificity of 0.93.
Conclusions: This algorithm demonstrated exceptional results for the diagnosis of PN. However, larger real-world studies are needed to validate its diagnostics ability.

Comments. Currently, CCM image analysis can be done using manual and automated software. While manual analysis relies on manual tracing of the nerves, it is a time-consuming process which requires substantial expertise. Although different, both approaches have shown a solid correlation between them and good reliability and reproducibility for the main corneal nerve parameters – corneal nerve fibre density, branch density and length. Now, automated CCM image quantification has advanced to the utilization of artificial intelligence-based DLA, which has been successful.

In this brief report, Meng Y et al. proposed an algorithm that allows a binary classification of the presence or absence of PN. The algorithm showed several benefits: 1. excellent results in identifying PN by using just one CCM image per participant; 2. no need for expert annotation, remedying operator bias or automated segmentation with a reliance on pre-determined morphological parameters; 3. rapid automated classification of CCM images which could potentially be used in diabetic neuropathy screening.

The use of artificial intelligence-based DLA is a crucial step to demonstrate full ability of CCM for the diagnosis of small fibre neuropathy in diabetes, which could potentially be implemented alongside the screening of diabetic retinopathy.

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Reference. Meng Y, Preston FG, Ferdousi M, Azmi S, Petropoulos IN, Kaye S, Malik RA, Alam U, Zheng Y. Artificial Intelligence Based Analysis of Corneal Confocal Microscopy Images for Diagnosing Peripheral Neuropathy: A Binary Classification Model. J Clin Med 2023; 12(4):1284. https://doi.org/10.3390/jcm12041284
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