Initial outcomes with customized myopic PRK, guided by automated ray tracing optimization: a novel technique

Using multiple diagnostics (Sitemap) and artificial intelligence to customize laser ablations
First clinical data

Is corneal imaging our most reliable tool today for laser vision correction?

ASCRS
ANNUAL MEETING
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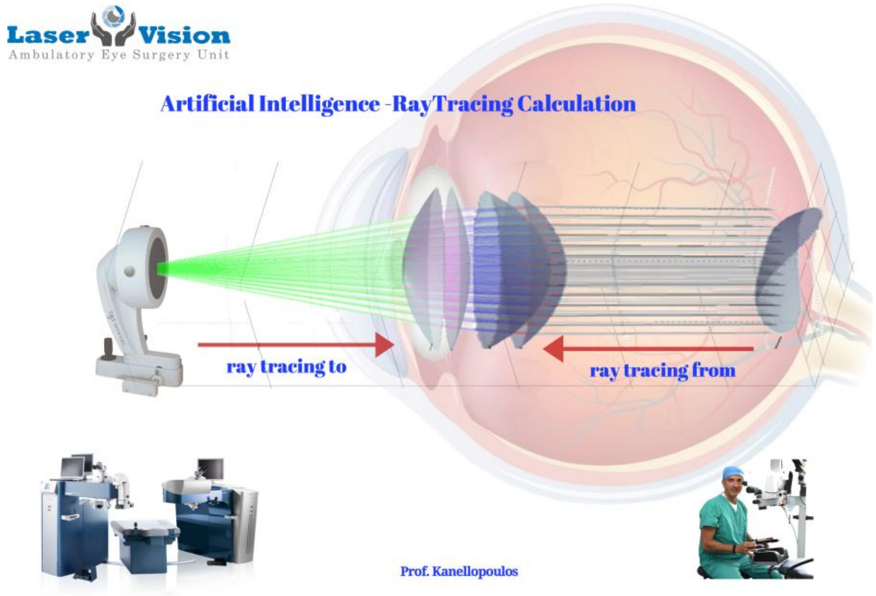

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[2] Consultant for AJKMD events, Alcon, Avedro, i-Optics, Keramed, Zeiss, ISP Surgical

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Utilizing topography-guided LASIK

AAO New Orleans 2004 **Kanellopoulos AJ**

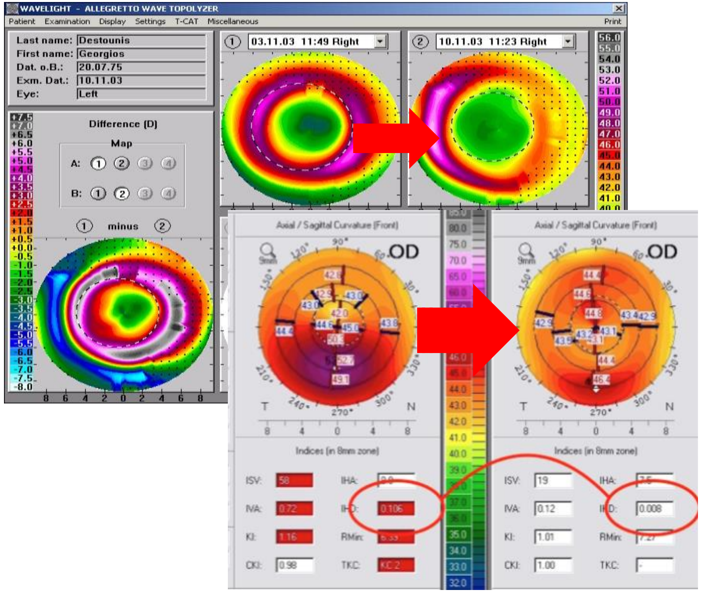
Tool for irregular corneas

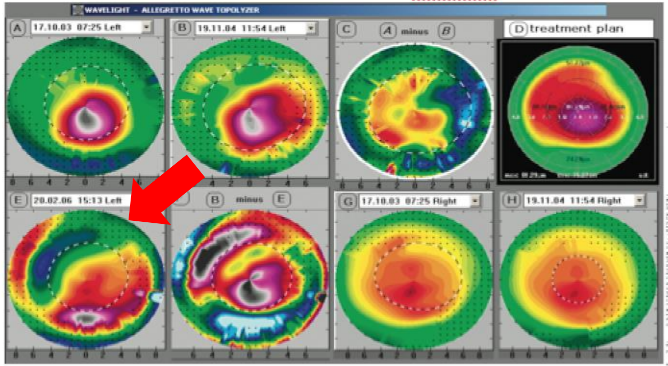
J Cornea
August 2007

Topography-guided Custom Retreatments in 27 Symptomatic Eyes

A. John Kanellopoulos, MD

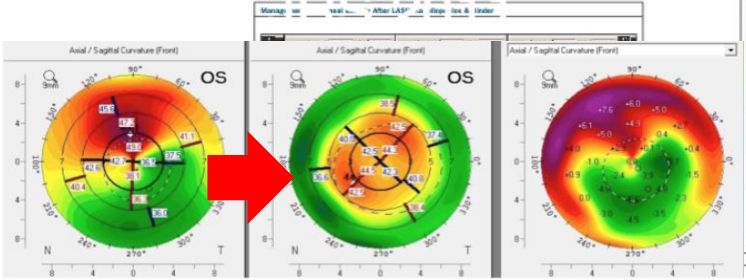
JRS Sept/Oct 2005

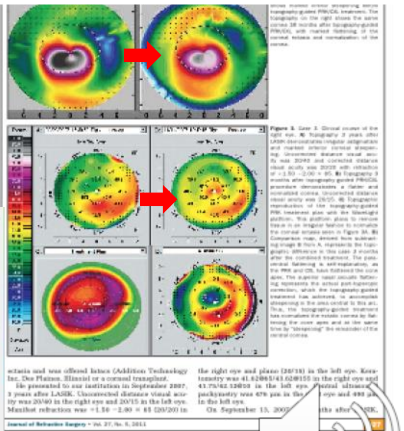




Management of Corneal Ectasia After LASIK With Combined, Same-day, Topography-guided Partial Transepithelial PRK and Collagen Cross-linking: The Athens Protocol

Anastasios John Kanellopoulos, MD; Perry S. Binder, MS, MD





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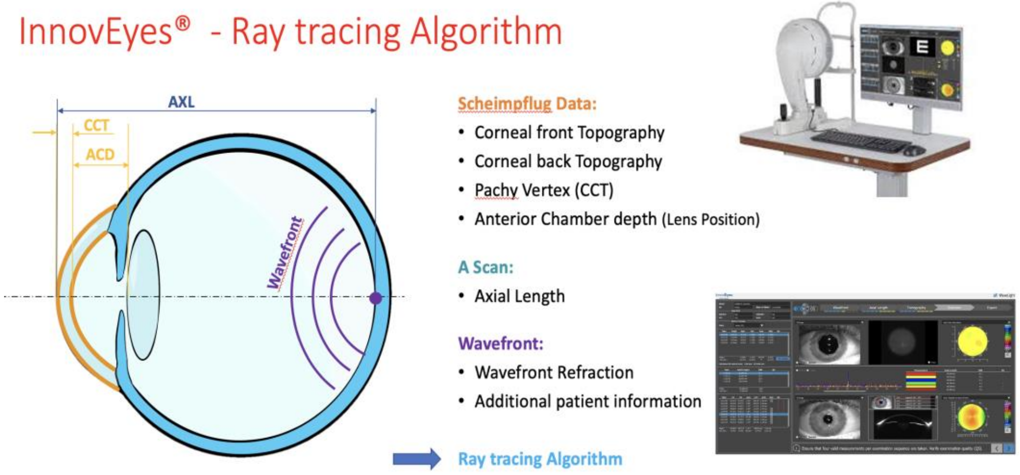
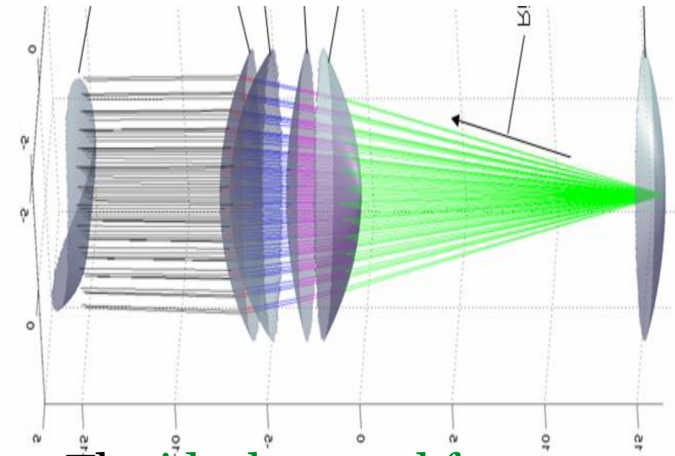
Methods:

In a consecutive case series, 10 patients (20 eyes) undergoing PRK were evaluated. The novel, artificial-intelligence platform, initially calculates the ablation profile based on a model eye for each case, based on interferometry axial length data. Low and high order aberrations calculation is performed by ray-tracing based on Wavefront and Scheimpflug tomography measurements, all from a single diagnostic device. Visual Acuity, refractive error, keratometry, topography, high order aberrations and contrast sensitivity were evaluated, over six months follow-up.





The ideal corneal front surface can be calculated based on an individualized 3-dim eye model derived from topography, wavefront and biometric measurements of a patient eye

Once received by the treatment computer the data are processed by the artificial intelligence in the device software in 4 steps to calculate ray tracing in 2 “opposite” directions:

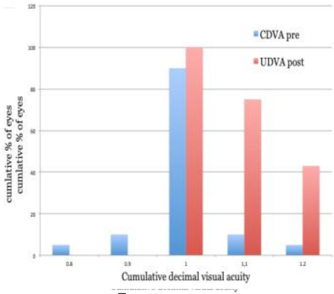
Step 1: The axial length measurements give precise measurements of all anatomical refractive surfaces in the line-of-sight and a theoretical model eye is “constructed” with them, in order to proceed to the next steps.

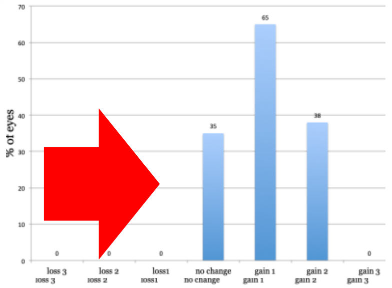
Step 2: The corneal tomography measurements are used to calculate the propagation of light rays (2000 in number) through the anterior corneal surface, the cornea stroma, out the posterior corneal surface, through the anterior chamber and onto the anterior lens surface.

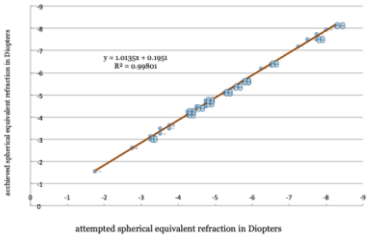
Step 3: The Wavefront data are used to calculate each of the above light-ray “travel” in a retrograde fashion: From the retina, through the vitreous cavity, onto the posterior lens surface, through the crystalline lens, and onto the anterior surface of the lens. 2000 rays are actually traced and calculated in these 2 steps for the algorithm determination.

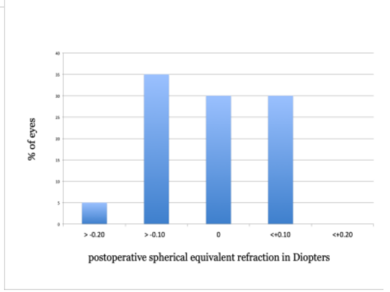
Step 4: A final fourth step: Tilt is calculated by the Scheimpflug tomography images and the incidence of rays projected onto the anterior surface of the cornea. The internal tilt between the actual anterior cornea surface orientation towards the ray tracing orientation used in steps 2 and 3 is additionally taken into consideration and corrected by the Innoveyes artificial intelligence software. The software attempts to “line-up” the corneal surface to the whole eye orientation used in the ray tracing steps 2 and 3, thus adjusts the cornea surface by applying a prism-like ablation in order to perform the high order aberrations correction measured on the optimally conformed anterior corneal surface.

Results: Change from pre- to 6 months post-operative: mean refractive error from pre- to 3 months post-operative: mean refractive error from -5.06 ± 2.54 diopters (D) (range -8.0 to -0.50 D) to -0.11 ± 0.09 D; Refractive astigmatism from -1.07 ± 0.91 D (range -4.25 to 0 D) to -0.15 ± 0.04 D, topographic astigmatism from -1.65 ± 0.85 D to -0.26 ± 0.11 D. 65% of eyes gained one line of vision and 38% 2 lines. Pre- to post-operative high order aberrations average: RMSh changed from 0.25 um to 0.35 um. Contrast sensitivity improved post-operatively.

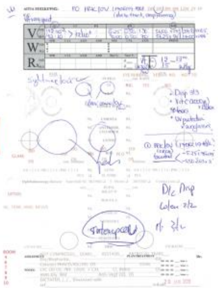


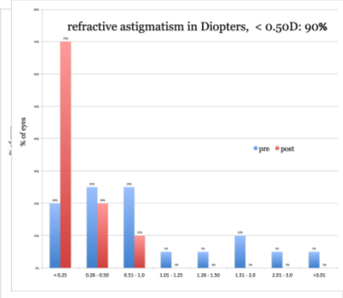


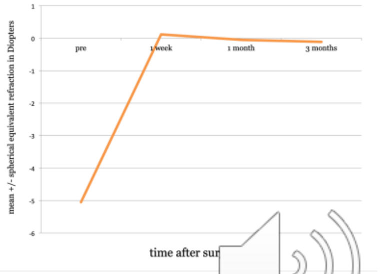




Example case post-op data UDVA 20/10!! Gained 2 lines of vision 29yo M







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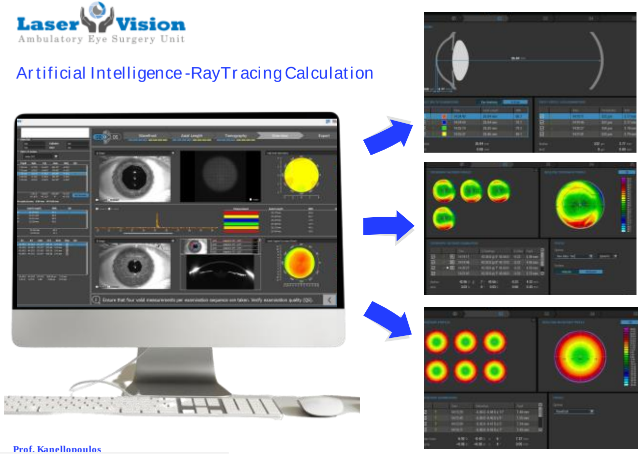
Conclusions:

We report preliminary outcomes with a novel excimer laser customization by ray tracing optimization, for myopic PRK treatments, employing several independent up-till-now diagnostics and a customized eye model reference for each case. It bears the potential advantage through total eye aberration data and ray tracing refraction calculation to offer improved and more predictable visual outcomes.

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ORIGINAL RESEARCH

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Introduction

Kanellopoulos AJ. Initial Outcomes with Customized Myopic LASIK, Guided by Automated Ray Tracing Optimization: A Novel Technique. Clin Ophthalmol. 2020 Nov 17;14:3955-3963.

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