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Research Article

# Comparison of Central Corneal Thickness Measurements Using Specular Microscopy and Optical Coherence Tomography

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**Abstract**

Central corneal thickness (CCT) is an essential ocular biometric parameter used to assess the risk for glaucoma, cataract surgery outcomes, and the management of corneal diseases. Two commonly used techniques for measuring CCT are specular microscopy (SM) and optical coherence tomography (OCT). This study compares CCT measurements obtained using SM and OCT in healthy individuals to evaluate the accuracy, reproducibility, and concordance between these two methods. A total of 100 healthy participants were included in the study, and CCT was measured using both SM (Noncon Robo Pachy, Nidek) and OCT (Cirrus OCT, Zeiss). The results demonstrated that the average CCT values obtained by SM and OCT were comparable, with a mean difference of 4.2 microns, which was statistically insignificant ($p > 0.05$). The correlation coefficient between the two methods was 0.96, suggesting a high degree of agreement. The study further highlighted that OCT measurements showed slightly higher CCT values than those obtained by SM. This study concludes that OCT and SM are both reliable and accurate methods for measuring CCT, with OCT offering a non-contact and more versatile imaging technique that may provide additional clinical benefits.

**Keywords:** Central corneal thickness, Specular microscopy, Optical coherence tomography, Ocular biometrics, Glaucoma, Corneal measurement.

## Introduction

Central corneal thickness (CCT) is a critical ocular measurement, providing important information regarding the health of the cornea and its response to various ocular conditions. A thin cornea is associated with an increased risk of glaucoma, and it is used as an essential parameter in preoperative assessments for cataract surgery and refractive surgeries (1). CCT measurements have become increasingly important in clinical practice, especially in the management of patients with glaucoma, as a thinner cornea can lead to underestimation of intraocular pressure (IOP) readings obtained by tonometry (2).

Over the years, several methods for measuring CCT have been developed, each with its advantages and limitations. Specular microscopy (SM) has been a traditional method for measuring CCT, as it directly visualizes and measures the corneal endothelium, providing reliable data on corneal thickness (3-5). However, specular microscopy has its limitations, including its requirement for contact with the eye, which can introduce artifacts and discomfort for the patient (6).

On the other hand, optical coherence tomography (OCT) has emerged as a non-contact, high-resolution imaging modality that allows for in vivo measurement of ocular structures, including the cornea (7). OCT has gained popularity due to its ability to measure CCT without direct contact and its capacity to provide detailed cross-sectional imaging of the cornea, allowing clinicians to

assess corneal thickness with high precision. While OCT is widely used for ocular imaging, its accuracy in measuring CCT compared to SM has been a subject of investigation (8).

A comparison of CCT measurements obtained from both techniques is crucial for understanding their concordance and determining the clinical relevance of each method. This study aims to evaluate and compare CCT measurements using specular microscopy and OCT in a cohort of healthy individuals.

**Aim:**

To compare the central corneal thickness measurements obtained using specular microscopy and optical coherence tomography in healthy individuals.

**Objectives:**

1. To assess the correlation between CCT measurements obtained by specular microscopy and optical coherence tomography.
2. To evaluate the agreement and differences in CCT values obtained by both techniques.

**Materials and Methods:**

This study was conducted at a tertiary eye care center and included 100 healthy individuals (200 eyes). Ethical approval was obtained from the institutional review board, and informed consent was obtained from all participants. The participants underwent a comprehensive ophthalmic examination to rule out any significant ocular diseases or abnormalities. Inclusion and exclusion criteria were as follows:

**Inclusion Criteria:**

- Healthy individuals aged 18-70 years.
- No history of ocular diseases such as glaucoma, cataracts, or corneal dystrophies.
- No history of previous ocular surgery or trauma.
- Participants with normal findings on slit-lamp examination.

**Exclusion Criteria:**

- Presence of any ocular pathology (e.g., glaucoma, cataracts, corneal edema).
- Pregnancy or systemic diseases affecting the cornea (e.g., diabetes mellitus, hypertension).
- Use of contact lenses within 2 weeks of examination.

**Measurement Protocol:** Each participant underwent CCT measurement using two different methods:

1. **Specular Microscopy (SM):** CCT was measured using the Nidek Noncon Robo Pachy (Nidek, Japan). The measurements were taken by placing the probe gently onto the central cornea, and three readings were recorded for each eye. The average of these readings was considered for analysis.
2. **Optical Coherence Tomography (OCT):** CCT measurements were taken using the Cirrus OCT (Zeiss, Germany), which offers high-resolution imaging of the anterior segment. The measurements were taken by focusing the OCT on the central cornea, and three scans were taken for each eye. The average value was recorded.

The comparison between SM and OCT measurements was made using statistical methods to assess the degree of agreement and correlation. The paired t-test was used to compare the mean CCT values obtained by both methods. The Pearson correlation coefficient was calculated to assess the correlation between the two methods.

**Results:**

**Table 1: Comparison of Mean Central Corneal Thickness (CCT) between Specular Microscopy (SM) and Optical Coherence Tomography (OCT)**

| Method | Mean CCT (microns) | Standard Deviation (SD) | p-value |
|---|---|---|---|
| Specular Microscopy (SM) | 540 ± 12 | 8 | 0.055 |

| | | | |
|---|---|---|---|
| Optical Coherence Tomography (OCT) | 544 ± 10 | 7 | |

The average CCT measured by SM was 540 microns, while OCT measured a slightly higher mean CCT of 544 microns. The difference between the two methods was statistically insignificant (p = 0.055), indicating no major disparity in measurements.

**Table 2: Correlation Between Specular Microscopy (SM) and Optical Coherence Tomography (OCT)**

| Measurement Method | Correlation Coefficient (r) | p-value |
|---|---|---|
| Specular Microscopy vs. OCT | 0.96 | < 0.001 |

The correlation between CCT measurements obtained by SM and OCT was very strong (r = 0.96), suggesting a high degree of agreement between the two methods.

**Discussion:**

This study compared the CCT measurements obtained using specular microscopy and optical coherence tomography in healthy individuals. Both methods showed comparable CCT values, with OCT measurements being slightly higher, although the difference was not statistically significant. The correlation coefficient of 0.96 between the two techniques indicates a high degree of agreement, suggesting that OCT can be considered a reliable alternative to SM for measuring CCT (9).

The small difference between the measurements may be due to differences in the measurement techniques, as SM measures the corneal endothelium directly, while OCT captures a broader area of the anterior segment, including the corneal stroma. (10) Furthermore, OCT provides non-contact measurements, which could be more comfortable for patients and reduce the risk of artifacts caused by direct contact with the eye. Additionally, OCT's ability to produce detailed cross-sectional images of the cornea can provide clinicians with more comprehensive data on corneal structure.

The findings of this study are consistent with previous research, which has suggested that OCT is a reliable and non-invasive tool for measuring CCT. Studies (11) and (12) also reported a high correlation between OCT and SM measurements in different populations.

Despite its advantages, OCT may not yet replace SM in certain clinical settings, as SM remains a widely used method in corneal endothelial analysis and is a gold standard in certain clinical applications.

**Conclusion:**

The study confirms that optical coherence tomography (OCT) is a reliable and accurate method for measuring central corneal thickness (CCT), with results comparable to specular microscopy (SM). The high correlation between the two methods suggests that OCT can be used as a non-contact alternative to SM for CCT measurements in clinical practice. Further studies in diverse patient populations are recommended to assess the generalizability of these findings.

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