Swept-Source OCT Biometry–Derived Corneal Optical Quality: Repeatability Limits for IOL Design Selection in Refractive Cataract Surgery

Background and Purpose

Modern refractive cataract surgery increasingly depends on comprehensive assessment of corneal optical quality to guide intraocular lens (IOL) selection and optimize postoperative visual outcomes. This consideration is particularly pertinent in the context of presbyopia-correcting, multifocal, extended depth-of-field (EDOF), and enhanced monofocal IOLs, where higher-order aberrations (HOAs) and corneal spherical aberration may significantly influence contrast sensitivity, scotopic vision, and overall patient satisfaction.

Although swept-source OCT (SS-OCT) biometers are widely used for ocular biometry, the repeatability of their wavefront-derived corneal optical quality measurements had not previously been established in cataract patients.

The purpose of this study was to evaluate the repeatability and measurement reliability of corneal wavefront metrics obtained with the ANTERION® platform with SS-OCT (Heidelberg Engineering) and assess their potential clinical relevance for IOL design selection in refractive cataract surgery.

Methods

A retrospective instrument evaluation study was performed at the Department of Ophthalmology, Hanusch Hospital, Vienna, Austria. The study included 56 eyes of 56 cataract patients who underwent three consecutive preoperative scans using ANTERION®. All measurements were acquired by a single operator under standardized conditions. Corneal higher-order aberrations, including coma, trefoil, spherical aberration, and total HOA root mean square (RMS), were analyzed across 3-mm, 4-mm, and 5-mm pupil-centered optical zones. Repeatability was evaluated using within-subject standard deviation (Sw), Repeatability limits (R = 2.77 × Sw), Intraclass correlation coefficients (ICC), and Coefficients of variation (COV).

Results

ANTERION® demonstrated excellent repeatability for corneal wavefront parameters.

At the 4-mm optical zone:

Parameter (µm)	Repeatability Limit (R)	ICC
Coma	0.08 um	0.88
Trefoil	0.06 um	0.85
Spherical Aberration	0.03 um	0.84
Total Corneal HOA RMS	0.07 um	0.89

Conclusions

Corneal optical quality parameters can be reliably derived from the ANTERION® platform with SS-OCT at optical zones relevant to refractive cataract surgery. The study demonstrates that SS-OCT-derived corneal aberrometry provides measurement precision comparable to dedicated anterior segment devices and may support more informed IOL selection in refractive cataract surgery. Clinicians should consider measurement repeatability limits when interpreting corneal wavefront metrics that may influence IOL design selection, patient counseling, and future outcome-based research.

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