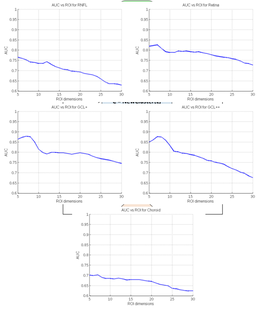

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Analysis of retinal layers using SS-OCT registries for diagnosing multiple sclerosis

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INTRODUCTION

Purpose

To investigate the diagnostic capacity of multiple sclerosis (MS) in early stages of the disease from the analysis of the thickness of several layers of the retina, obtained with swept-source optical coherence tomography (SS-OCT).

The OCT

A non invasive way to obtain thickness measures for each retinal layer is optical coherence tomography (OCT), a technique based on low coherence interferometry. It consists in projecting light waves from an external source which, once reflected from different depths inside a sample, contain the information needed for a three-dimensional reconstruction.

METHOD

Subjects Database

The OCT registers from the right eye of 18 MS patients (M:F =2:16; 49.11±12.52 years) with no history of optic neuritis and 31 controls subjects (M:F=8:23; 58.87±10.14 years) are analyzed. Thickness measurements of the retinal nerve fiber layer (RNFL), ganglion cell layer GCL+, GCL++ and retinal thickness are analyzed. AUC (area under the ROC curve) values are obtained in square LxL regions, which are used to identify the region with the most discriminating power. This study analyzes the data corresponding to the right eye.

The recordings

The registers were obtained using a Deep Range Imaging-OCT Triton with the wide protocol which covers an area between macula and optic nerve using a 45x60 cube grid. The acquisition system implements the necessary segmentation algorithms to obtain the five specified layers (Fig. 1). A quality scale is also considered, according to which low quality images are discarded.

The average wavelength was 1050 nm, obtaining 100 000 cross sectional images/s.

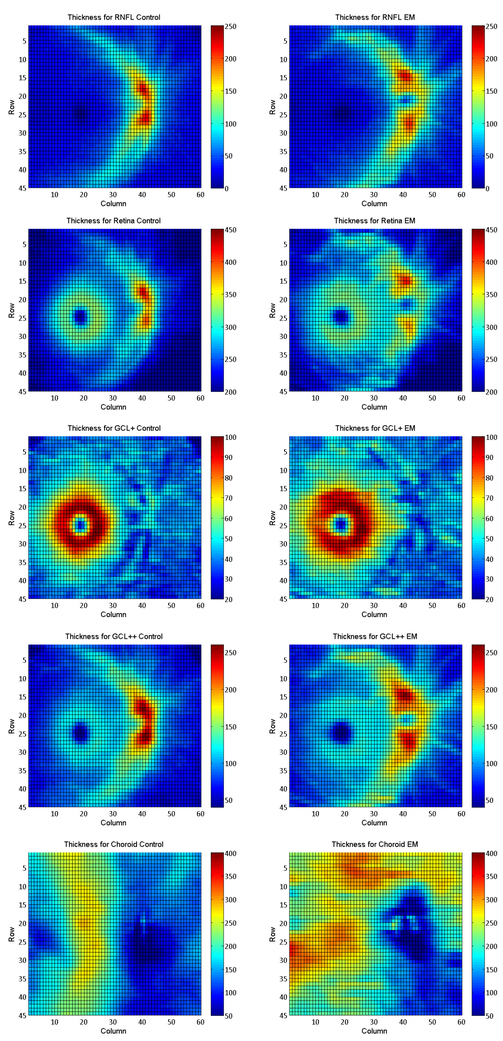

Fig. 1

Analysis of the discriminating power

For each available layer the difference between the average thickness of control subjects and MS patients is evaluated. This is done by using the AUC as the main parameter.

In signal processing, ROC curves are used to estimate the quality of a certain binary classifier through the ratio of true positives and false positives, or in other words, considering the sensibility and specificity of said classifier, to then choose the best among them.

The analysis is done considering square windows of LxL dimensions (Lmin=5; Lmax=30), which travel through the established data grid. For each layer, a search for the optimum window size is performed, this is, that which holds the highest difference (maximum AUC) between controls and patients (Fig. 2).

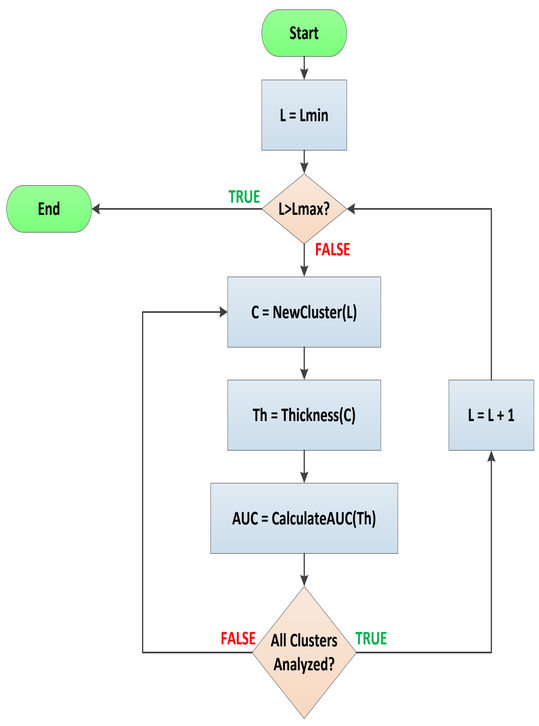

Fig. 2

RESULTS

Best AUC and L values			
Layer	**L**	**Starting coordinate**	**Highest AUC**
RNFL	5	(47,28)	0.7652
Retina	7	(14,23)	0.8262
GCL+	7	(15,23)	0.8781
GCL++	7	(13,22)	0.8763
Choroid	7	(37,39)	0.7025

Optimum window size is found at L=7 for most layers, with maximum AUC decreasing substantially as L is increased beyond that value.

Thickness in zones of maximum AUC (µm)		
Layer	**Controls**	**MS**
RNFL	80.48 ± 31.62	61.11 ± 11.77
Retina	288.18 ± 13.90	272.45 ± 9.93
GCL+	76.07 ± 6.74	63.23 ± 9.70
GCL++	97.60 ± 8.24	83.52 ± 9.29
Choroid	135.00 ± 90.69	149.69 ± 39.36

DISCUSSION

The most differentiated zone is the GCL+ layer, closely followed by the GCL++ layer. In all layers there was a significant thickness difference between controls and patients recorded. Unsurprisingly due to the lower amount of nerve fibers in this zone, the layer with the smaller discriminatory power is the choroid. This layer also constitutes the only case in which MS patients tissue thickness is higher.

CONCLUSION

The high obtained AUC values suggest that the structural analysis of retinal layers can contribute to the diagnostic and the evolution of multiple sclerosis, and that the middle layers GCL+ and GCL++ are the most interesting zones of study for this end.

LITERATURE

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