

A novel quantitative analysis method for idiopathic epiretinal membrane

Panagiotis Tsoutsanis¹, Davide Allegrini^{1,2}, Mario R. Romano^{1,2}

¹ Department of Biomedical Sciences, Humanitas University, Milan, Italy, ² Department of Ophthalmology, Humanitas Gavazzeni-Castelli, Bergamo, Italy



Competing interests: The authors have declared that no competing interests exist.

Introduction

- The global prevalence of epiretinal membrane (ERM) in the population oscillates between 7% and 11.8%, with a 5-year incidence of 5.3%. Idiopathic bilateral ERM were found in 19.5-31% of the cases with a 5-year incidence affecting the contralateral eye in 13.5%.
- Idiopathic ERM is a fibrotic, semi-translucent, thick and contractile membrane that exerts a tractional force tangential to the retinal plane leading to puckering of the central vision area: the macula. This condition ultimately threatens vision and requires surgical treatment. Surgical timing is currently debated, and all previous classification methods focused on bi-dimensional changes observed in a small region.

Aim

- To evaluate the extent of morphological changes following the removal of idiopathic ERM on the basis of the macular surface plexus deformation. For this purpose, a specific software application was created in order to analyse this phenomenon.

Methods

- Fourteen eyes from 14 patients who underwent peeling of the Inner Limiting Membrane (ILM) to treat visually significant epiretinal membrane (ERM) were retrospectively analyzed. All patients were examined at intervals of one, three and six months post-surgery.
- We measured the shift of vascular crossings position after surgery from a fixed point, which is the retinal pigmented epithelium. This is performed using optical coherence tomography angiography (OCT-A) scans.
- This shift is defined as the relaxation index (RI) and represents a direct measure of the released traction and is related to the functional visual outcome. The inter-grader agreement was measured using a Bland-Altman plot and the 95% limits of agreement.
- Two independent graders manually marked clearly identifiable vessel crossings on the baseline OCT-A. Since each grader could select a different number of vessel crossings, the agreement was measured on the mean RI.
- For the subsequent analyses, we used the average of the two mean RI from each grader. At all visits, best corrected visual acuity (BCVA) was also measured.

Results

Our results indicate that BCVA was significantly better than the baseline at 6-months follow-up ($p = 0.005$), There was a significant correlation between the RI and the BCVA ($p < 0.001$). A higher baseline RI was a significant predictor of postoperative BCVA at 6 months ($p = 0.0489$).

Figure 1

Changes in relaxation index (top) and BCVA (bottom) over time. The dots show the individual subjects, according to the surgical procedure they received.

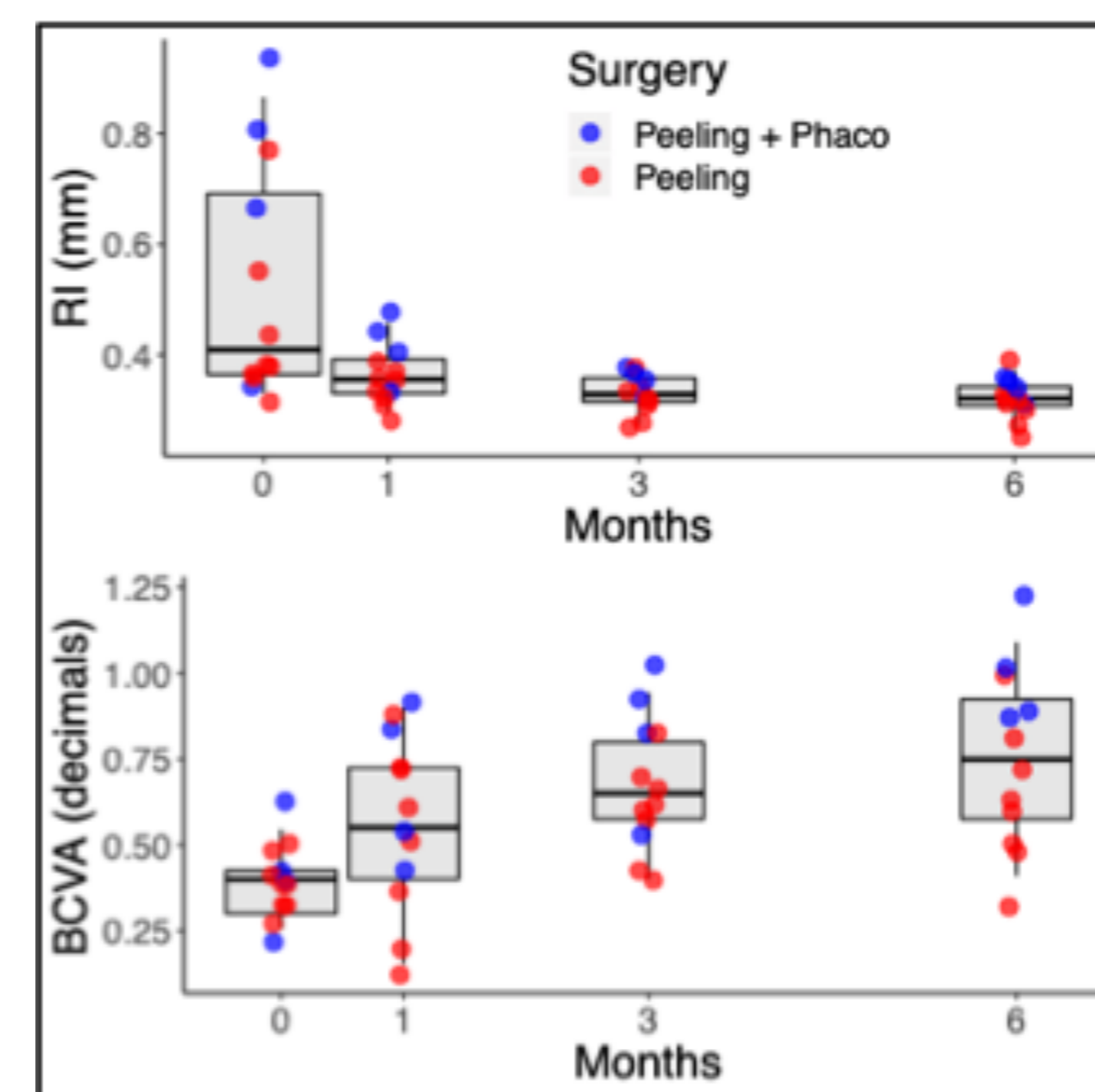


Figure 2

Relationship between the BCVA at 6 months and the RI at baseline. The size of the dots represents the BCVA at baseline.

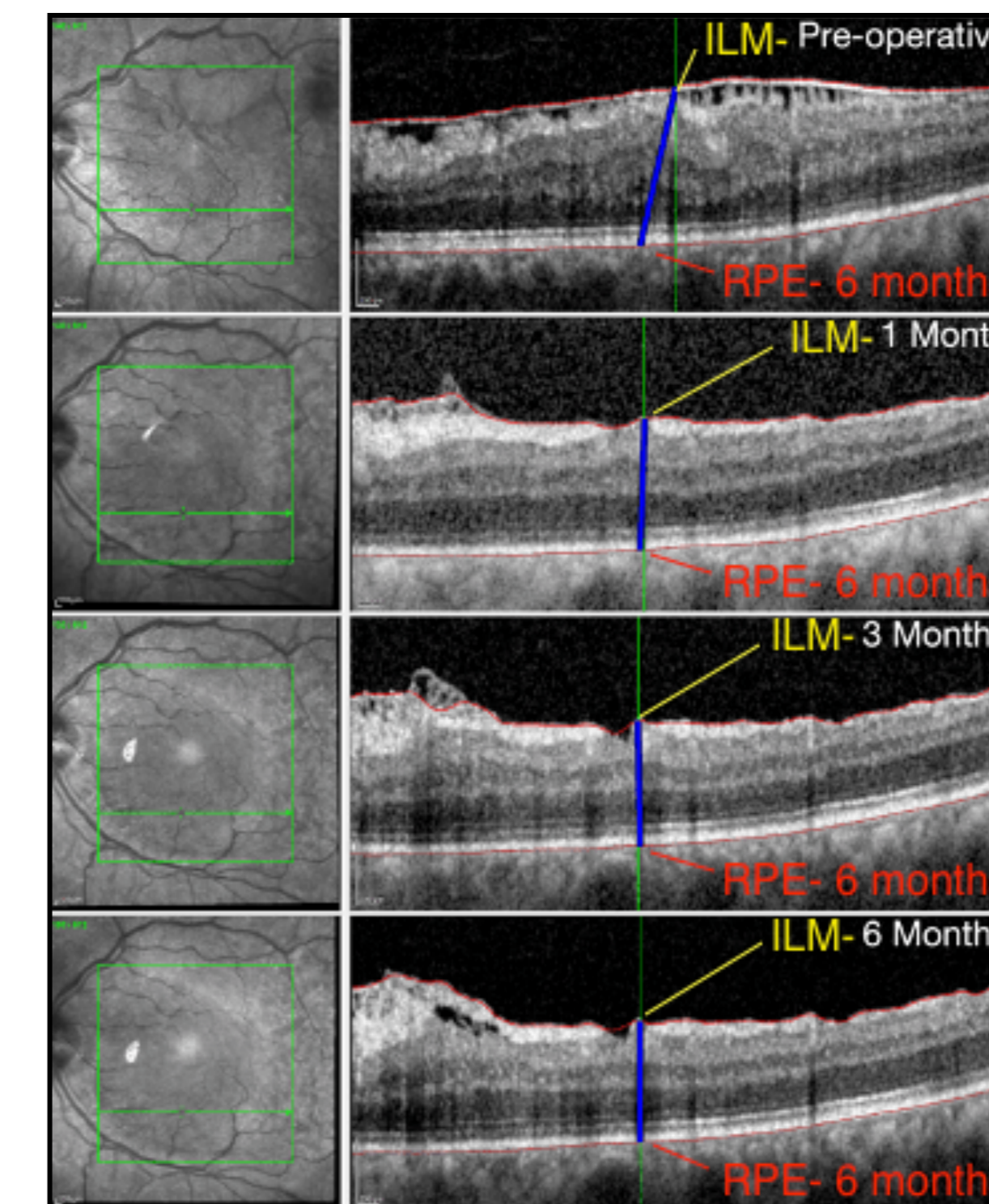
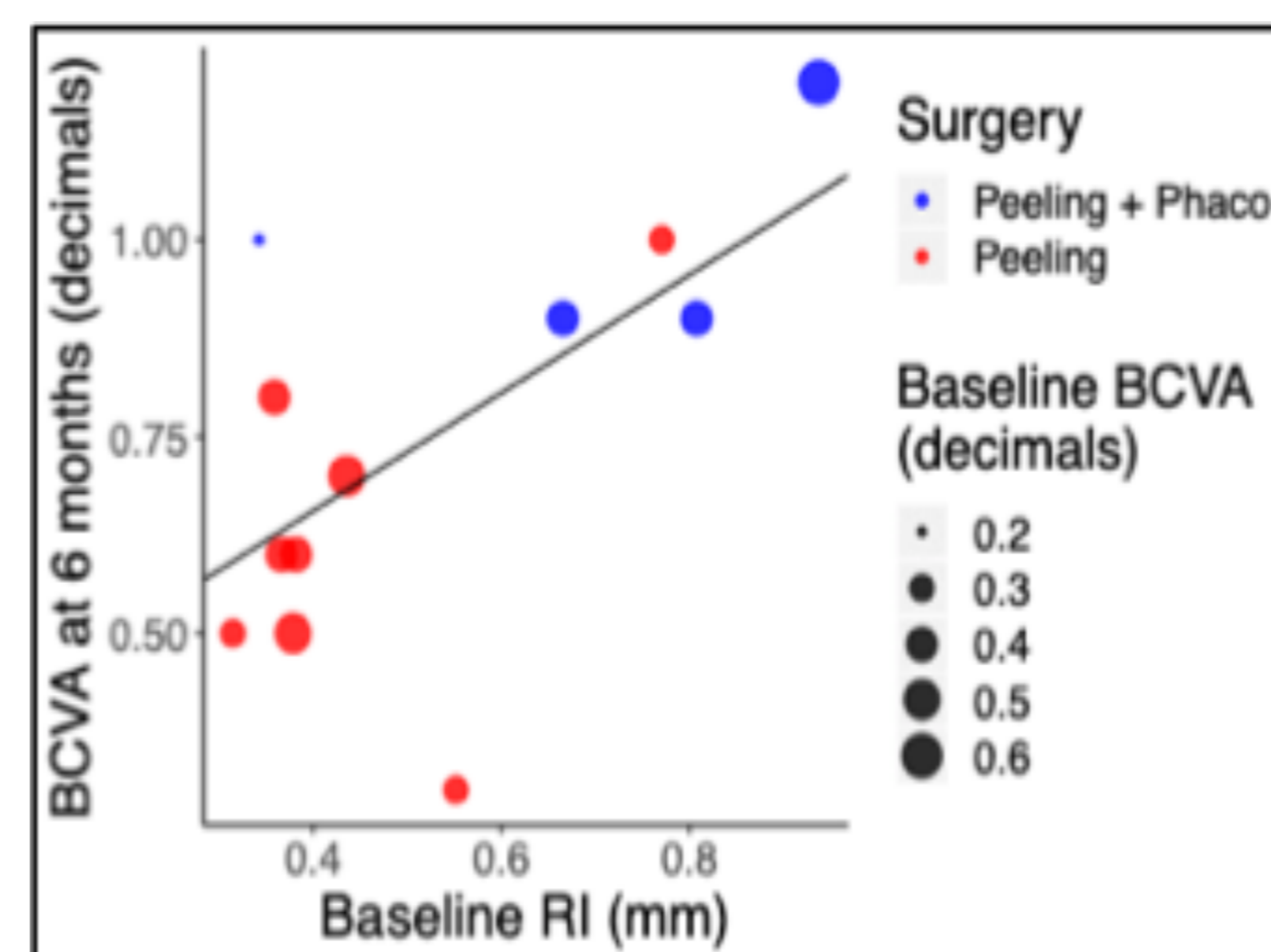


Figure 3

The Relaxation index is denoted by the length of the blue line. It connects the final position (6 - months) of the vessel crossing on the Retinal pigmented epithelium (RPE) to the vessel crossing's position over each point in time on the Inner limiting membrane (ILM).

Conclusions

- This study introduces a novel method to quantitatively analyse, in three dimensions, traction forces in a vast area of the ocular posterior pole.
- This proposed new method measures retinal stress induced by epiretinal traction, allowing a precise and comprehensive evaluation of the macular region and its changes.
- This study demonstrates that patients with an increased release of traction after surgery reach a higher BCVA at 6 months. Therefore, tangential traction can be easily measured and correlated with functional outcomes.
- In the future, integrating RI measurement into processing software can allow systematic measuring of epiretinal traction.
- This allows the potential creation of a new prognostic factor that can guide surgical timing and predict results.