



## COMPARISON OF CHOROIDAL AND RETINAL NERVE FIBER LAYER THICKNESS IN SMOKERS AND NON SMOKERS.

<b>Bhawna Chawla</b>	MBBS, PG-Resident, NC Medical College and Hospital, Israna; Panipat.
<b>Manika Sharma</b>	MBBS, PG-Resident, NC Medical college and Hospital, Israna; Panipat.
<b>Kanav Gupta*</b>	MS Ophthalmology, FVR, NC Medical College and Hospital, Israna; Panipat. *Corresponding Author
<b>Brij K Gupta</b>	MS Ophthalmology, NC Medical College and Hospital, Israna; Panipat.

### ABSTRACT

Cigarette smoking has been regarded as a risk factor for the incidence of a wide variety of chronic illnesses. It has been associated with low blood velocity of the ophthalmic artery. This study aimed to evaluate the effects of smoking on choroidal and RNFL thickness. The study was conducted in a tertiary care hospital in rural area of Panipat for a period of 6 months from April 2023 to September 2023. It included 40 patients who were categorized into two equal groups. The smokers group included 20 smokers who practiced continuous smoking at least 2 cigarettes/ bidis per day, at least 5 days per week for 2 yrs. Controls included 20 healthy individuals, who were matched for their age with the study group participants. An inquiry about the habit of smoking in detail was done. OCT images were obtained for measurement of the subfoveal choroidal thickness (CT) and RNFL thickness. The RNFL thickness of all the four quadrants (superior, inferior, nasal and temporal) was recorded separately, as well as the overall average thickness. Inferior and Nasal RNFL thicknesses were  $101.9 \pm 31.231$  and  $77.8 \pm 16.548$   $\mu\text{m}$  in the smokers group and  $126.85 \pm 26.738$   $\mu\text{m}$  and  $98 \pm 24.35$   $\mu\text{m}$  in the nonsmoker group, respectively. The differences were statistically significant ( $p=0.0099$ ,  $p=0.0040$  respectively). Average RNFL Thickness was  $87.5 \pm 22.47$   $\mu\text{m}$  and subfoveal CT was  $290.365 \pm 36.404$   $\mu\text{m}$  in the smoker group, while these values were  $102.45 \pm 17.9$   $\mu\text{m}$  and  $328.8015 \pm 59.414$   $\mu\text{m}$  in the nonsmoker group, respectively. There were significant differences in these comparisons ( $p=0.0254$ ,  $p=0.0183$ , respectively). This could be associated with reduced blood flow to the choroid following smoking. Thus, we recommend a routine eye examination for smokers and encourage them to give up smoking.

**KEYWORDS :** Smoking, Optical coherence tomography, Choroidal thickness, Retinal nerve fiber layer thickness

### INTRODUCTION-

Nowadays, tobacco smoke is the leading single preventable cause of death all over the world, as it is responsible for seven million deaths each year. Smoking affects the eye, as smoking toxins reduce the blood supply and initiate clot formation within ocular vessels. This subsequently leads to the inevitable deprivation of vital substances essential for normal health as well as the functioning of the eye. (1,2)

Smoking is recognized to change the macrovasculature and microvasculature anatomically, making it the major cause of atherosclerotic cardiovascular disease. (3)

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The possible pathophysiological mechanism of the harmful effects of smoking is thought to be exerted through the production of an oxidative stress process. The oxidizing constituents produce free radicals, which in turn cause cell destruction and death. (4,5)

The choroid is a vascular layer that lies between the retina and the sclera and extends from the ora serrata to the head of the optic nerve. The inner layers of the retina receive blood supply from the central retinal artery, whereas the outer layers and the optic nerve prelaminar part receive their blood supply from the choroid. The choroid receives the highest blood flow rate per unit volume of the tissues. (6) Structurally and functionally normal choroidal vasculature is essential for retinal function: abnormal choroidal blood volume and/or compromised flow can result in photoreceptor dysfunction and death (7). Choroidal vasculature, the major source of the blood supply to the posterior segment of the eye, is also accountable for transporting waste metabolites from the retinal pigment epithelium (RPE), so it plays a main role in normal retinal

function (8). Choroidal thickness measurement was utilized in this investigation since it has been established that choroidal blood flow alters choroidal thickness. (3)

The RNFL fibers appear as a highly reflective layer due to their unique perpendicular arrangement with the direction of the OCT light beam, which allows its borders to be automatically detected and its thickness measured using computer algorithms. (9) Peripapillary retinal nerve fiber layer (RNFL) thickness is calculated by averaging multiple measurements on a peripapillary circle placed around the optic disc. (10)

Optical coherence tomography is a non invasive, noncontact, highly sensitive modality that is used to acquire high resolution cross-sectional scans of the choroid and RNFL (11,12). OCT could help in the identification of potential harmful effects of smoking on choroidal and RNFL thicknesses. Early detection of such changes could help in the prevention of subsequent deterioration and could permit early diagnosis and therapeutic intervention. (13)

### METHODS-

This prospective study was conducted at the Ophthalmology Department of N.C. medical college, Israna, Panipat for a period of six months from April 2023 to September 2023. It included 40 patients who were categorized into two equal groups. The smokers group included 20 smokers who practiced continuous smoking at least 2 cigarettes/ bidis per day, at least 5 days per week for 2 yrs.

Controls included 20 healthy individuals, who were matched for their age with the study group participants. Written informed consent was obtained from all participants. All participants were assessed systematically. First of all, history taking was completed with a collection of patient demographics, and an inquiry about the habit of smoking in detail was done. History taking was followed by an ocular examination of both eyes for all participants. The unaided and BCVA were tested by the Snellen chart.

The slit-lamp biomicroscopic examination (Appaswamy Associates , Chennai) was performed to detect any abnormalities or media opacity of the anterior segment of the eye. Finally, the fundus examination was completed by slit lamp using a noncontact +90 D Volk lens. OCT images were obtained by the OCT HOCT-1/HOCT-1F (Huvitz Co. Ltd, Korea). This system is provided by an orthogonal registration algorithm called Motion Correlation Technology, which minimizes motion artifacts produced by involuntary saccades and changes in fixation during data acquisition. OCT was used for the measurement of choroidal thickness (CT) and RNFL thickness. CT was measured manually with the white/black mode for better contrast. CT is defined as the distance from the inner surface of the sclera to the outer part of the hyperreflective line corresponding to the retinal pigment epithelium. The CT was measured. For RNFL thickness measurements, a 360° 3.45-mm diameter peripapillary circle scan was performed using the standard protocol for RNFL assessment. The thicknesses of the four quadrants (superior, inferior, temporal, and nasal) were recorded separately, as well as the overall average thickness. A data analysis Statistical Package was used for the statistical analysis of the collected data. All tests were conducted with a 95% confidence interval. A p value less than 0.05 was considered statistically significant.

Inclusion criteria:

All Patients above 18 years with a history of smoking for more than 2 years. Exclusion criteria:

1. Patients with previous ocular trauma.
2. Patients with previous ocular surgery.
3. Patients who were on long-term topical medications.
4. Patients on any steroids and immunosuppressant drugs.
5. Patients with any type of choroidal or retinal pathology.

**Findings-**

Evaluations were carried out on 20 eyes of 20 smokers (13 males, 7 females) and 20 eyes of 20 nonsmokers (10 males, 10 females). Median smoking exposure was 19.75 ± 11.62. Table 1 shows the demographic and clinical characteristics of these groups and their statistical significance. There were no significant differences in age or gender between the smoker and nonsmoker groups. Mean intraocular pressure was 17.65 ± 3.43mmHg in the smoker group and 18.40 ± 2.92mmHg in the control group (p=0.40).

In the smoker group, RNFL thickness was 101.9 ± 31.231 μm and 77.8 ± 16.548 in the inferior and nasal quadrant respectively; these values were 126.85 ± 26.738 μm and 98 ± 24.35 μm respectively in the nonsmoker group. Intergroup differences in these two values were statistically significant (p=0.0099 and p=0.0040, respectively). There were no significant differences between the groups in peripapillary RNFL thickness in the other quadrants (Table 2 and Graph 1). Average RNFL thickness and Subfoveal CT were 87.5 ± 22.47 μm and 290.365 ± 36.404 μm in the smoker group, compared to 102.45 ± 17.9 μm and 328.8015 ±

59.414 μm in the nonsmoker group, respectively. Intergroup differences in these two values were statistically significant (p=0.0254 and p=0.0183, respectively)(Table 2, Table 3 and Graph 2).

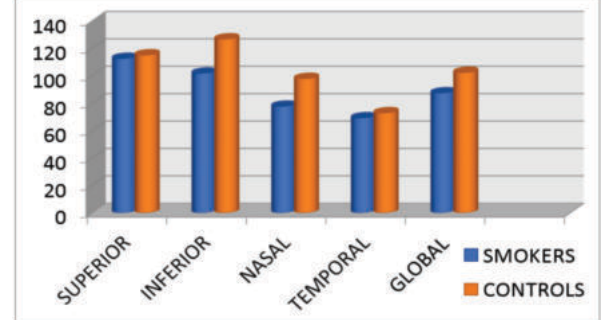
**Table 1: Demographic and clinical characteristics of these groups**

	Smokers (n= 20)	Controls (n=20)	P value
Age, years(mean ± SD)	66.15 ± 10.47	66.4 ± 11.50	0.9431
Gender (male/female)	13/7	10/10	-
Pack×years *	19.75 ± 11.62	0	0.01
IOP (mm Hg)	17.65 ± 3.43	18.40 ± 2.92	0.40

\*Pack×year: number of packs smoked per day × number of years smoking. IOP: Intraocular pressure, SD: Standard deviation

**Table 2: Peripapillary RNFL thickness in four Quadrants of these groups**

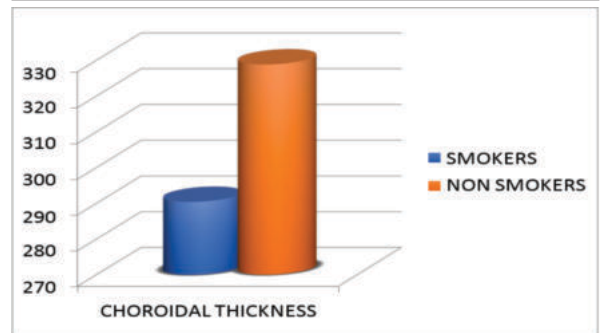
Peripapillary RNFL Thickness	Smokers (n= 20)	Controls (n=20)	P value
SUPERIOR	112.65 ± 32.62	115.2 ± 31.99	0.8042
INFERIOR	101.9 ± 31.231	126.85 ± 26.738	0.0099
NASAL	77.8 ± 16.548	98 ± 24.35	0.0040
TEMPORAL	69.35 ± 15.611	73 ± 17.005	0.4838
GLOBAL	87.5 ± 22.47	102.45 ± 17.9	0.0254



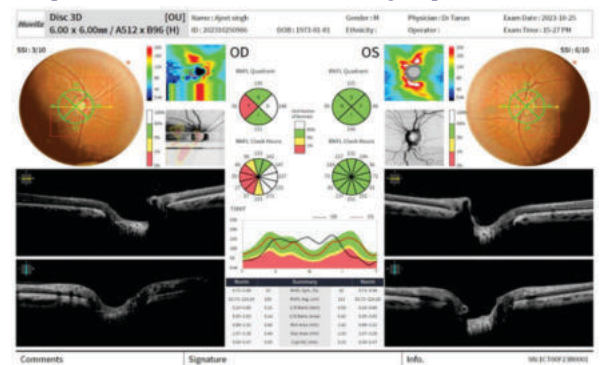
**Graph 1: Peripapillary RNFL thickness in four Quadrants of these groups**

**Table 2: Choroidal thickness of these groups**

	Smokers (n=20)	Controls (n=20)	P value
Choroidal Thickness	290.365 ± 36.404	328.8015 ± 59.414	0.0183



**Graph 2: Choroidal thickness of these groups**



**Figure 1 -OCT showing RNFL thickness in a participant.**

**DISCUSSION**

Effects of cigarette smoking on the microcirculation involve cooperated endothelial- dependent vasorelaxation, aggregation of platelets, and dysfunction of endothelial cells. These effects cause vasodilatation or vasocontraction which leads to vascular blood flow changes(14) Harmful effects of

cigarette smoking on the ocular microcirculation were studied in humans due to having dense microvascular bed readily measurable to noninvasive methods(15).

In the current study, there was a statistically significant decrease in CT in smokers than in nonsmokers. In line with these results, Moschos et al. (16) noted that the CT in subfoveal, nasal, temporal, superior, and inferior regions was significantly reduced in smokers than in the control group. On the contrary, Tayyab et al. [17], Kantarci et al. [18], and Teberik [19] revealed no significant difference between smokers and nonsmokers in CT findings. The discrepancy in CT findings can be explained by the different methods of scan acquisition and the differences between the algorithms for alignment and the registration of OCT scans.

In the current study, there was significant thinning of peripapillary RNFL in the smoker group at the inferior and nasal quadrants and in average, than in the control group. In concordance with these results, Narnoli et al. [2] and Mukhtar et al. [20] found that RNFL thickness was reduced significantly in all four quadrants in smokers when compared with nonsmokers. On the other hand, Duman et al. (2017) compared the thicknesses of the retinal layers in smokers and nonsmoking healthy participants utilizing (SD-OCT).

Although the study focused on the thickness of all retinal layers inside the core Early Treatment Diabetic Retinopathy Study (ETDRS) zone of 1000, 3000, and 6000  $\mu$ m diameter, our study concentrated on peripapillary RNFL thickness. They found that there are not any significant differences in the RNFL thickness between the smoker and nonsmoker groups [21]. This controversy can be explained by that their smokers smoked less duration and a lesser number of cigarettes, whereas our patients were heavier smokers who had smoked for a longer duration.

OCT can help in the identification of potential harmful effects of smoking on choroidal and RNFL thicknesses. Early detection of such changes could help in the prevention of subsequent deterioration and could permit early diagnosis and therapeutic intervention.

It's never too late to quit smoking. Quitting smoking improves your mental and physical health. The measures include prescription of nicotine in a nasal spray or inhaler, Nicotine patches, gum and lozenges, and non-nicotine stop-smoking drugs such as bupropion and varenicline.

## CONCLUSION-

We found that there was a significant reduction in CT and RNFL thickness owing to smoking. This reduction could be associated with reduced blood flow to the choroid following smoking. This implies that cigarette smoking is a factor of systemic and ocular vascular disorder has an effect on posterior layers of eye decreasing its thickness. Thus, we recommend a routine eye examination for smokers and encourage them to give up smoking.

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**Conflicts of Interest Statement:** Nil

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