Artificial Intelligence Analysis of OCT Biomarkers for Predicting Long-Term Visual Outcomes after Vitrectomy for Epiretinal Membrane

Lorenzo Ferro Desideri,[1] Leandro Hinrichsen,[2] Nina Eldridge,[3] Hung-Da Chou,[4] Yousif Subhi,[5] Raphael Sznitman,[3] Martin Zinkernagel[1] Rodrigo Anguita[1]

1: Department of Ophthalmology, Inselspital, Bern University Hospital, University of Bern, Switzerlandm. 2: Faculty of Medicine, University of Bern. 3: ARTORG Research Center Biomedical Engineering Research, University of Bern. 4: Department of Ophthalmology, Chang Gung Memorial Hospital, Linkou Medical Center, Taiwan. 5: Department of Ophthalmology, Copenhagen University Hospital, Copenhagen, Denmark

Purpose

- To identify preoperative OCT biomarkers that predict visual outcomes after vitrectomy for idiopathic epiretinal membrane (ERM) using artificial intelligence (AI) and to correlate these biomarkers with functional recovery

Methods

- This multicenter, retrospective study included patients with ERM who underwent pars plana vitrectomy.
- Preoperative OCT scans were analyzed using an AI platform (Discovery OCT Biomarker Detector; RetinAI AG) to quantify retinal layers and fluids: outer nuclear layer (ONL), photoreceptor and retinal pigment epithelium (PR+RPE), retinal nerve fiber layer (RNFL), intraretinal fluid (IRF), and subretinal fluid (SRF).
- A **Random Forest** regression model assessed feature importance score (FIS) to predict best-corrected visual acuity (BCVA) at 12 months postoperatively.

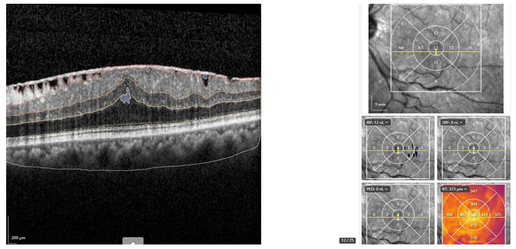


Figure 1 Example of an OCT image processed by Discovery platform, with automatic segmentation of retinal and choroidal layers and retinal volumes. In the preoperative scan of a patient with epiretinal membrane, the presence of a small quantity of intraretinal fluid is detected and quantified by the software (highlighted in blue)

Table 1. Table showing the Person correlation coefficient for each retinal and choroidal thickness/volume associated with 12-month BCVA.

OCT Feature	Pearson correlation	P-value
CC+CS Thickness (µm)	0,06676435	0,566623153
GCL+IPL Thickness (µm)	0,004689517	0,967929753
INL+OPL Thickness (µm)	0,044786315	0,700859804
ONL Thickness (µm)	0,226877967	0,048737751
PR+RPE Thickness (µm)	0,075051169	0,519350405
RNFL Thickness (µm)	-0,10687912	0,358124739
RT Thickness (µm)	-0,13029889	0,261911673
IRF (nL)	-0,25962132	0,023524877
SRF (nL)	-0,18742793	0,104957194
HF Probability	-0,17731261	0,125441838

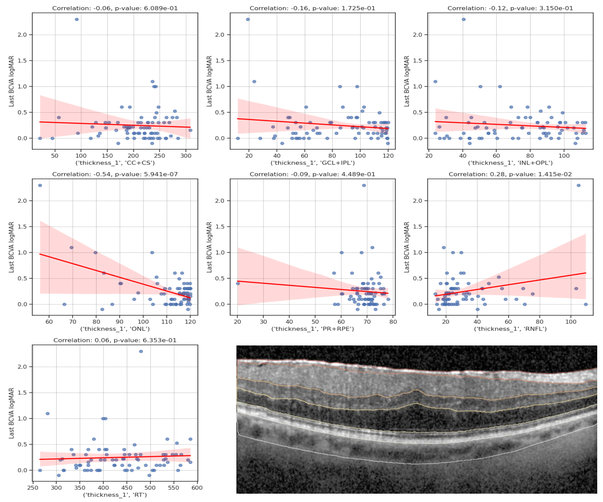


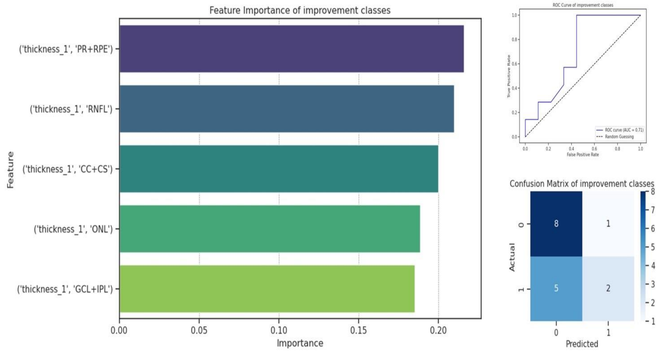
Figure 2 shows the feature importance of retinal layer thicknesses, with PR+RPE thickness being the most influential, followed by RNFL, CC+CS, ONL, and GCL+IPL. The model's performance is illustrated through a confusion matrix and mean coverage analysis, highlighting its ability to classify visual improvement outcomes.

Conclusion

- Thinner preoperative ONL and PR+RPE layers, along with thicker RNFL, may predict poorer visual recovery after ERM surgery.
- AI-derived OCT biomarkers provided a clinically actionable framework for prognostication, with emphasis on the critical role of outer retinal integrity and inner retinal traction in patients with ERM.

Results

- Seventy-one patients (38 female) were included in the study.
- Mean postoperative BCVA improved significantly from 0.51 ± 0.41 to 0.25 ± 0.33 LogMAR (P<0.001).
- In univariate analysis, thinner preoperative ONL (110.47 ± 13.50 µm) strongly correlated with worse BCVA (r=−0.54, P<0.001), while thicker RNFL (32.23 ± 20.31 µm) correlated with poorer outcomes (r=0.28, P=0.014).
- Lower preoperative IRF volume (25.35 ± 45.89 nL) predicted greater visual improvement (r=−0.26, P=0.024).
- The **random forest model** (below) (AUC=0.71) identified three key predictors of outcomes: preoperative PR+RPE thickness (FIS=0.216), RNFL thickness (0.210), and ONL thickness (0.189).



Contact: lorenzo.ferrodesideri@insel.ch

Conflicts of interest: None
Commercial Relationship None