Comparative Diagnostic Efficacy of Swept-Source OCT and Scheimpflug Imaging in Clinically Unaffected Eyes of Very Asymmetric Ectasia

Background and Purpose

Early detection of corneal ectasia is essential for identifying patients at risk of disease progression and for patient selection to prevent postoperative ectasia following refractive surgery. Detecting the earliest structural changes remains challenging because conventional topographic and tomographic parameters may appear normal before clinical signs develop.

Recent advances in anterior segment imaging and artificial intelligence have enabled the development of new diagnostic indices that combine multiple corneal parameters to improve early ectasia detection.

This study compared the diagnostic performance of SCORE* (Screening Corneal Objective Risk of Ectasia) obtained with the ANTERION® swept-source OCT platform (Heidelberg Engineering) against established Scheimpflug-based tomography and biomechanical indices, including Tomographic Biomechanical Index (TBI v2), Belin/Ambrósio Display Final D (BAD-D) and Pentacam Random Forest Index (PRFI), for identifying clinically unaffected fellow eyes of patients with very asymmetric ectasia.

Methods

A prospective cross-sectional study was performed at the Department of Ophthalmology, University Hospital Carl Gustav Carus, TU Dresden, Germany.

The study included:

- 228 healthy eyes
- 308 keratoconus eyes
- 91 eyes from patients with very asymmetric ectasia with no clinical ectasia signs (VAE-NES) with ectasia in the fellow eye
- 75 unoperated fellow eyes from patients with very asymmetric ectasia with ectasia (VAE-E)

All participants underwent examination using:

- Slit lamp biomicroscopy
- Swept-source OCT (ANTERION®)
- Rotating Scheimpflug tomography (Pentacam® HR)
- Air-puff tonometry (Corvis® ST)

Receiver operating characteristic (ROC) curve analysis was performed to evaluate the diagnostic performance of each parameter in differentiating normal and ectatic eyes, including the assessment of sensitivity and specificity.

Based on:

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Results

SCORE demonstrated excellent diagnostic performance for detecting early ectasia susceptibility.

Receiver Operating Characteristic (ROC) analysis of parameters in detecting VAE-NES eyes from healthy eyes:

Parameter	Device/s	AUC	Sensitivity	Specificity
SCORE	ANTERION®	0.888	75%	85%
TBI	Pentacam HR + Corvis ST	0.847	77%	81%
PRFI	Pentacam HR	0.765	58%	86%
BAD-D	Pentacam HR	0.686	41%	90%

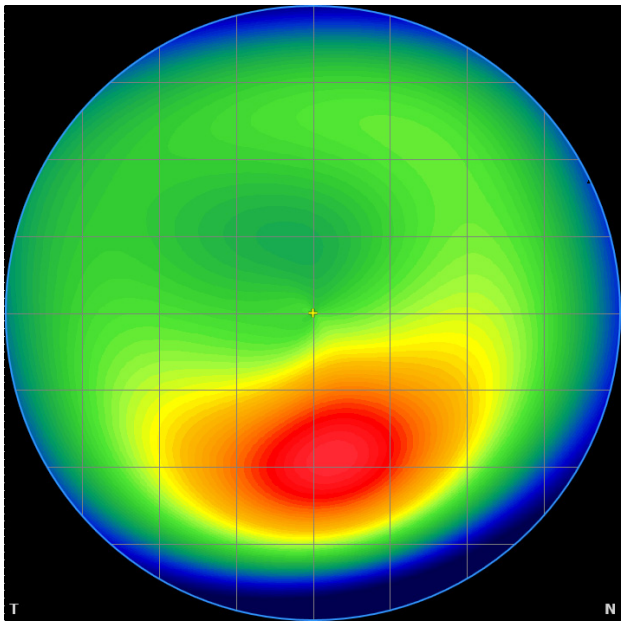
Additional findings included:

- SCORE demonstrated significantly higher diagnostic performance than PRFI and BAD-D.
- SCORE showed comparable performance to TBI, despite TBI combining tomography with biomechanical measurements.
- Among tomography-only parameters, SCORE provided the highest diagnostic accuracy for detecting eyes without clinical signs but with ectasia susceptibility.
- For distinguishing healthy eyes from all ectatic eyes, SCORE achieved an AUC of 0.978, demonstrating excellent overall diagnostic capability.

Conclusions

This study demonstrates that the SCORE index derived from the ANTERION® platform with swept-source OCT provides excellent diagnostic performance for detecting early ectasia susceptibility.

SCORE achieved diagnostic performance comparable to the combined tomographic and biomechanical TBI while significantly outperforming conventional Scheimpflug-derived tomographic indices, including BAD-D and PRFI.



▲ Typical cone in early ectatic disease

*Powered by Dr. Gatinel and Dr. Saad for AInsight

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