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Original Article

Optical coherence tomography findings in Parkinson's disease

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Abstract The aim of this study is to compare optical coherence tomography (OCT) findings of retinal thickness (RT) and retinal nerve fiber layer thickness (RNFLT) of idiopathic Parkinson's disease (IPD) patients to those of healthy subjects, and to investigate whether there is any relationship between the severity of the disease and the RNFLT values. This prospective study was included 25 IPD patients and 29 healthy controls. In the IPD group, the Hoehn and Yahr (H&Y), *Unified Parkinson's Disease Rating Scale* (UPDRS), and Mini-Mental State Exam (MMSE) were performed. Intraocular pressure (IOP), visual acuity (VA), spherical equivalent, axial length (AL), and central corneal thickness (CCT) were measured using OCT in both groups. The RT was measured in the central retinal (RTc), nasal (RTn), and temporal (RTt) segments. Nasal (RNFLTn), nasal superior (RNFLTns), nasal inferior (RNFLTni), temporal (RNFLTt), temporal superior (RNFLTts), and temporal inferior (RNFLTti) measurements were made and mean RTFLT was calculated (RNFLTg) for each individual. In the patient group, IOP and VA values were statistically significantly lower The RTn and RNFLTg were significantly thinner in the patient group. There was no statistically significant relationship between the severity of IPD and these findings. In our study, RNFLTg and RTn were found to be thinner in the IPD group, which may have caused lower VA scores. The effects of retinal dopamine depletion on RT and RNFLT, and lower IOP values in the non-glaucomatous IPD patients should be further investigated.

Conflicts of interest: All authors declare no conflicts of interest.

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Introduction

Idiopathic Parkinson's disease (IPD) is a neurodegenerative disorder accompanied by motor and non-motor symptoms [1]. The main motor features of IPD are primarily linked to the selective degeneration of dopaminergic neurons located in pars compacta of substantia nigra, which leads to a severe depletion of dopamine in the striatum [2].

Dopamine dysfunction is seen not only in basal ganglia but also in retina, particularly in the horizontal and amacrin, bipolar, and ganglion cells. In an autopsy study in eight patients with IPD, Harnois et al. [3] found reduced dopamine levels in the retina.

Optical coherence tomography (OCT) is a potential biomarker for IPD [4,5]. It is an optical signal acquisition and processing method which measures the differences in optical properties of different layers of tissues. The retinal nerve fiber layer thickness (RNFLT) may predict the severity of IPD [6,7]. In a study, Altintas et al. [8] demonstrated a relationship between the severity of IPD and retinal thickness (RT) measured by OCT.

However, review of the relevant literature on the RNFLT in IPD has yielded controversial findings. In some studies, the RNFLT was found to be significantly thinner in the patients with IPD, whereas some of them reported RNFLT loss in the temporal quadrant [6–14].

On the other hand, in a recent study including 34 patients with IPD and 17 healthy controls, Archibald et al. [15] reported no significant differences in the RNFLT between the groups. Other four recent studies have also shown no significant differences in the RNFLT between the IPD and control groups [16–19]. The aim of this study is to determine whether the RT and RNFLT are different in patients with IPD from healthy individuals and to investigate whether there is a relationship between the severity of IPD and these thicknesses.

Methods

This prospective study included a total of 25 patients with IPD who were admitted to Abant Izzet Baysal University, Education and Research Hospital, Bolu, Turkey and a control group consisting of 29 healthy individuals between 2014 and 2015. The study was approved by the local Ethics Committee (no: 2013/69) and conducted in accordance with the Declaration of Helsinki. All participants were informed about the study and a written informed consent was obtained from each participant.

Patients having any systemic diseases, any ophthalmic surgery, except cataract surgery without any complication, refraction error >5 spherical diopters or >3 cylindrical diopters, and conditions affecting retina and optic nerve, such as glaucoma or macular degeneration were excluded from the study. The diagnosis of was made according to the United Parkinson's Disease Rating Scale (UPDRS). Only patients with IPD were included in this study, while those with secondary Parkinsonism were excluded.

Neurological evaluation was performed by a single experienced neurologist in both groups. The modified Mini-Mental State Examination (MMSE), Hoehn and Yahr (H&Y) scale, and UPDRS were administered to the patients with IPD.

Ophthalmic evaluation

Each participant underwent a detailed ophthalmic examination, including the best recovered visual acuity (VA), anterior and posterior segmental biomicroscopic examination, and intraocular pressure (IOP) measurement. Visual acuity was measured by a Snellen chart and converted to logMAR. Intraocular pressure was measured by non-contact tonometer.

All OCT examinations were carried out simultaneously by a single experienced physician. To provide the reliability of the measurements, only the images with a signal strength level >20, which are above the recommended signal strength level in OCT images, were obtained. The OCT examinations were performed using the Spectralis OCT device (Heidelberg Engineering, Heidelberg, Germany-Software version 5.3).

For each participant, an OCT image of a horizontal section passing through the central fovea was taken, and three RT measurements were obtained from points at the center of the fovea, at 1500 μm from the fovea in its nasal macula, and at 1500 μm from the fovea in its temporal macula, respectively (Fig. 1). All images were obtained without changing any settings of enhanced depth imaging (EDI), already existing in the OCT device to provide standardization of measurements for each subject. The RNFLT was measured without changing any settings of measurement mode, already existing in the OCT device. Spherical equivalent, axial length (AL), central (RTc), nasal (RTn) and temporal (RTt) thickness measurements were compared in the patient and control group. The central corneal thickness (CCT), nasal (RNFLTn), nasal superior (RNFLTns), nasal inferior (RNFLTni), temporal (RNFLTt), temporal superior (RNFLTts), and temporal inferior (RNFLTti) thickness were measured for each participant (Fig. 2a–b). The RNFLT global (RNFLTg) was calculated as the mean of the RNFLT measurements.

Statistical analysis

Statistical analysis was performed using the SPSS for Windows version 17.0 (SPSS Inc., Chicago, IL, USA). Descriptive statistics were expressed in mean ± standard deviation (SD). The chi-square test was used to compare the distribution of age and sex between the patient and control groups. The independent sample *t*-test was used to investigate whether there was any significant difference between the IPD and control groups having normally distributed data in terms of OCT findings and obtained data. The Mann–Whitney *U* test was used compare the groups having abnormally distributed data. The correlation between the MMSE and UPDRS scores and VA, IOP, and RNFLT in both groups was analyzed using the analysis of variance (ANOVA) and Pearson's correlation analysis. A P value of less than 0.05 was considered statistically significant.

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