MULTIPLE SCLEROSIS: ASSESSMENT OF RETINAL MICROSTRUCTURE BY OPTICAL COHERENCE TOMOGRAPHY

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Abstract

Aims: To measure the thickness of the peripapillary neurofibrillary layer of the retina (pRNFL) and the volume of the macula in patients with multiple sclerosis (MS), and to compare them with those in healthy volunteers.

Study design: prospective pilot study

Methods: In this prospective pilot study, a total of 40 eyes were examined: twenty eyes of ten patients with multiple sclerosis and twenty eyes of ten healthy volunteers of the same age without eye or systemic disease. A complete eye examination was performed, including visual acuity with the best correction, refraction, color vision test, and intraocular pressure. Optical coherence tomography (OCT) was performed with 3D Topcon 2000FA + OCT, measuring and comparing the retinal neurofibrillary parameters (pRNFL) and macular volume in all eyes.

Results: OCT studies revealed changes in pRNFL thickness and macular volume in patients with multiple sclerosis.

Conclusion: Patients with MS show thinning of pRNFL and reduction of macular volume - changes that are indicative of the course of neurodegeneration throughout the body.

Key words: multiple sclerosis, optical coherence tomography, retina

Introduction:

Optical coherence tomography (OCT) is a leading diagnostic technique with the ability to display in vivo biological tissues at high resolution (1). In the last years since its appearance on the market and the introduction of spectral domain devices, OCT has established itself as an indispensable technique for examining the anterior and posterior segment of the eye, an important part of diagnosing and monitoring a number of social diseases such as glaucoma and other neurodegenerative pathology, macular degeneration, diabetic retinopathy (1, 2).

In recent years, studies have been conducted on the applicability of the method in patients with multiple sclerosis (MS) in order to determine the value of the method as a tool for assessing changes in the eye in acute optic neuritis, as well as the involvement of the posterior visual pathways by the demyelination process (3).

The morphological changes detected by the study can serve as a prognostic marker for the clinical recovery of visual function, which is essential for the quality of life of patients with MS. Unlike magnetic resonance imaging of the brain and optic nerves, OCT makes it possible to study a structure in the central nervous system consisting of isolated axons (unmyelinated axons in RNFL) (3). Several studies have already shown a reduction in the total mean thickness of pRNFL in MS and in particular in acute optic neuritis (3-5). Some authors believe that the study of the volume of the ganglion cell complex, as a way to quantify the loss of neurons in the retina, better correlates with visual impairment (6). The objective of this study is to measure the thickness of the peripapillary retinal nerve fibre layer (pRNFL) and macular volume in patients with multiple sclerosis (MS), and to compare them with those in healthy volunteers.

Material and methods

A total of 40 eyes were examined in this prospective pilot study: twenty eyes of ten patients with multiple sclerosis and twenty eyes of ten healthy volunteers of the same age, without ocular or other systemic diseases. The mean age of patients with MS was 27 ± 4 years, the duration of the disease was less than 5 years, all had no evidence of optic neuritis in the past. A complete eye examination was performed, including visual acuity with the best correction, refraction, color vision test, and intraocular pressure. All examined eyes met the inclusion criteria (visual acuity > 0.8 single-eyed, <± 2.0Dsph refraction error , normal color vision and intraocular pressure <21mmHg).

Optical coherence tomography (OCT) was performed with a 3D Topcon 2000 FA + OCT with a scanning speed of 50,000 A-scans / sec, a resolution of 5 μm, a penetration of up to 2.3 mm and a 16.5 MP camera (Fig. 1). The 3D Macula and 3D Disc protocols were developed in all patients.

Figure 1

The peripapillary neurofibrillary layer of the retina pRNFL (Fig. 2) and the volume of the macula - Total Volume in all eyes were measured and compared (Fig. 3, 4, 5).

Results

OCT studies have revealed changes in pRNFL thickness and macular volume in patients with multiple sclerosis.

Table 1

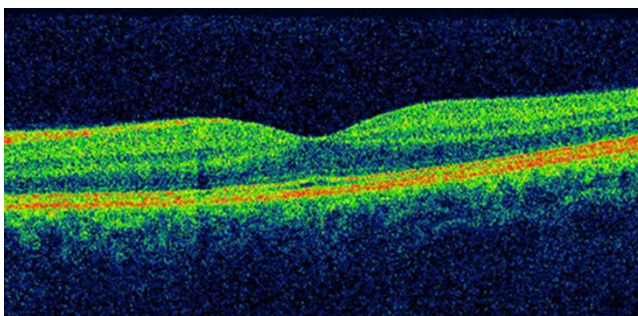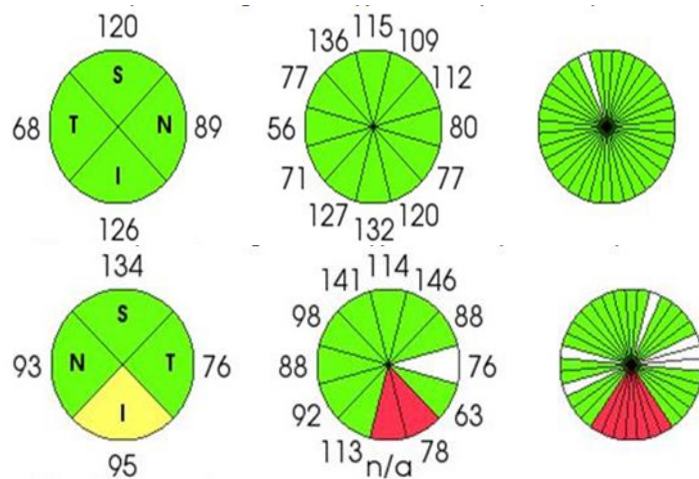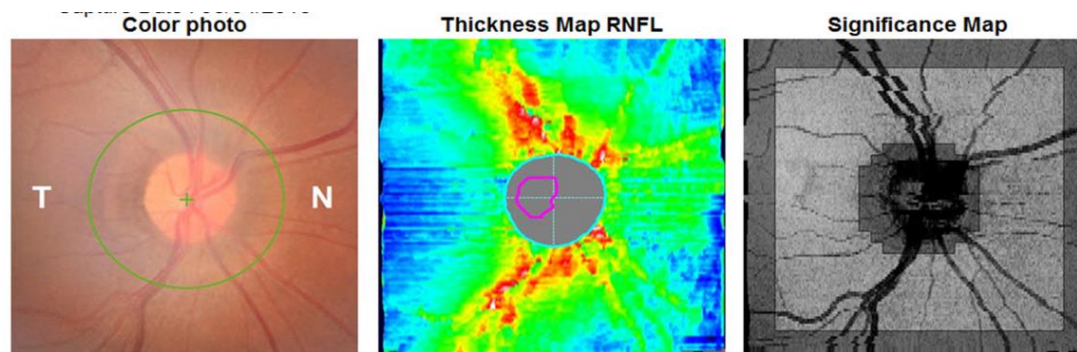| Parameter	Study group (±SD)	Control group (±SD)	p
pRNFL	105.2±3.8 μm	114.3±2.93 μm	p<0.001
Macula: Total Volume	7.84±0.13 mm³	8.34±0.22 mm³	p<0.001

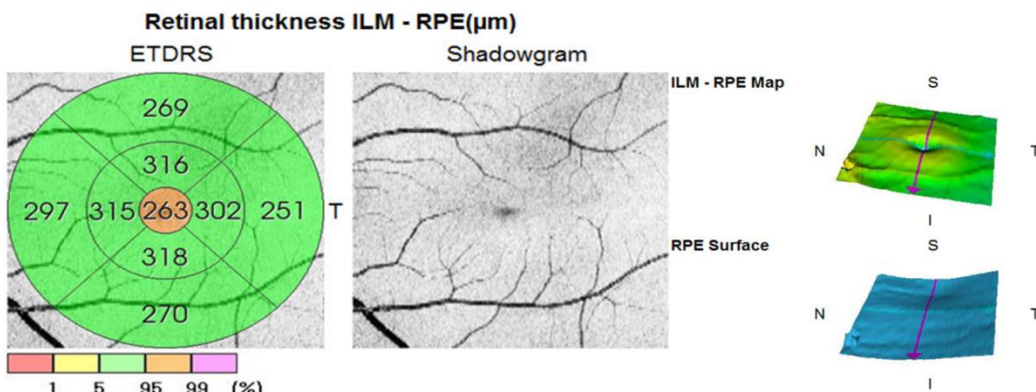*Figure 2*

Figure 3

Figure 4

Figure 5

In the MS patients we examined, we found a marked reduction in pRNFL thickness and macular volume compared to those in healthy controls. The average thickness of pRNFL in the eyes of the patients we studied is 105.2 ± 3.8 μm μm, while that of healthy subjects is 114.3 ± 2.93 μm.

For the volume of the macula, the values were respectively 7.84 ± 0.13 mm³ for the examined subjects compared to 8.34 ± 0.22 mm³ for the controls (Table 1).

Discussion

The findings described by us correspond to the data reported in the literature from studies conducted so far on the use of OCTs in patients with MS, in which a decrease in the thickness

of RNFL and GCC in the range of 5-40 micrometers, with an average thickness loss of 20.38 μm (data from studies conducted in the last few years on the use of OCTs in multiple sclerosis) (3-6).

Conclusions

In conclusion, OCT demonstrates a high value as a non-invasive diagnostic method for real-time examination and monitoring of changes in the studied morphometric indicators of retinal damage (pRNFL and macular volume), correlating with clinical symptoms for visual impairment. Patients with MS show thinning of these layers - changes that are indicative of the course of neurodegeneration throughout the body. Optical coherence tomography has the potential to monitor the effect of new neuroprotective therapeutic agents.

Conflict of interest

All authors of the manuscript entitled MULTIPLE SCLEROSIS: ASSESSMENT OF RETINAL MICROSTRUCTURE BY OPTICAL COHERENCE TOMOGRAPHY certify that they do not have any conflict of interest.

Acknowledgement

All authors of the manuscript entitled MULTIPLE SCLEROSIS: ASSESSMENT OF RETINAL MICROSTRUCTURE BY OPTICAL COHERENCE TOMOGRAPHY certify that they qualify for authorship because of substantial contribution to the work submitted. The authors declare that the manuscript has not been published elsewhere.

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Tables:
Table 1: Comparison of measured pRNFL values and macular volume in the two groups of patients.

Figure legends:
Figure 1: 3D Topcon 2000 FA+ OCT.
Figure 2: Optical coherence tomography - 3D Macula scan of the macula (normal).

Figure 3: Sector analysis of pRNFL-3D Disc protocol thickness in a healthy patient (above) and in a patient with MS (below) - manifest thinning in the lower sector.

Figure 4: 3D Disc protocol in a patient with MS - color image on the left, pRNFL thickness map in the middle, significance map on the right.

Figure 5: 3D Macula protocol in a healthy patient: left sectoral analysis of retinal thickness, in the middle - shadowgram, right - map of the macula.