Retinal Structural Changes before and after Idiopathic Epiretinal Membrane Peeling - a study using OCT Segmentation

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ABSTRACT

Purpose: We aim to study the microstructural changes and thickness of individual retinal layers in patients with idiopathic epiretinal membrane (ERM) treated with peeling.

Methods: 47 eyes of 46 patients underwent macular SD-OCT scan before and after ERM peeling. Visual acuity (VA) and central retinal layers thickness were recorded before and at the last follow up visit.

Results: The layers that most have changed and contributed to the reduction of central thickness treated with peeling were the Internal Retinal Layers (IRL): Retinal Nerve Fiber Layer (RNFL), Ganglionar Cell Layer (GCL) and Internal Plexiform Layer (IPL).

Conclusions: Visual acuity improvement was not statistically correlated with CMT or IRL thickness reduction, probably due to a small number of patients. However. alterations in the thickness of each retinal layers are easily obtained and its value as a noninvasive biomarker of VA warrants further investigation.

Keywords: idiopathic epiretinal membrane, individual retinal layers, thickness changes, automated segmentation, optical coherence tomography

INTRODUCTION

An idiopathic epiretinal membrane (ERM) is a common macular disease that may cause a reduction in the visual acuity (VA) and metamorphopsia. Vitrectomy and ERM peeling can improve these symptoms. However, an improvement in the VA after the ERM surgery may not always lead to patient satisfaction because of residual metamorphopsia[1]

The noninvasive, readily performed imaging modality of spectral domain-optical coherence tomography (SD-OCT) provides reliable, high-resolution imaging of retinal anatomy, assess the morphological changes in macular disease and quantification of central retinal thickness. Previous investigations using OCT demonstrated that

central retinal thickness is only modestly correlated with current VA or change in VA [2]. Various other SD-OCT anatomic findings have been studied, but these have not demonstrated adequate correlation to be useful as reliable predictors of VA[3]

The purpose of this study was to determine the microstructural changes and thickness of the inner retinal layer in patients with epiretinal membrane treated with peeling, and investigate whether this could be used as a surrogate marker for visual acuity improvement

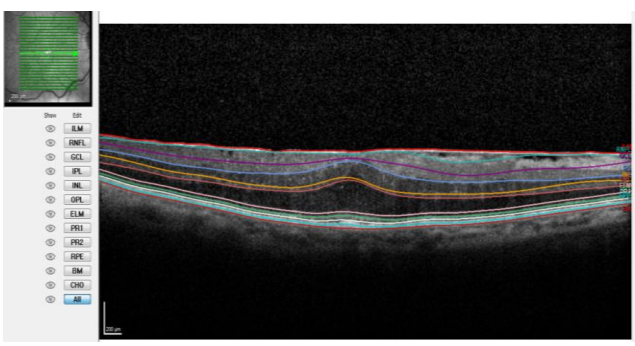
MATERIALS AND METHODS

Institutional review board approval was obtained to review the medical record data of the patients described here in.

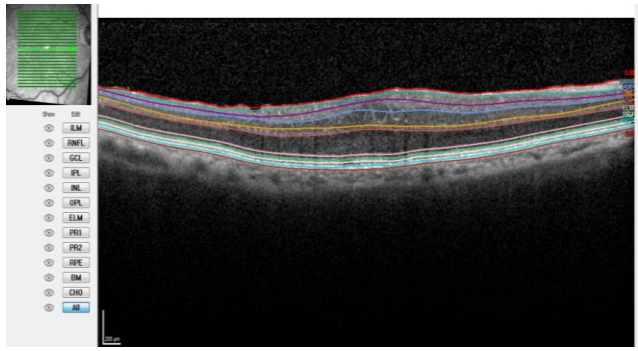
This was a single center, retrospective observational study conducted at the Hospital of Santa Maria, a tertiary referral center for Ophtahlmologic care.

We included patients treated for idiopathic epiretinal membrane between January 2014 and December 2015. All the patients had a minimum follow-up of 2 months and maximum of 18 months, who underwent baseline and follow-up SC-OCT imaging (Spectralis; Heidelberg Engineering). Exclusion criteria were secondary causes of ERM, incomplete medical history or follow up.

Were recorded before and at the last follow up visit the best corrected visual acuity (BCVA) and the central retinal layers thickness given by automated segmentation tool software of SD - OCT Heidelberg Spectralis (average thickness of all points within the central 1000 um of diameter). The retinal layers thickness was given by automated segmentation of OCT Heidelberg Spectralis but the accuracy was verified and when in disagreement, manual correction of the segmentation was made and the new measured thickness was used (Image 1).



A – before surgery



B – After surgery

Image 1 – Automated segmentation tool software of SD - OCT Heidelberg Spectralis with average thickness of all points within the central 1000 um of diameter; (a) before surgery (b) after surgery.

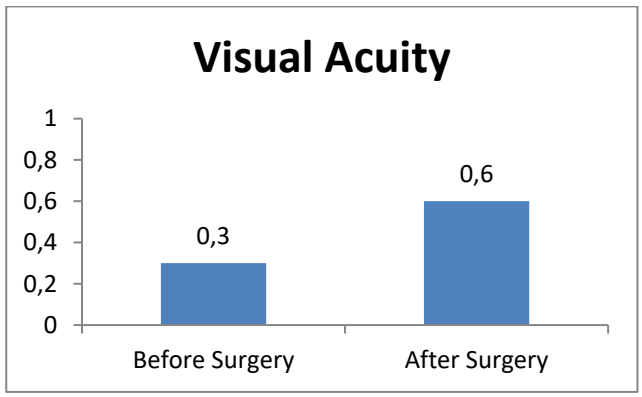
RESULTS

47 eyes of 46 patients were included with a mean age of 73.44 years. Our sample had 42% of men and 58% of women.

33 patients were treated with combined phacoemulsification and peeling and 14 patients had only peeling of the ERM with a 23 gauge pars plana vitrectomy.

Our results showed that the mean BCVA was improved significantly from 0.3 ± 0.1 to 0.6 ± 0.2 ($p<0.0001$).

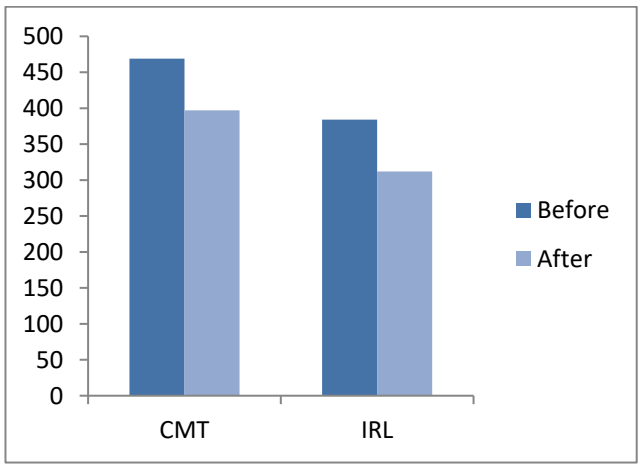
Graphic 1 – Improvement in the best corrected visual acuity after ERM peeling

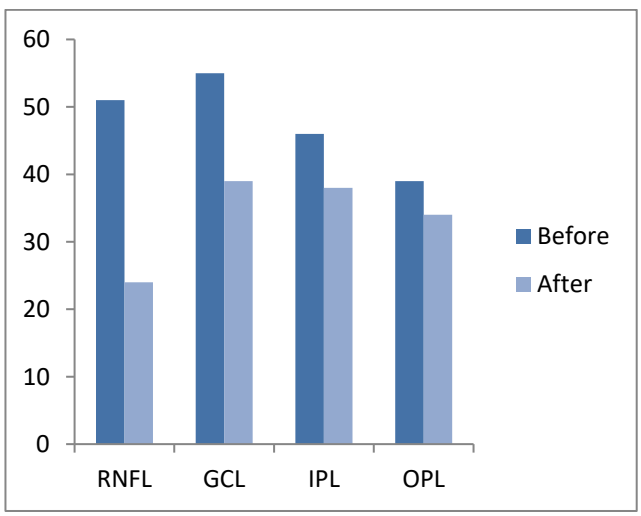


From the tomographic analysis, was noted a significant reduction in the mean central macular thickness (CMT) from 469.4 ± 97.74 to 397.8 ± 71.16 ($p<0.0001$), in the retinal nerve fiber layer (RNFL) thickness from 51.2 ± 49.84 to 24.71 ± 23.21 ($p<0.0001$), in the ganglion cell layer

(GCL) thickness from 55.4 ± 25.22 to 39.2 ± 13.08 ($p<0.0001$), in the internal plexiform layer (IPL) thickness from 46.31 ± 13.46 to 38.62 ± 13.62 ($p=0.0012$), in the outer plexiform layer (OPL) thickness from 39.71 ± 9.04 to 34.38 ± 7.9 ($p=0.0016$) and in the internal retinal layers (IRL) thickness from 384.5 ± 97.7 to 312.8 ± 70.8 ($p<0.0001$).

Graphic 2 – Significant reduction in thickness in the individual layers, 1mm central

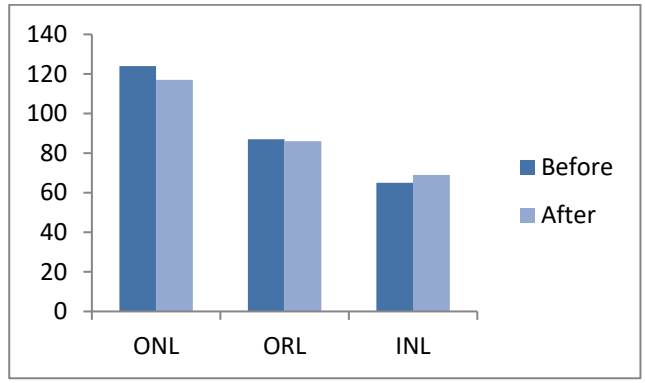




Legend: CMT – central macular thickness, RNFL – retinal nerve fiber layer, GCL – ganglion cell layer, IPL – internal plexiform layer, OPL – outer plexiform layer, IRL – internal retinal layers.

There was no statistical difference in the thickness of the outer retinal layer, outer nuclear layer and inner nuclear layer before and after membrane peeling.

Graphic 3 – Retinal layers with no significant statistic reduction in central thickness



Legend: ONL – outer nuclear layer, ORL – outer retinal layers, INL – inner nuclear layer.

Visual acuity improvement was not statistically correlated with CMT or IRL thickness reduction.

DISCUSSION

The relatively new OCT software that automatically segments the individual retinal layers can give us the opportunity to study in more detail the microstructural alterations in several macular disorders and try to correlate the changes in thickness with the surgery outcomes.

The use of this instrument could be useful to understand the anatomic alterations present in patients with ERM and the response to surgery, as well as potentially identify microstructural alterations that could influence the visual prognosis of these patients.

We investigated the microstrutural changes in thickness of the IRL in patients with ERM before and after surgery.

Other biomarkers have been identified but not fully described: the integrity of the photoreceptor inner segment/outer segment (IS/OS) junction line have been reported to be predictive factors for the postoperative BCVA after surgery [4].

The layers that most have changed and contributed to the reduction of central thickness treated with peeling were the Internal Retinal Layers (IRL): RNFL, GCL and IPL.

Visual acuity improvement was not statistically correlated with CMT or IRL thickness reduction, probably due to a small number of patients.

Therefore, anatomic changes as alterations in the thickness may represent a valuable and easily obtained

noninvasive biomarker of VA that is applicable to clinical care and research studies and warrants further investigation.

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