Personalized Prognosis in Early/Intermediate Age-Related Macular Degeneration based on Drusen Regression

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Purpose and Motivation

- Drusen are deposits of cellular waste products that begin to accumulate between the retinal pigment epithelium (RPE) and the Bruch’s membrane (BM).
- The presence of drusen is the hallmark of early/intermediate AMD, and their sudden regression is strongly associated with the onset of late AMD [1].
- The purpose is to develop a data-driven interpretable predictive model of incoming drusen regression from longitudinal OCT datasets using image-based features.

Methodology

- We developed a machine-learning based method that uses a large set of biomarkers to estimate the risk of regression at the level of an individual druse.
- The model relies on imaging biomarkers measured at baseline and the first follow-up visit, only three months apart.

Outer Retina Segmentation

- Graph-theoretic approach using Iowa Reference Algorithms [2]

Hyperreflective Foci (HRF) Segmentation

- Machine learning with auto-context method [3]

Individual Drusen Segmentation

- Confluent drusen separated into individual drusen
- Defines individual drusen footprint

Predictive Model

- Cox Proportional Hazards (CPH) Survival Model
- Features of individual drusen describing: Shape and size, attenuation, and overlying HRF volume
- 16 features from the baseline + 16 difference to follow-up

Results – Risk Stratification

- 61 eyes from 38 patients with intermediate AMD.
- 3-month follow-up for 1-5 years with Spectralis SD-OCT
- 944 drusen at baseline, out of which 249 regressed (26 %) during the follow-up and 74 (7.8 %) over the first year

Results – Prediction at Year 1

Conclusions

- Prediction of drusen regression is possible (AUC~0.75).
- A promising step toward identification of imaging biomarkers of incoming drusen regression.
- Enables prognostic value at the individual level.
- The results are expected to:
  - Advance our understanding of AMD.
  - Help identify patients at greater risk of progression and thus adjust their personalized screening schedule.
  - Help develop therapies for early treatment before AMD advances, currently a large unmet clinical and social need.

References


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