Weill Cornell Medicine

AI-Enhanced Corneal Confocal Microscopy for Early Detection and Monitoring of Neurodegeneration

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Background & Unmet Need

- Dementia affects 40-50 million people worldwide, with MCI diagnosis challenging due to insidious onset and cognitive decline influenced by age, education, and cultural factors
- Current AD biomarkers (amyloid-PET, CSF analysis, brain MRI) are limited by high cost, invasiveness, radiation exposure, and inability to distinguish MCI from normal cognition
- Corneal confocal microscopy (CCM) is a rapid, non-invasive imaging technique that captures high-resolution images of corneal nerves using laser scanning technology
- Dr. Malik and his team has previously demonstrated they could visualize corneal nerve loss in diabetic neuropathy
- **Unmet Need:** Accurate, reliable, non-invasive, and inexpensive method for early detection of neurodegeneration and monitoring disease progression in MCI and dementia

Technology Overview

- **The Technology:** AI-enhanced CCM platform that automatically quantify corneal nerve architecture
- Deep learning convolutional neural networks automatically extract and analyze corneal nerve features without requiring manual feature engineering or pre-processing steps
- **The Discovery:** In a study of 182 subjects, progressive reduction in corneal nerve fiber density, branch density, and length correlated with cognitive decline from normal through MCI to dementia
- **PoC Data:** CCM achieved 78-86% diagnostic accuracy for distinguishing MCI from healthy controls versus 40-53% for medial temporal atrophy, with 85% accuracy for dementia detection comparable to brain MRI (92% accuracy)
- Longitudinal data shows accelerated corneal nerve loss in MCI (7.8% annually) and dementia (11.2% annually) versus normal aging (3.1% annually), demonstrating disease progression monitoring

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Publications:

Williams et al. Diabetologia 2020.
Ponirakis et al. Ann Clin Transl Neurol. 2019.
Malik et. al. *Diabetologia*. 2003.

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Cornell Reference:
D-9551, D-11290, D-11801

Weill Cornell Medicine

MCI: mild cognitive impairment; AD: Alzheimer's Disease
CSF: cerebrospinal fluid; PET: positron emission tomography

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Technology Applications

- Early diagnostic and prognostic tool for MCI detection and identifying progression risk to dementia
- Therapeutic monitoring for assessing treatment efficacy in neurodegenerative disease trials
- Broader neurological applications for diagnostic assessment in Parkinson's disease, multiple sclerosis, autism, and epilepsy

Technology Advantages

- Non-invasive, rapid, and cost-effective with no radiation exposure or painful procedures required
- Superior early detection capability for MCI compared to current brain imaging methods
- Objective quantification reduces variability and enables standardized assessment across clinical sites

Supporting Data / Figures

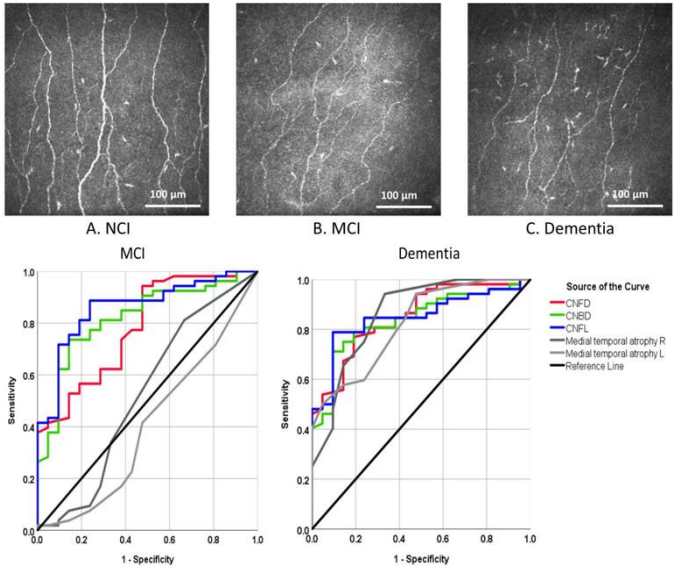

Figure 1: CCM images showing progressive corneal nerve reduction from normal cognition to MCI to dementia. ROC analysis showing diagnostic accuracy of CCM versus MTA for distinguishing MCI and dementia from normal cognition.

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