

Effect of Smoking on Corneal Endothelium

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ABSTRACT

Purpose: To determine if smoking has an effect on corneal endothelium.

Study Design: Descriptive observational.

Place and Duration of Study: Lamar eye center in Kerbala city in Iraq during December, 2023 and January, 2024.

Methods: A total of 108 eyes were selected, 54 eyes of smokers and 54 eyes of non-smokers. The smokers included in this study had history of smoking for more than twenty years and they smoke more than 40 cigarettes per day. All the participants were male. Specular microscopy was used to determine four corneal parameters; cell density, hexagonality, coefficient of variation and central corneal thickness.

Results: Patients age ranged from 50 to 60 years. Central Corneal Thickness was 515.29 ± 40.62 and 522.37 ± 36.68 in smokers and non-smokers respectively with $p=0.32$. Coefficient of variation and, Cell Density and Hexagonal shape parameters were also not statistically different between the two groups ($p>0.05$).

Conclusion: Smoking does not have a statistically significant effect on the corneal endothelium in terms of cell density, hexagonality, coefficient of variation, and central corneal thickness. However, more studies are needed to provide further evidence.

Key Words: Corneal endothelium, specular microscope, smoking, hexagonality, corneal edema.

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INTRODUCTION

Cornea is an avascular, transparent tissue consisting of five layers, the epithelium, the Bowman layer, the stroma, the Descemet membrane, and the endothelium.¹ It has two main functions, a protective function and refractive function as it is responsible for three-quarters of the refractive power of the eye. Nutrition and waste product removal occurs through the aqueous humour posteriorly and through the tears anteriorly.²

Corneal endothelial cells are hexagonal in shape and constitute the posterior most layer of cornea attached to the Descemet membrane. If corneal endothelial cell loss occurs, the remaining cells enlarge and spread to compensate, as the corneal endothelium cannot replicate. However, this enlargement does not occur uniformly, causing some cells to become larger than others, which increases the variation in cell shapes and sizes among the corneal endothelial cells.³ The function of the corneal endothelium is to maintain the cornea transparent by controlling corneal hydration. Corneal hydration can be maintained by pumping extra fluid from the stromal layer back to the aqueous humor.¹

Corneal endothelial cells status can be described by 3 parameters measured by specular microcopy. Endothelial cell density (ECD) represents the number of corneal endothelial cells per square millimeter,

hexagonality is the percentage of hexagonal cells (% Hex) and the coefficient of variation (CoV) represents the mean cell area divided by the standard deviation of the cell area.⁴

The cell abnormalities can be observed by specular microscopy and described as polymegethism (variability in cells size), polymorphism (variability in cells shape) and the number of corneal endothelial cells depending on the age of cells depending corneal endothelial cell count is approximately 2500 cells/mm² in an adult. If corneal endothelial cell count is less than 500cells/mm²there is a risk of developing corneal edema.⁴

Many conditions can affect corneal endothelium, including age and systemic diseases such as diabetes mellitus and atherosclerosis. Ocular diseases such as uveitis and dry eye also have adverse effect on corneal endothelium.^{5,6}

Cigarettes contain toxic substances which cause increased oxygen radicals and decreased ascorbic acid in aqueous humor.^{7,8} Use of cigarettes has been associated with ocular damage in the form of cataract, glaucoma, keratitis, age-related macular degeneration and thyroid eye disease.^{9,10} Different mechanisms have been proposed including decreased corneal sensitivity which increases the risk of keratitis and defective tear film leading to ocular surface damage and dry eye. Although there is ample evidence which shows association of smoking with ocular diseases, data investigating the effect of smoking on corneal endothelium is limited.¹¹⁻¹²

The aim of our study is to investigate the effect of smoking on the health of the corneal endothelium.

METHOD

It was a cross-sectional observational study conducted at Lamar eye center in Kerbala city in Iraq from December 2023 to January 2024. During this period, 108 eyes were selected, 54 eyes of smokers and 54 eyes of nonsmokers. All the participants were male. They had history of smoking for more than twenty years and smoke more than 40 cigarettes per day. The age of the participants (both groups) was between 50 and 60 years. After history, complete ocular examination was done including visual acuity by Snellen chart, Intraocular pressure (IOP) by air puff tonometer and anterior segment was examined by slit lamp and fundus examination by condensing lens +90. Participants with IOP of more than 22 were excluded

from the study. Participants with history of contact lens wear, refractive error of more than 2 diopters, uveitis, pseudo-exfoliation, diabetes, chronic retinal diseases and ocular trauma including ocular surgery were also excluded. Specular microscopy was done using Topcon specular microscope SP-1P and all data were saved. Four parameters were tested including central corneal thickness, hexagonality, cell density, and coefficient of variation.

Data analysis was done by SPSS version 29 and the difference between the two groups was analyzed using student t-test. P value of less than 0.05 was considered significant.

RESULTS

Mean age of the patients was 55 years. The corneal parameters are shown in Table 1.

Table 1: Difference between the corneal endothelial parameters between the smokers and non-smokers.

Parameters	Smokers	Non-smokers	p-value
Central Corneal Thickness	515.29±40.62	522.37±36.68	0.32
Coefficient of variation	33.39±4.90	33.02±7.89	0.77
Cell Density	2659.61±486.35	2586.78±453.64	0.47
Hexagonality	54.14±8.22	54.49±11.52	0.34

DISCUSSION

Many studies have examined the various effects of smoking on different systems of the human body, revealing that smoking impacts nearly all of them, including the eyes.¹³ Effect of smoking on cornea has been studied in different part of the world but local data from Iraq is very limited.

Effects of smoking on corneal epithelium is related to tear film instability, evidenced by lower tear stability values in smokers. Additionally, smokers exhibit more extensive corneal staining. These findings can help eye-care providers better manage dry eye conditions related to smoking.¹⁴ In our study four endothelial parameters have been studied in the two groups. According to some researchers, while neither diabetes (DM) nor smoking alone has a statistically significant effect on corneal endothelium, the combination of DM and smoking leads to a significant decrease in endothelial cell density.¹⁵ In our study we excluded patients with systemic diseases. There are

studies showing effect of smoking on lens and corneal clarity but direct effect of smoking on corneal clarity is still lacking.^{16,17}

Central corneal thickness is an indirect test for the corneal endothelial function as endothelial dysfunction leads to increase in corneal thickness due to accumulation of fluid in the corneal stroma.¹⁸ In our study corneal thickness was not significantly different between the two groups.

The other variant which was tested was the cell density. Normal corneal endothelium density differs according to age. The endothelial cells density is about six thousand cells per millimeter in the first month of life, by age of 20 years the number become about three thousand cells per millimeter and by the age of fifty years the number become about 2500 cells per millimeter.¹⁹ Corneal endothelial density remained similar in our groups.

The third variant was the coefficient of variation, which represent the variability in cells size. It is considered the most sensitive index of corneal endothelial dysfunction and the normal value should be less than 40.^{20,21} It was 33.39 and 33.02 in smokers and non-smokers respectively.

We also studied percentage of hexagonal cells. Less hexagonal cell percentage is associated with abnormal function even with normal count. The two groups had insignificant difference of hexagonality.

The variable results among different studies regarding effect of smoking could be due to other local factors. Some studies have concluded that smoking has no effect of corneal endothelium while other studies concluded an adverse effect.^{6,7} There are other studies which concluded that smoking had an effect only on corneal thickness and endothelial cells density with no effect on other parameters.^{5,8}

In comparison with the previous mentioned studied the different results may indicate that the genetic or the environmental factors may have a role to determine the effect of smoking on corneal endothelium.

Limitations of the study include gender bias which included only male participants. The age range was also not applicable to other groups. With only 108 eyes included, the sample size may be too small to detect subtle differences or to generalize the findings broadly. We also did not take into account specific demographic details of the participants which might

influence the applicability of the results to other populations.

CONCLUSION

The study concludes that smoking does not have a statistically significant effect on the corneal endothelium in terms of cell density, hexagonality, coefficient of variation, and central corneal thickness. However, it suggests that further studies are needed to provide more definitive evidence.

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Patient's Consent: Researchers followed the guidelines set forth in the Declaration of Helsinki.

Conflict of Interest: Authors declared no conflict of interest.

Ethical Approval: The study was approved by the Institutional review board/Ethical review board (23-25).

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Authors Designation and Contribution

Moaiad Abdul Lateef Almasoudy; Senior Ophthalmologist: *Concepts, Design, Literature search, Data analysis, Statistical analysis, Manuscript preparation.*

Wisam Hado; Senior Ophthalmologist: *Concepts, Literature search, Data acquisition, Manuscript review.*

Khaldoon Khalil Nile; Senior Ophthalmologist: *Concepts, Design, Manuscript preparation, Manuscript editing.*

