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## Review

# Update on visual function and choroidal-retinal thickness alterations in Parkinson's disease<sup>☆</sup>

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### ABSTRACT

Parkinson's disease (PD) is a neurodegenerative process that affects 7.5 million people around the world.

Since 2004, several studies have demonstrated changes in various retinal layers in PD using optical coherence tomography (OCT). However, there are some discrepancies in the results of those studies. Some of them have correlated retinal thickness with the severity or duration of the disease, demonstrating that OCT measurements may be an innocuous and easy biomarker for PD progression. Other studies have demonstrated visual dysfunctions since early phases of the disease. Lastly, the most recent studies that use Swept Source OCT technology, have found choroidal thickness increase in PD patients and provide new information related to the retinal degenerative process in this disease.

The aim of this paper is to review the literature on OCT and PD, in order to determine the altered retinal and choroidal parameters in PD and their possible clinical usefulness, and also the visual dysfunctions with higher impact in these patients.

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## Actualización sobre alteraciones de función visual y espesores coriorretinianos en la enfermedad de Parkinson

### RESUMEN

La enfermedad de Parkinson (EP) es un proceso neurodegenerativo que afecta a unos 7,5 millones de personas en el mundo.

Desde 2004, varios estudios han demostrado cambios en el espesor de diversas capas de la retina en la EP utilizando tomografía de coherencia óptica (OCT). Sin embargo, existen resultados contradictorios entre los diferentes estudios. Algunos de ellos relacionan los espesores retinianos con la severidad o duración de la enfermedad, lo cual convierte a las mediciones de la OCT en biomarcadores de progresión de la EP, inocuos y de fácil adquisición. También existen estudios que demuestran pérdida de capacidad o función visual desde fases

#### Palabras clave:

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Función visual

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Espesor de la capa de fibras

nerviosas de la retina

Espesor coroideo

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tempranas de la enfermedad. Por último, los estudios más recientes que utilizan OCT de tecnología *Swept Source* demuestran aumento del espesor coroideo en la EP y aportan nueva información relacionada con el proceso degenerativo retiniano en esta enfermedad.

Este trabajo pretende revisar la bibliografía existente sobre OCT y EP con el fin de determinar los parámetros retinianos y coroideos alterados en la EP y su posible utilidad clínica, así como analizar cuáles son las disfunciones visuales más relevantes en estos pacientes.

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## Introduction

Parkinson's disease (PD) is a neurodegenerative process that produces selective loss of dopaminergic neurons, mainly in the substantia nigra of the basal cerebral ganglia. Neuron damage could be caused by the formation of Lewy bodies due to alpha-synuclein accumulation.<sup>1</sup> Fig. 1 shows a scheme of the physiopathology of PD.

The worldwide prevalence of PD is estimated at 0.3% of the population over 40, approximately 7.5 million individuals. In the 80+ years population the prevalence could reach 1.9%. It is expected that by 2030 the prevalence of PD will reach 9 million individuals. Incidence ranges between 8 and 18.6 for every 100,000 individuals-year.<sup>2</sup>

The main symptoms are related to movement alterations such as bradykinesia, tremor at rest, stiffness or postural instability, in addition to non-motor symptoms such as depression, autonomous nervous system alterations and dementia. It has been described that the latter has a prevalence of 41% in patients with PD.<sup>3</sup>

The diagnostic of PD is clinic. Despite multiple neurologic imaging tests and the rapid developments they are achieving,

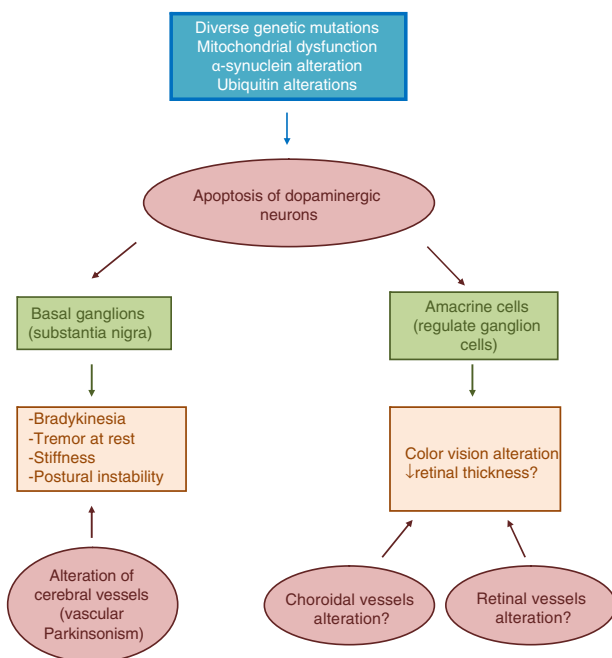
said tests are not very useful for diagnosing PD and they are mainly used to discard other causes of Parkinsonism and specific structural anomalies instead of to confirm PD diagnostic.

Amacrine cells are dopaminergic neurons that are found in the retina and regulate ganglion cells. Amacrine cells are affected by PD.<sup>4</sup> The degeneration of these cells produces alterations in contrast sensitivity and color vision. The loss of amacrine cells could also explain diminished retinal thickness, which some studies have documented with optical coherence tomography (OCT). A range of studies have described macular thickness and retinal nerve fiber layer (RNFL) compromise in PD patients.<sup>5,8,12</sup> However, other studies (the majority with smaller sample sizes) have not found a significant differences in these parameters.<sup>9,15</sup>

RNFL is mainly made up of non-myelinated axons from the retinal ganglion cells, and therefore measuring their thickness provides a relatively direct assessment of axons, and accordingly the damage they may have suffered.

In what concerns choroidal thickness in PD, there is little literature to date. A study utilizing spectral domain OCT has also demonstrated diminished choroidal thickness.<sup>22</sup>

A bibliographic review on OCT and PD follows, aimed at assessing the retinal and choroidal parameters that are altered in PD and their possible clinic usefulness. To this end, a bibliographic search was carried out in the Pubmed database on articles about OCT in PD in order to assess the thicknesses of the various retinal and choroidal layers in the macular and peripapillary areas. The search included the Mesh terms ("Parkinson Disease" [Mesh]) AND "Tomography, Optical Coherence" [Mesh], obtaining 56 results. In order to increase the search, the phrase "Parkinson's disease optical coherence tomography" was subsequently included to obtain 100 results overall. No meta-analysis was found on OCT on PD in Pubmed or in the Cochrane Library. This review will first analyze the articles referred to retinal thicknesses and subsequently those related to choroidal thicknesses. In general, the articles are presented in chronological order to provide the evolution of findings in this field. In the selection of articles, preference was given to those published earlier and which made reference to each aspect, those with larger sample sizes and those that made significant contributions (comparisons between various OCT devices, segmentation of the retina in layers, results contrary to the general tendency, physiopathological hypotheses about the disease). In addition, the review has taken into account the finding of correlations between parameters and the severity or duration of the disease, as well as correlations with other ophthalmological parameters in addition to OCT.



**Fig. 1 – Physiopathology of PD and its ophthalmological involvement.**

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