

Clinical Validation of the Cassini Color LED Corneal Topography (CLCT) in post penetrating keratoplasty (PKP)

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Source

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Purpose:

To report results of a clinical investigation involving comparison of corneal aberration measurements of CLCT with conventional Placido based and Scheimpflug based topographers.

Methods:

23 PKP eyes from 16 subjects (age: 58 years $\pm$ 14 years, ranging from 35 to 81 years, 9 OD and 14 OS) were measured by three instruments: Cassini (i-Optics BV, The Hague, The Netherlands), OPD Scan (Nidek, Gamagori, Japan) and Pentacam (Oculus, Wetzlar, Germany). Corneal aberrations (Zernike Convention at 6 mm corneal zone) were compared. An artificial toric surface with gold standard measurement of 2.22 Diopter was also measured to assess the accuracy of the instruments. The standard deviation of three trials for every eye measurement was used to characterize precision of the instrument. The measurement with median defocus was used for inter-instrument comparison. The paired student's t-test was used on the median data to find statistically significant differences.

Results:

Nidek OPD measures astigmatism of the toric surface with 2.7% error while CLCT measures the toric surface with 0.5% error. The Pentacam has a precision reaching a mean of 0.25 μ m for astigmatism measurements. Both the OPD and CLCT do not exceed a mean of 0.096 μ m of precision in the measurement of corneal aberrations. Statistically significant differences have been found between the Cassini and the OPD for astigmatism ($p = 0.0292$) and quadrafoil ($p = 0.0281$) aberrations. The spherical aberration measured with Pentacam was significantly different from both Cassini and OPD ($p = 0.0114$ and $p = 0.0194$ respectively).

Conclusion:

The lower accuracy of the OPD in measuring rotationally non-symmetric aberrations such as astigmatism and quadrafoil, can be explained by the fact that rings are used in the measurement. The use of rings does not measure the irregular features of the cornea accurately. The poorer repeatability of the Pentacam is a result of motion artifacts during acquisition. The Cassini and the OPD have comparable repeatability because it takes instantaneous measurements and is therefore not affected by motion artifacts. Among the three instruments, the Cassini measures corneal aberrations both accurately and precisely. >>

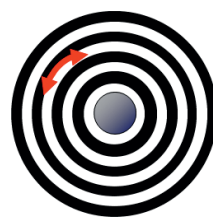
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Clinical Impact

This study shows that Placido ring based corneal topography is not accurate in measurements of rotationally non-symmetric shape features while the Scheimpflug technique is different in measurements of spherical aberration.

Because the Cassini CLCT measures all corneal shape features accurately, significant differences were found between Cassini measurements compared to that of the OPD scan and the Pentacam. Another advantage that was observed in this study is the better repeatability of Cassini measurements compared to that of the Pentacam. The Cassini therefore fulfills both accuracy and precision requirements that is important in clinical practice.

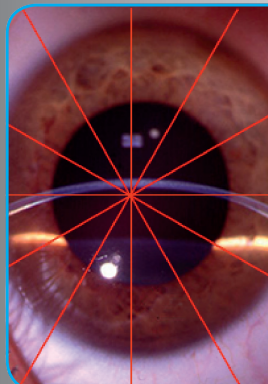
Placido based Nidek OPD



Placido principle

The OPD Scan corneal shape measurement is based on the placido principle. Rings are projected on the cornea and the reflections are imaged. The image processing software of the OPD Scan detects the rings and the ring locations are used to calculate corneal shape. Corneal surface depth variation along the rings are not reliably captured because of the ring pattern. This results in an inaccuracy in determining aberrations that are not rotationally symmetric such as astigmatism and quadrafoil

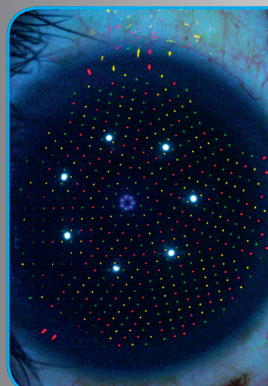
Scheimpflug based Oculus Pentacam



Scheimpflug principle

The pentacam is based on the scheimpflug principle. The pentacam is able to measure the rotationally non-symmetric features accurately. However, the image acquisition involves a rotation of the imaging system. This results in motion artifacts due to inevitable eye movement during the longer acquisition time. These displacements make the pentacam measurements less repeatable.

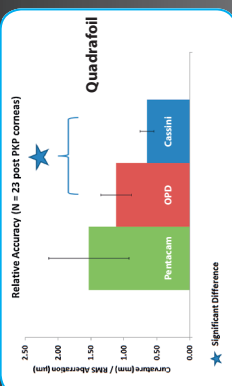
Color Led Corneal Topography i-Optics Cassini



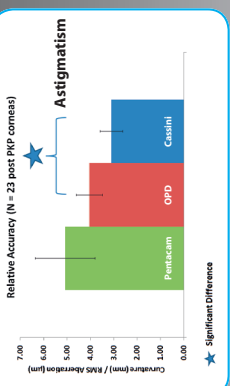
CLCT Principle

The Cassini is based on the CLCT principle. Points are used instead of rings so that both rotationally symmetric and non-symmetric features of the cornea can accurately be measured. The Cassini can acquire measurements at high speed, similar to placido based systems. A colored LED pattern is used to uniquely identify LEDs in the image.

Quadrafoil



Astigmatism



Spherical Aberration



Higher Order Aberrations

