Data driven discovery of anti-VEGF treatment response groups based on fully automatic vitreomacular interface segmentation

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Purpose

To study the effect of vitreomacular adhesion (VMA) on functional response to anti-vascular endothelial growth factor (VEGF) therapy using fully automated image processing of optical coherence tomography (OCT) data in large scale clinical trials populations.

Data

Baseline SD-OCT scans (Heidelberg Spectralis, 6x6mm, 49 B-scans) of 238 / 187 patients included in prospective trials evaluating anti-VEGF therapy for macular edema secondary to branch / central retinal vein occlusion (BRVO / CRVO) were collected. The progression of best-corrected visual acuity (BCVA) scores were analyzed for each patient up to month 6 (BRVO) and month 12 (CRVO).

Methods

Each baseline OCT scan was processed using a fully automated 3D segmentation algorithm yielding an inner limiting membrane (ILM) and posterior vitreous boundary (VIT) surface (see Fig. 1). The two surfaces were used to generate distance maps which were grouped into multiple clusters using unsupervised machine learning algorithms (see Fig. 2). Each patient was assigned to the closest cluster center and the progression of the absolute best-corrected visual acuity scores and scores relative to baseline were analyzed for each patient subgroup up to month 6 / 12.

Results

Fig. 1: top: example B-scan bottom left: automatic segmentation of posterior vitreous boundary (VIT, white), inner limiting membrane (ILM, green) and retinal pigment epithelium (RPE, red) bottom right: ILM-VIT distance map

Fig. 2: top: progression of BCVA scores center: ILM-VIT distance maps of closest cluster centers

Conclusion

The configuration of the vitreomacular interface can be efficiently analyzed in detail using ILM-VIT distance maps obtained by our fully automated segmentation method.

Unsupervised machine-learning based clustering of the vitreous configuration maps revealed robust morphologic subgroups of patients with clinically distinct functional response patterns to anti-VEGF therapy in branch / central vein occlusion.

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