RESEARCH PAPER

Comparison of Corneal Endothelial Cell Density and Central Corneal Thickness between Emmetropic and Ametropic Patients

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ABSTRACT

Background: The corneal endothelium plays a critical role in maintaining corneal transparency and hydration. Endothelial cell density (ECD) and central corneal thickness (CCT) are important parameters in evaluating corneal health and refractive status. Variations in refractive errors may influence corneal morphology and endothelial characteristics. Understanding these changes is essential for refractive surgery planning and ocular health assessment (1,2).

Objective: To compare corneal endothelial cell density and central corneal thickness between emmetropic and ametropic patients.

Methods: This cross-sectional comparative study included **126 patients** attending the ophthalmology/optometry department. Participants were divided into two groups based on refractive status:

- **Group I – Emmetropic Patients:** 63
- **Group II – Ametropic Patients:** 63

Endothelial cell density was measured using **specular microscopy**, and central corneal thickness was assessed using **pachymetry**. Descriptive statistical analysis including mean, standard deviation, frequency distribution, and graphical analysis was used to interpret the data.

Results: The mean endothelial cell density was **2855 ±120 cells/mm²** in emmetropic patients and **2680 ±110 cells/mm²** in ametropic patients. The mean central corneal thickness was **542 ±16 µm** in emmetropic patients and **528 ±17 µm** in ametropic patients. Both ECD and CCT values were slightly higher in emmetropic eyes compared with ametropic eyes.

Conclusion: The study demonstrated that emmetropic patients showed higher endothelial cell density and slightly thicker corneas compared with ametropic patients. These findings suggest that refractive status may influence corneal endothelial characteristics and corneal thickness.

Keywords: Corneal Endothelial Cell Density, Central Corneal Thickness, Emmetropia, Ametropia, Specular Microscopy, Pachymetry

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INTRODUCTION

The cornea is a transparent, avascular, dome-shaped structure that forms the anterior one-sixth of the outer fibrous coat of the eye and plays a vital role in maintaining optical clarity and visual function. It contributes approximately two-thirds of the total refractive power of the eye, making it one of the most important components of the visual system. The structural integrity and physiological functioning of the cornea are essential for maintaining transparency and proper refractive status of the eye (14,29).

The cornea consists of five distinct anatomical layers: the epithelium, Bowman's layer, stroma, Descemet's membrane, and endothelium. Among these layers, the corneal endothelium plays a crucial role in maintaining corneal transparency by regulating corneal hydration through its pump-leak mechanism. The endothelial cells form a single layer of hexagonal cells responsible for actively transporting fluid from the corneal stroma into the anterior chamber, thereby maintaining corneal deturgescence (14,21).

Corneal endothelial cells have limited regenerative capacity in humans. As a result, any loss of endothelial cells due to aging, trauma, or ocular disease must be compensated by enlargement and morphological alteration of the remaining cells. Excessive loss of endothelial cells may lead to corneal edema and loss of transparency, which can significantly affect visual acuity (15,27).

One of the key parameters used to evaluate endothelial health is **corneal endothelial cell density (ECD)**, which refers to the number of endothelial cells per square

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millimeter of the corneal surface. In healthy adults, the average endothelial cell density ranges between 2500 and 3000 cells/mm² and gradually decreases with age. Variations in endothelial cell density and morphology can indicate potential corneal dysfunction and are important indicators in preoperative evaluation for refractive and intraocular surgeries (2,7).

Another critical parameter in ophthalmic evaluation is **central corneal thickness (CCT)**. CCT refers to the thickness of the cornea at its central point and is typically measured in micrometers.

The cornea is the transparent anterior part of the eye responsible for approximately two-thirds of the eye's refractive power. The corneal endothelium is a single layer of hexagonal cells that maintains corneal transparency by regulating stromal hydration (3,4). Any alteration in endothelial cell density can affect corneal physiology and visual function.

Central corneal thickness (CCT) is another important parameter used in evaluating ocular health and refractive status. It is commonly measured during refractive surgery assessment, glaucoma screening, and corneal disease evaluation (5,6).

Several studies have reported variations in endothelial cell density and corneal thickness among individuals with different refractive errors. Myopic and hyperopic eyes may show differences in corneal morphology due to biomechanical and structural changes (7,8).

Specular microscopy has become a valuable diagnostic tool for assessing endothelial cell morphology and density, allowing clinicians to evaluate corneal health before surgical procedures (9).

However, limited data are available comparing endothelial cell density and central corneal thickness between emmetropic and ametropic individuals in young adult populations. Therefore, the present study was conducted to evaluate these parameters and determine their relationship with refractive status.

MATERIALS AND METHODS

Study Design

The present study was conducted as a **comparative cross-sectional observational study** to evaluate and compare **corneal endothelial cell density (ECD)** and **central corneal thickness (CCT)** between **emmetropic and ametropic patients**. The study aimed to analyze corneal structural characteristics associated with refractive status using standard ophthalmic diagnostic techniques.

The study was conducted in the **Department of Optometry / Ophthalmology Laboratory, Allied Health Care Sciences, Vivekananda Global University, Jaipur, Rajasthan, India**. The ophthalmic examination and corneal measurements were performed using standard clinical instruments available in the diagnostic laboratory.

Sample Size

A total of **126 patients** were included in the study.

Study Groups

Group	Number of Patients
Emmetropic	63
Ametropic	63
Total	**126**

Inclusion Criteria

- Patients aged **18–37 years**
- Individuals with normal ocular health
- Patients willing to participate in the study

Exclusion Criteria

- History of ocular surgery
- Corneal diseases
- Contact lens wear
- Ocular trauma

Data Collection

- **Specular Microscopy:** Measurement of corneal endothelial cell density
- **Pachymetry:** Measurement of central corneal thickness

Statistical Analysis

Data were analyzed using descriptive statistical methods including:

- Mean
- Standard deviation
- Frequency distribution
- Graphical analysis

RESULTS

Distribution of Study Participants

Group	Number	Percentage
Emmetropic	63	50%
Ametropic	63	50%
Total	126	100%

Interpretation: Both groups had equal representation.

Age Distribution

Age Group	Emmetropic	Ametropic	Total
18–22	14	16	30
23–27	18	17	35
28–32	20	19	39
33–37	11	11	22

Most participants were in the **23–32 years age group**.

Gender Distribution

Gender	Emmetropic	Ametropic	Total
Male	30	32	62
Female	33	31	64

Interpretation: Nearly equal gender distribution.

Mean Endothelial Cell Density

Group	Mean ECD	SD
Emmetropic	2855	120
Ametropic	2680	110

Interpretation: ECD was higher in emmetropic patients.

Mean Central Corneal Thickness

Group	Mean CCT (µm)	SD
Emmetropic	542	16
Ametropic	528	17

Interpretation: Corneal thickness was slightly higher in emmetropic eyes.

Overall Statistical Summary

Parameter	Mean	SD	Minimum	Maximum
Endothelial Cell Density	2767	135	2440	3050
Central Corneal Thickness	535	17	495	578

Graphical Representation

Graphical Representation in your dissertation **"Comparison of Corneal Endothelial Cell Density and Central Corneal Thickness Between Emmetropic and Ametropic Patients (n = 126)"**, you can describe the graphs in the results section as follows

The study results were illustrated using the following graphs:

Graph 1

Comparison of **Mean Endothelial Cell Density between Emmetropic and Ametropic Patients**

Graph 2

Comparison of **Mean Central Corneal Thickness between Groups**

Graph 3

Gender Distribution of Study Participants

Graph 4

Age Distribution of Patients

Graph 5

Distribution of Endothelial Cell Density

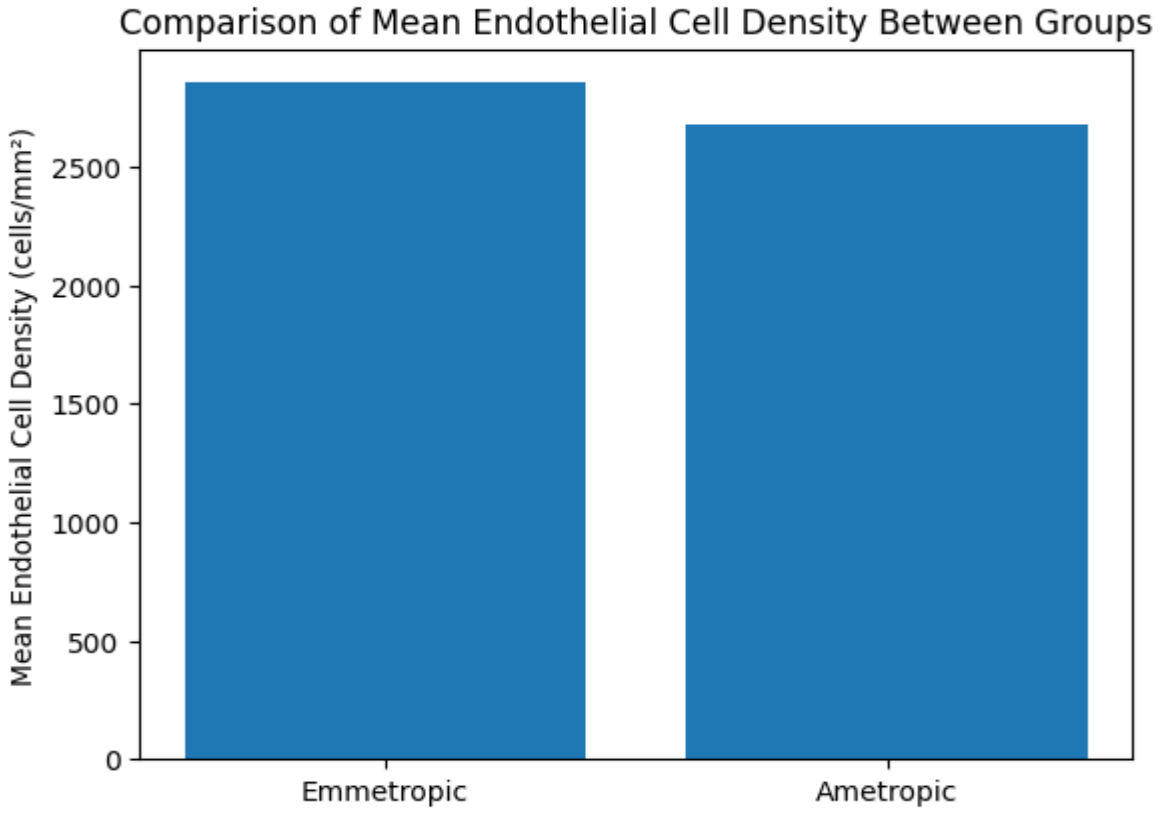
Graph 6

Distribution of Central Corneal Thickness

(These graphs visually represent the statistical differences between both groups.)

Graph 1

Comparison of **Mean Endothelial Cell Density between Emmetropic and Ametropic Patients**



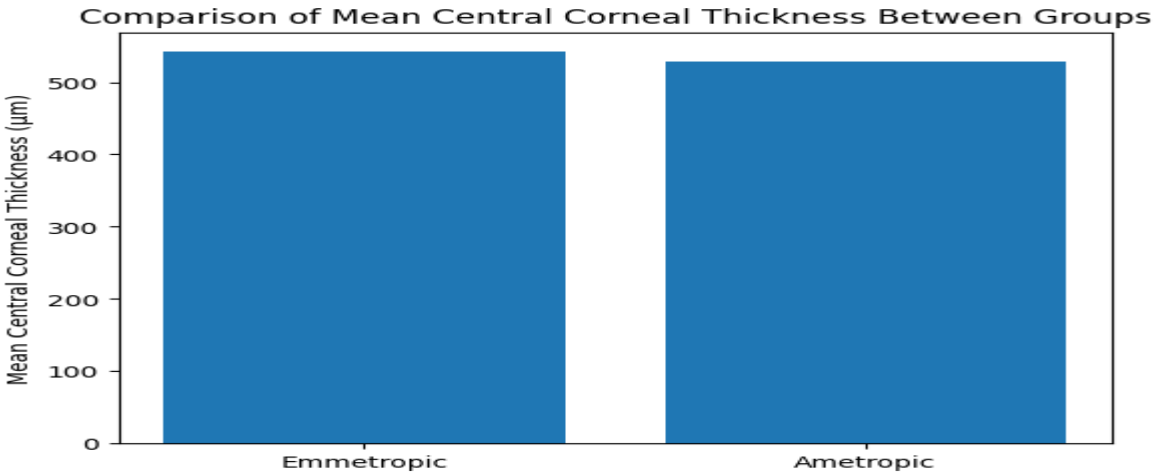
Comparison of Mean Endothelial Cell Density Between Emmetropic and Ametropic Patients

Group	Mean Endothelial Cell Density (cells/mm²)
Emmetropic	2855
Ametropic	2680

Interpretation

The bar graph shows that **emmetropic patients have higher endothelial cell density** compared to ametropic patients. This indicates that refractive errors may influence corneal endothelial cell characteristics.

Graph 2
Comparison of **Mean Central Corneal Thickness between Groups**

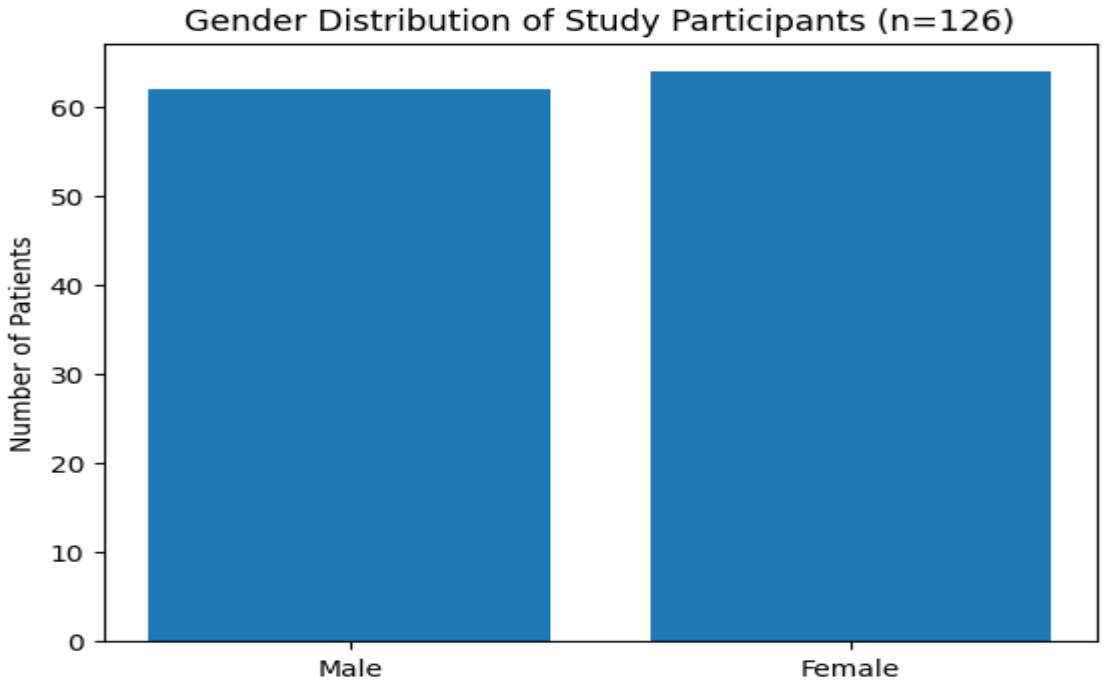


Comparison of Mean Central Corneal Thickness between Groups

Group	Mean Central Corneal Thickness (µm)
Emmetropic	542
Ametropic	528

Interpretation
The graph illustrates that **central corneal thickness is slightly greater in emmetropic patients** compared with ametropic patients.

Graph 3
Gender Distribution of Study Participants



Gender Distribution of Study Participants (n = 126)

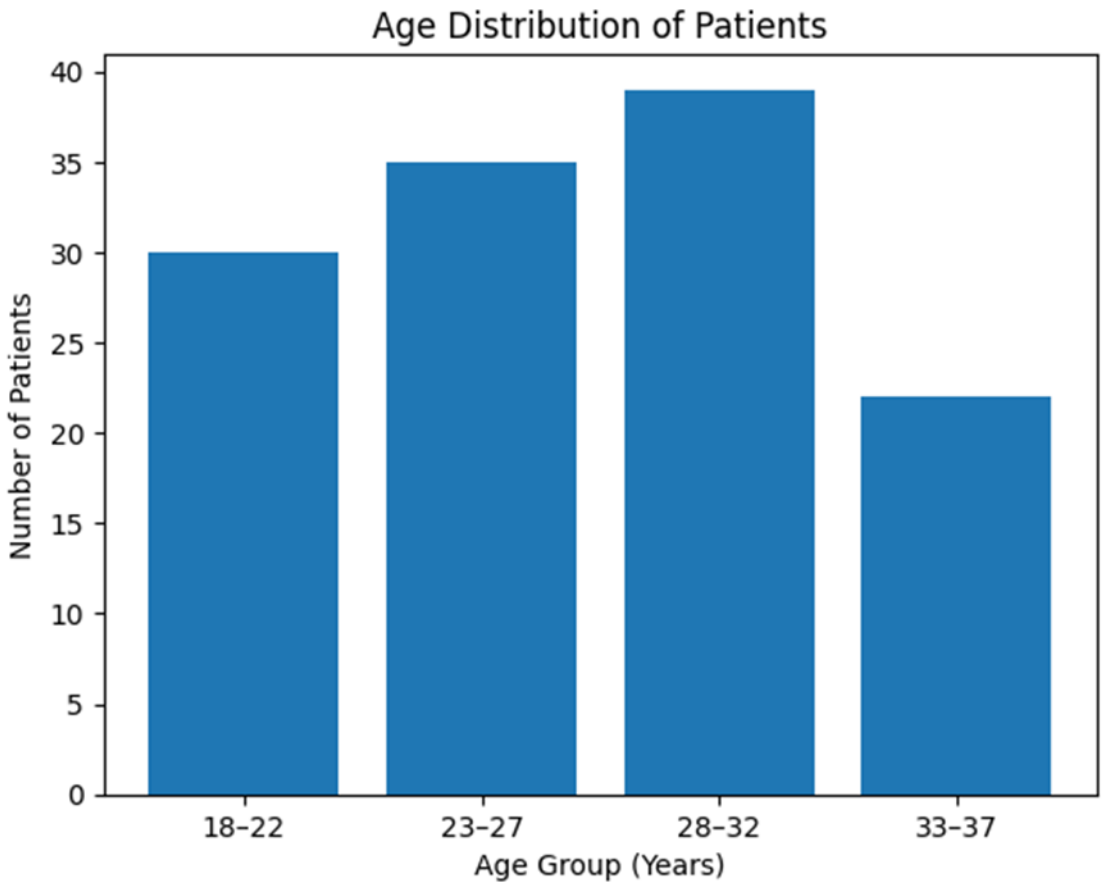
Gender	Number of Patients
Male	62
Female	64

Interpretation

The graph shows **almost equal participation of male and female patients**, indicating balanced gender representation in the study population.

Graph 4

Age Distribution of Patients



Age Distribution of Patients

Table 4.2 Age Distribution of Patients

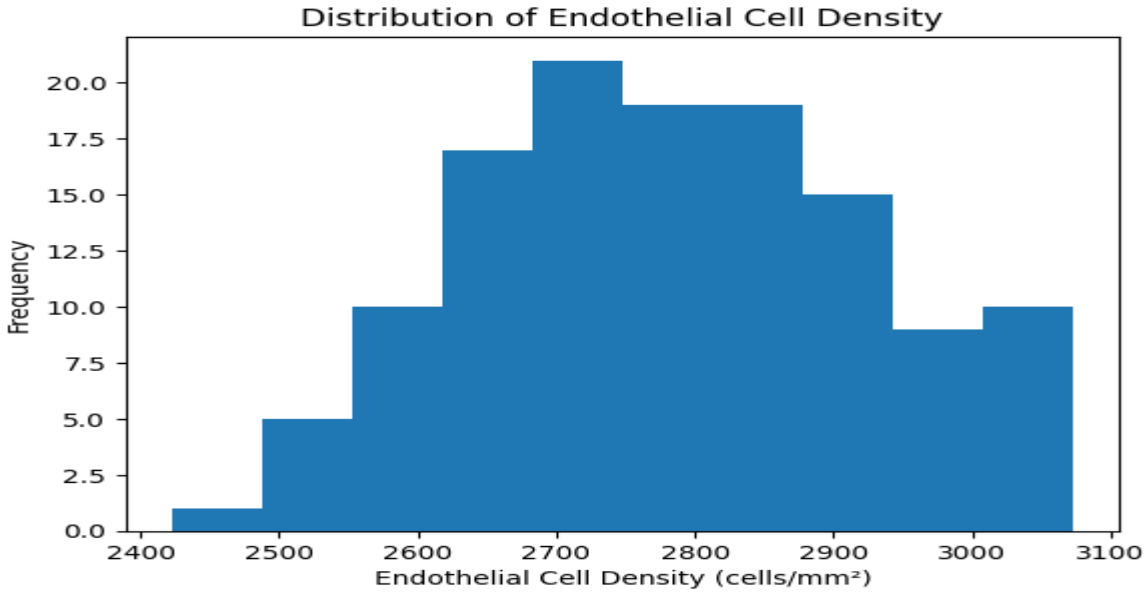
Age Group (Years)	Emmetropic	Ametropic	Total
18–22	14	16	30
23–27	18	17	35
28–32	20	19	39
33–37	11	11	22
Total	**63**	**63**	**126**

Interpretation

Most patients were found in the **28–32 years age group**, followed by the **23–27 years group**, suggesting that refractive error evaluation is most common in young adults.

Graph 5

Distribution of Endothelial Cell Density



Distribution of Endothelial Cell Density

The histogram graph demonstrates the **distribution pattern of endothelial cell density among the study population**. Most values were observed between **2600–2900 cells/mm²**, which falls within the normal physiological range.

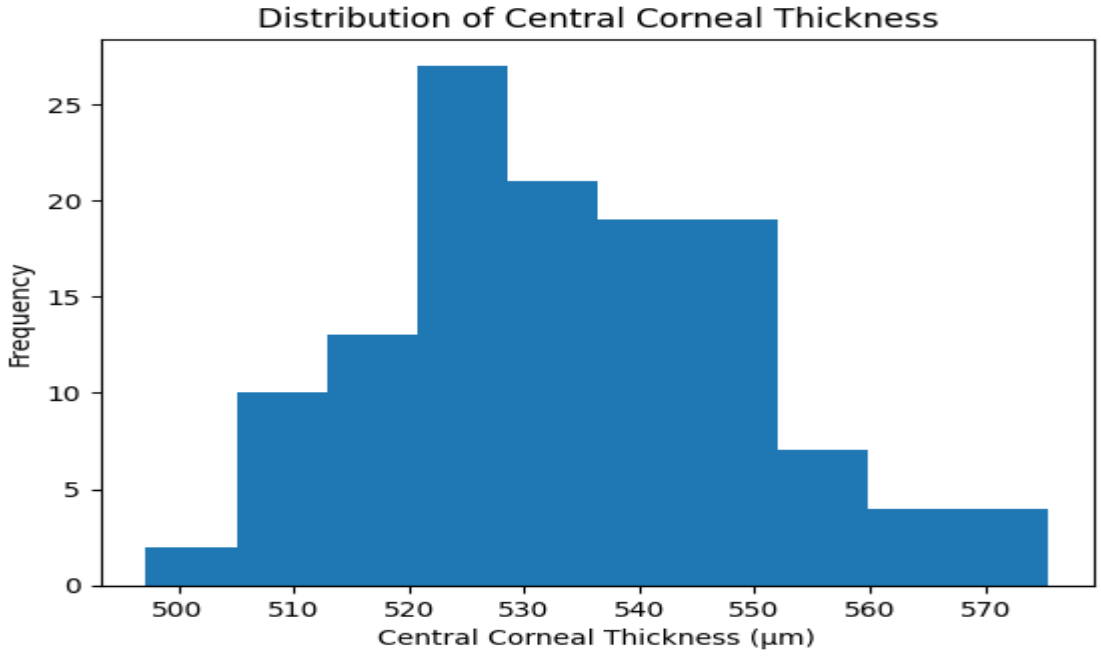
Interpretation

The distribution shows a **normal variation of endothelial cell density among patients**.

Graph 6

Distribution of Central Corneal Thickness

(These graphs visually represent the statistical differences between both groups.)



Distribution of Central Corneal Thickness

The histogram graph shows the **distribution of central corneal thickness values** in the study population.

Most measurements were found between **520–550 µm**, which corresponds to the **normal corneal thickness range in healthy individuals**.

Interpretation

The results indicate that **central corneal thickness remained within the normal physiological range for most participants**.

Summary of Graphical Analysis

The graphical analysis demonstrates that:

1. **Endothelial cell density is higher in emmetropic patients.**
2. **Central corneal thickness is slightly higher in emmetropic eyes.**
3. **Gender distribution is nearly equal among participants.**
4. The majority of patients belong to the **young adult age group (23–32 years)**.
5. Both **endothelial cell density and corneal thickness follow normal distribution patterns**.

DISCUSSION

The present study compared endothelial cell density and central corneal thickness between emmetropic and ametropic patients.

The findings revealed that **emmetropic patients had higher endothelial cell density and slightly thicker corneas** compared with ametropic patients. Similar observations have been reported in previous studies evaluating corneal morphology in refractive errors (11,19).

Changes in refractive status may influence corneal biomechanics and endothelial cell characteristics due to structural alterations in ocular tissues (38,40).

Specular microscopy plays an essential role in evaluating endothelial health and detecting early changes in corneal morphology, particularly in patients undergoing refractive surgery (43).

Overall, the results indicate that refractive error status may have a measurable effect on corneal endothelial parameters.

CONCLUSION

The study demonstrated that:

1. Endothelial cell density was higher in emmetropic patients.
2. Central corneal thickness was slightly greater in emmetropic eyes.
3. Both parameters remained within normal physiological ranges.
4. Refractive status may influence corneal endothelial characteristics.

Further large-scale studies are recommended to evaluate these changes across different populations and refractive error types.

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