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The effect of the smoking on choroidal thickness, central macular vascular and optic disc perfusion

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ABSTRACT

Objectives: To compare choroidal thickness, central macular vascular perfusion and optic disc perfusion in smokers and non-smokers.
Methods: Smoker participants defined group I and non-smoker participants(group II) Optical coherence tomography angiography (OCTA) performed to all volunteers and choroidal thickness, central macular vascular and optic disc perfusion were measured.
Results: In group I, 30 eyes of the 30 participants (6 male and 24 female) evaluated and in group II, 32 eyes of the 32 participants (13 male and 19 female) evaluated. The mean age of the volunteers were 43.09 ± 14.28 and 42.2 ± 8.24 year-old in group I and group II, respectively. The mean choroidal thickness were 345 ± 74 μm and 301.6 ± 71 μm in group I and group II, respectively (p = 0.022). The mean optic disc perfusions were 45.17 ± 1.46% and 45.25 ± 1.43% in group I and group II, respectively (p = 0.82). The mean central macular vascular perfusions were 20.20 ± 7.17% and 18.65 ± 7.46% in group I and group II, respectively (p = 0.4). There are a negative correlation between macular vascular perfusion, optic disc perfusion and smoking period (p = 0.32 and 0.62, respectively.)
Conclusion: Our study revealed that smoking statistically significantly effected choroidal thickness but effected central macular vascular and optic disc perfusion changes were not statistically significant.

1. Introduction

Choroid is a vascular tissue between sclera and retina of eye. Most of ethiologic reason of choridal diseases are not known. In the literature, choroidal diseases (Vogt-Koyanagi-Harada, polypoidal choroidal vasculopathy and pachychoroid diseases), central choroidal thickness (CCT) changes were reported [1–3]. Smoking also could cause retinal and choroidal changes [4–6]. According to World Health Organization by the year 2030, probably 9 milion people annually die secondary to smoking [7]. Effects of smoking cigarette on the vascular tissue was widely reported previously [8,9]. With this study, we aimed to assessed relationship of smoking between optic disc perfusions (ODP), central macular vascular perfusions (CMVP) and CCT.

2. Subjects and methods

2.1. Study design

This study was performed in 2019. The study adhered to the tenets of the Declaration of Helsinki and was approved by the ethics committee at İzmir Katip Celebi Education and Research Hospital. Informed consent was provided by all participants.

2.2. Ophthalmic examination

All participants underwent an ophthalmologic examination that included refraction, visual acuity, slit-lamp biomicroscopy, Goldmann applanation tonometry, and Fundus examination performed after pupil dilated with 1% tropicamide (Alcon, Denmark). All ophthalmic examination done by the same expert specialist (SGÖ). After ophthalmic examinations all participants underwent Optical cohorence tomography angiography(OCTA) examination.

2.3. Optical cohorence tomography Angiography examination

Optical coherence tomography Angiography (OCTA) Angioplex system(Zeiss) was the first OCTA-capable Food and Drug Administration (FDA) licensed device. Angioplex employs an 840 nm wavelength superluminescent diode light source, with 68 000 A-scans/second. OCTA scans coupled using the real-time tracking eye tracking

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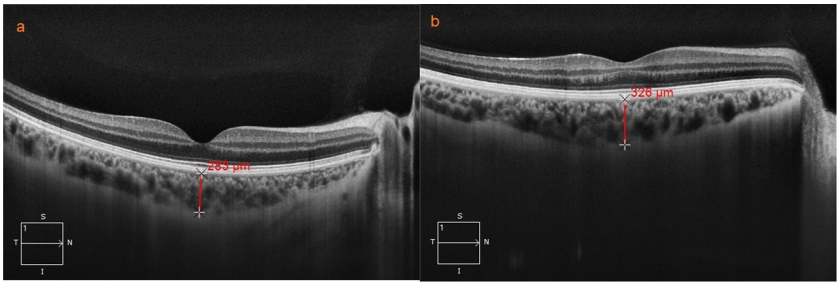

Fig. 1. Choroidal Thickness measurements.
a) A case within control group, b) A case within smoker group

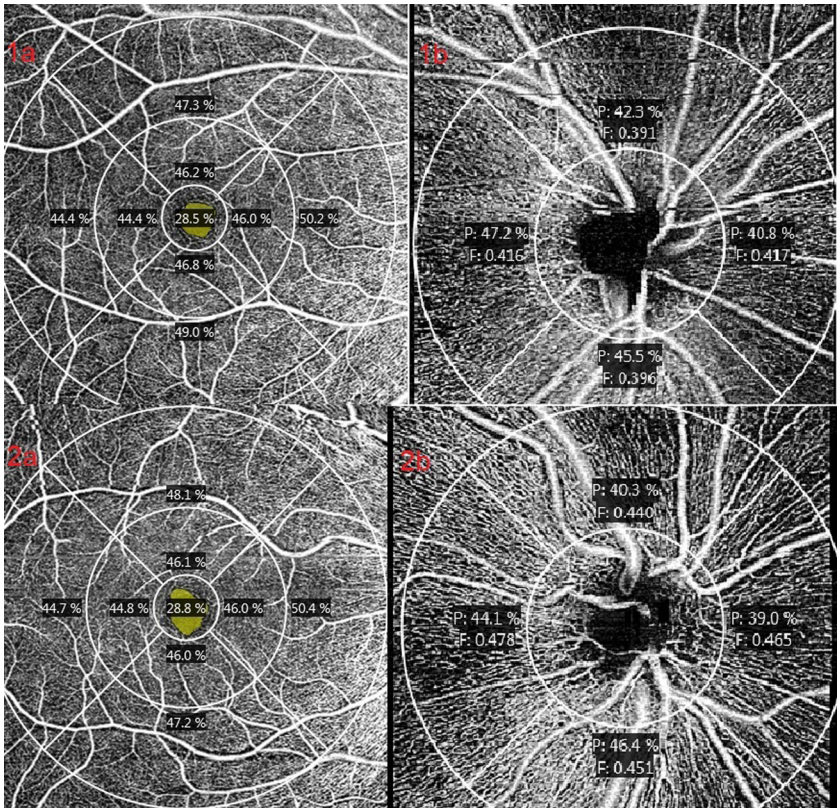

Fig. 2. Perfusion measurements with Angioplex OCTA.
1a) Macular perfusion measurement within control group via Angioplex OCTA, 1b) Optic disc perfusion within control group via Angioplex OCTA, 2a) Macular perfusion measurements within smoker group via Angioplex OCTA, 2b) Optic disc perfusion within smoker group via Angioplex OCTA

system. 6 × 6-mm subfoveal scan size images with a resolution of 320 × 320 were obtained and flattened Bruch membrane. The CMVP between Bruch's membrane and corresponding to the maximal CCT was calculated from the 6 mm diameter circular macular region centered on the fovea (Fig. 1). Also, ODP was calculated with algorithm of Angioplex. Angioplex uses an exclusive algorithm named optical microangiography (OMAG), that analyzes phase and intensity reports collected by the scans to distinguish variations and envision the microvasculature. The software provides for segmentation of the choroidal vasculature (Fig. 2).

2.4. Eligibility criteria

The inclusion criteria required volunteers who had consumed more than one pack of cigarettes for at least 5 years for the smoker group and control group had never smoked cigarettes. All participants had not taken any medications in the previous 4 months.

Exclusion criteria were a history of any ocular disease or any systemic disease with ocular findings, previous ocular surgery, laser therapy, use of any systemic medicine or contraceptive during the previous 4 months.

2.5. Outcome measures

The primary outcome of this study was the correlation of macular, optic disc perfusion and smoking

The secondary outcome was to evaluate the correlation CT and smoking.

2.6. Data analysis

Results are expressed as mean ± standard deviation. The correlation between the demographic characteristics, choroidal density and choroidal thickness were analyzed using Pearson's correlation and independent-Samples *t*-test E-PICOS software (New York) was used for data analysis and p values of < 0.05 were considered statistically significant.

3. Results

In group I, 30 eyes of the 30 participants (6 male and 24 female) evaluated and in group II, 32 eyes of the 32 participants (13 male and 19 female) evaluated. The mean age of the volunteers were

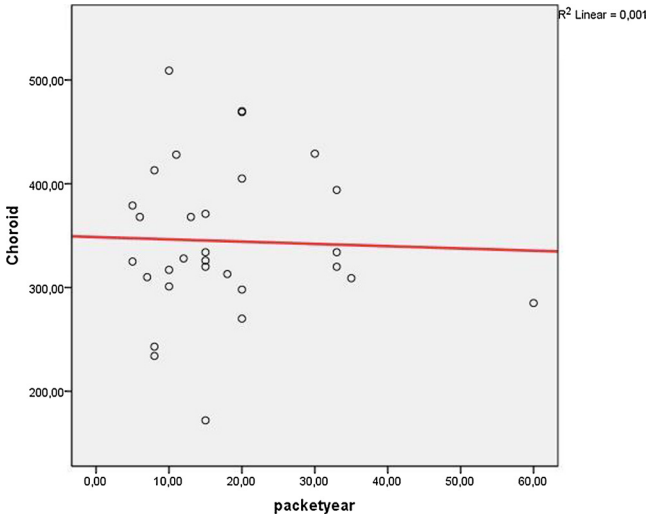

Fig. 3. The distribution of the choroidal thickness according to packet year.

43.09 ± 14.28 and 42.2 ± 8.24 year-old in group I and group II, respectively. The mean santral choroidal thickness were 345 ± 74 µm and 301.6 ± 71 µm in group I and group II, respectively (p = 0.022) [Fig. 3]. The mean optic disc perfusions were 45.17 ± 1.46% and 45.25 ± 1.43% in group I and group II, respectively (p = 0.82). The mean central macular vascular perfusions were 20.20 ± 7.17% and 18.65 ± 7.46% in group I and group II, respectively (p = 0.4). There are a negative correlation between CMVP, ODP and smoking period (p = 0.32 and 0.62, respectively.)

4. Discussion

Cigarette smoking has been known as the main risk factor for side effects in the coronary and cerebral circulatory systems [10]. The choroidal flow is heavily addicted to blood gases of smokers [11]. The decrease of the retinal blood flow with smokers reported by Omae et al but in their study vascular diameters assessed via laser doppler velocimetry and reported that not affected from smoking [10]. Although choroidal flow with via laser doppler velocimetry studied previously, optic disc and macular perfusion not investigated widely with OCTA. In our study, macular vascular perfusion, optic disc perfusion and CCT were evaluated via OCTA and reported smoking significantly associated with CCT but the association with ODP and CMVP not statistically significant.

As our knowledge, there was not a study that reported smoking period could cause retinal disorders. But, normally chronic disorders not effected retina before 5 years [12]. So, we prefer 5 years that identify as a chronic smoker in our study.

In literature, the relationship with choroidal thickness and smoking previously reported. Teberik reported 369.52 ± 105.36 µm in smokers and 347.42 ± 104.63 µm with healthy control group. In Teberik's study there was no statistically difference in both group [7]. Sigler et al reported CCT statistically significantly thinner with smoking people (p = 0.003) [4]. But in these studies the smoking periods were not reported. In our study, smoking period was at least 5 years a pack of cigarette. CFT of smokers 345 ± 74 µm and non-smokers 301.6 ± 71 µm (p = 0.022). Kantarcı et al. revealed that there was no statistically significant subfoveal thickness difference with long-term smokers [13]. To identify these different results on smoking participants other parameters should be evaluated. In our study, macular vascular perfusion and optic disc perfusion accompanied with CCT were assessed.

Kayhan et al also assessed macular perfusion in smokers and reported a significant decrease of the blood flow after one cigarette in a short period [14]. In our study, we assessed choronic effect of cigarette and reported a negative correlation between perfusion parameters and smoking period but this correlations was not statistically significant.

Low blood speed flow reported in Polypoidal choroidal vasculopathy (PCV) [15,16]. Also, smoking could decrease blood flow of the retina [17]. Cackett et al reported patients who smokes were more likely to be PCV and age-related macular degeneration (AMD) [18]. The relationship of between smokers, PCV and AMD could be because of decreasing blood flow with smoking. But, for identifying this relationship further prospective studies with large case numbers are needed.

The main limitation of our study was its retrospective nature. On the other hand, evaluating vascular flow with using non-invasive new technology (OCTA) were strengths of our study.

In conclusion, we could say smoking effect choroidal thickness. To identify, the relationship between smoking and vascular choroidal disease (PCV, AMD) further prospective studies are needed.

Contributors

EE, EA: conceived and designed the study; EE, SGÖ: were involved in patient care; EE, SGÖ: collected the data; EE, EA: analysis and interpretation of data; EE, EA: drafting the manuscript; EE, EA: design of the work, revising the work critically for importantintellectual content, EE, EA, SGÖ; approved the final version of manuscript.

Ethical approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the national research committee with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Informed consent was obtained from all individual participants included in the study.

Declaration of Competing Interest

The author declare that they have no competing interest

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