RAY-TRACING MEASUREMENT OF OPTICAL PROPERTIES CONTRIBUTING TO DYNAMIC ACCOMMODATIVE POWER AFTER LASER ANTERIOR CILIARY EXCISION

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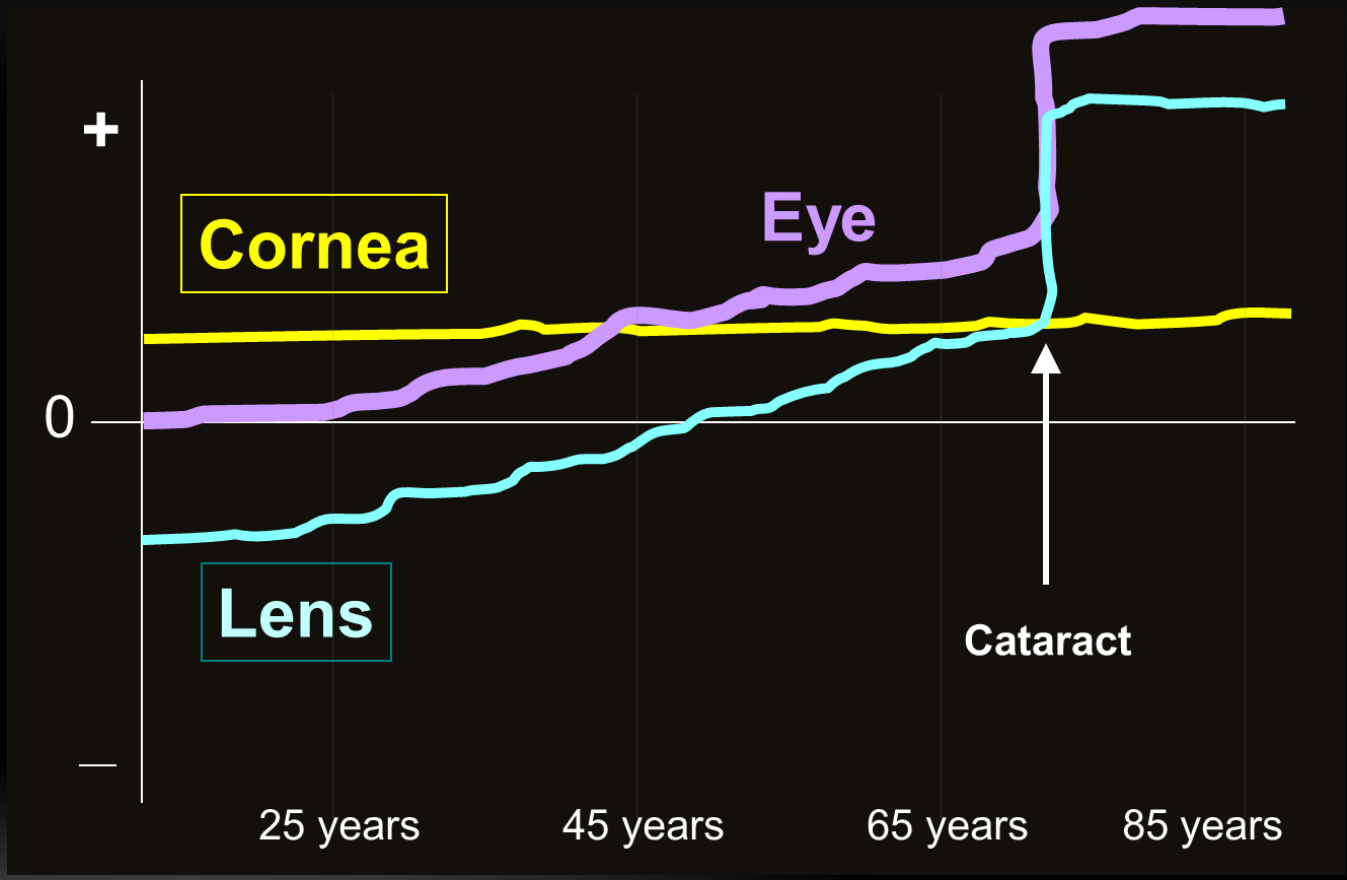
Financial Disclosure:
Author 1 & 2 have received research funding and travel expense reimbursement from Ace Vision Group, Inc.
Authors 3,and 4 have no financial interest.

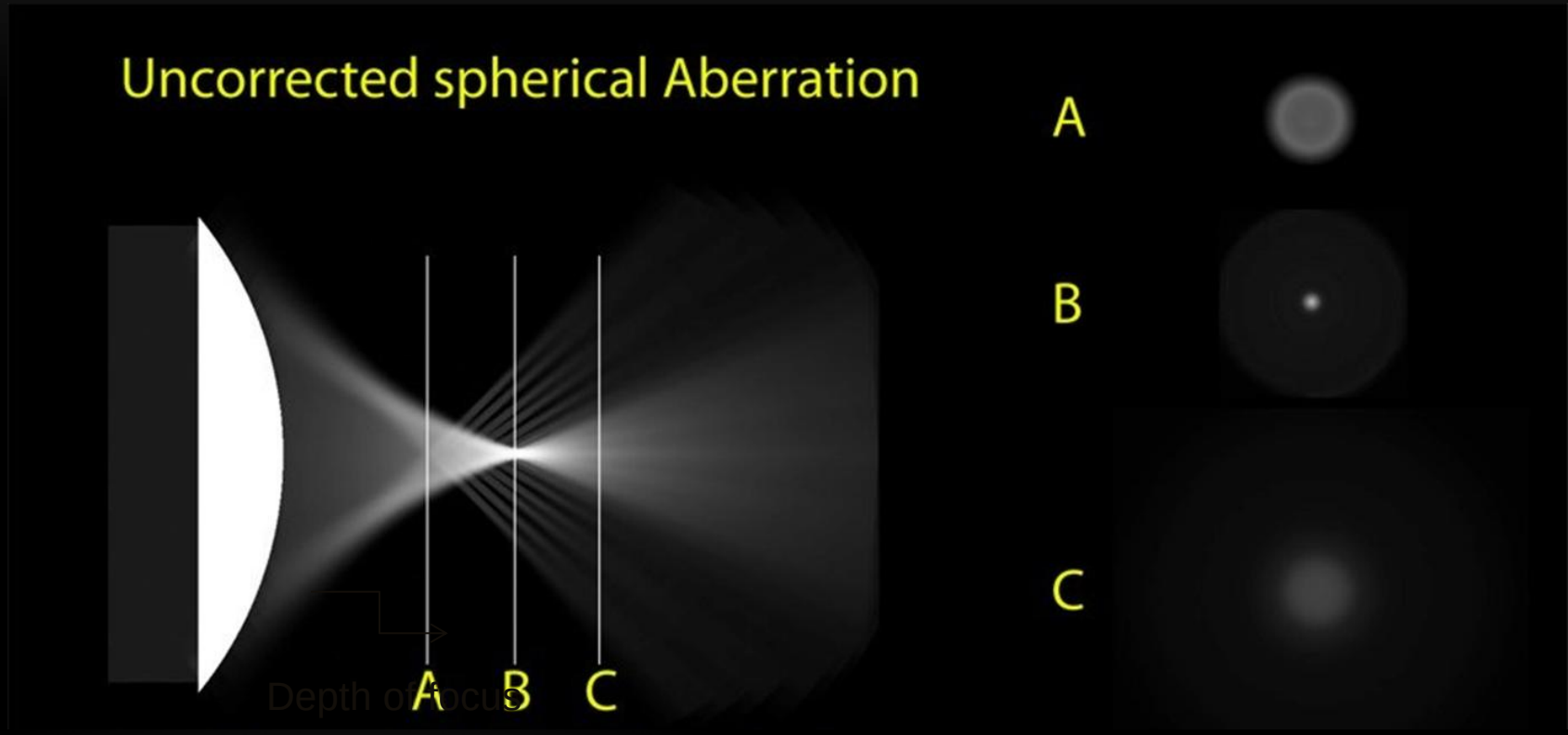
SPHERICAL ABERRATION AND AGE

- Corneal spherical aberration (SA) is stable with age
- The aging crystalline lens becomes less negative (or even more positive)
- The total optical SA increases by adding to the positive corneal SA



SPHERICAL ABERRATION AND DEPTH OF FOCUS

Depth of Focus (DOF): range of defocus error that degrades the retinal image quality.



SPHERICAL ABERRATION AND DEPTH OF FOCUS

- Both positive and negative spherical aberration expands the DOF
- DoF curve strongly increased (up to 2D) as spherical aberration was increased to +/-0.6microns.

ARTICLE

Expanding depth of focus by modifying higher-order aberrations induced by an adaptive optics visual simulator

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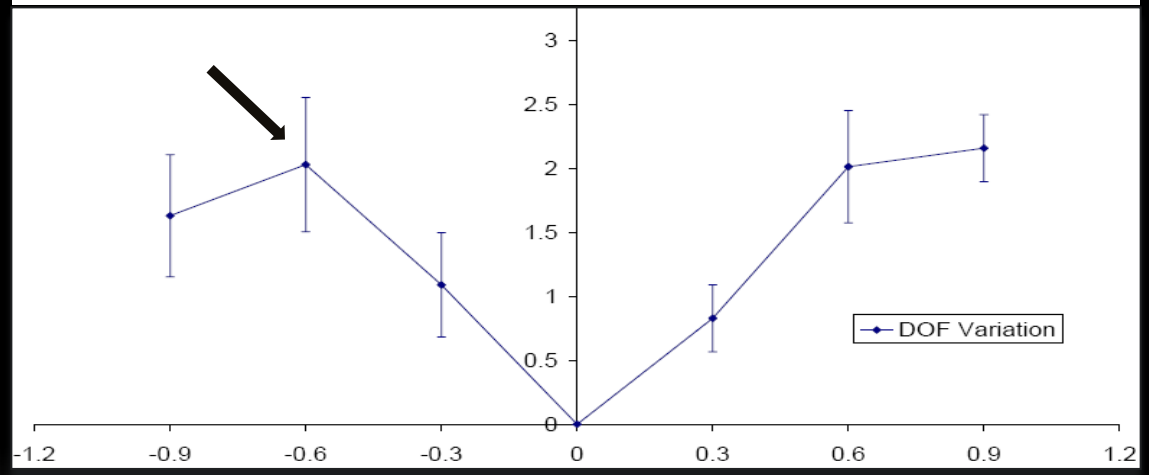


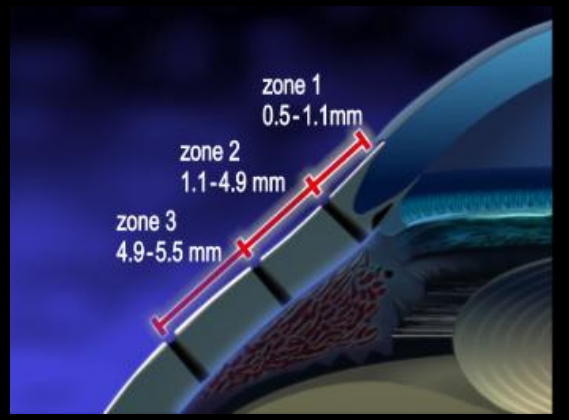
RAY-TRACING EVALUATION OF PSEUDO VS TRUE ACCOMMODATION IN PATIENTS S/P LASER ANTERIOR CILIARY EXCISION

Purpose: Define changes in spherical aberration, Coma, Trefoil, and defocus during dynamic accommodation in patients following a procedure for presbyopic restoration.

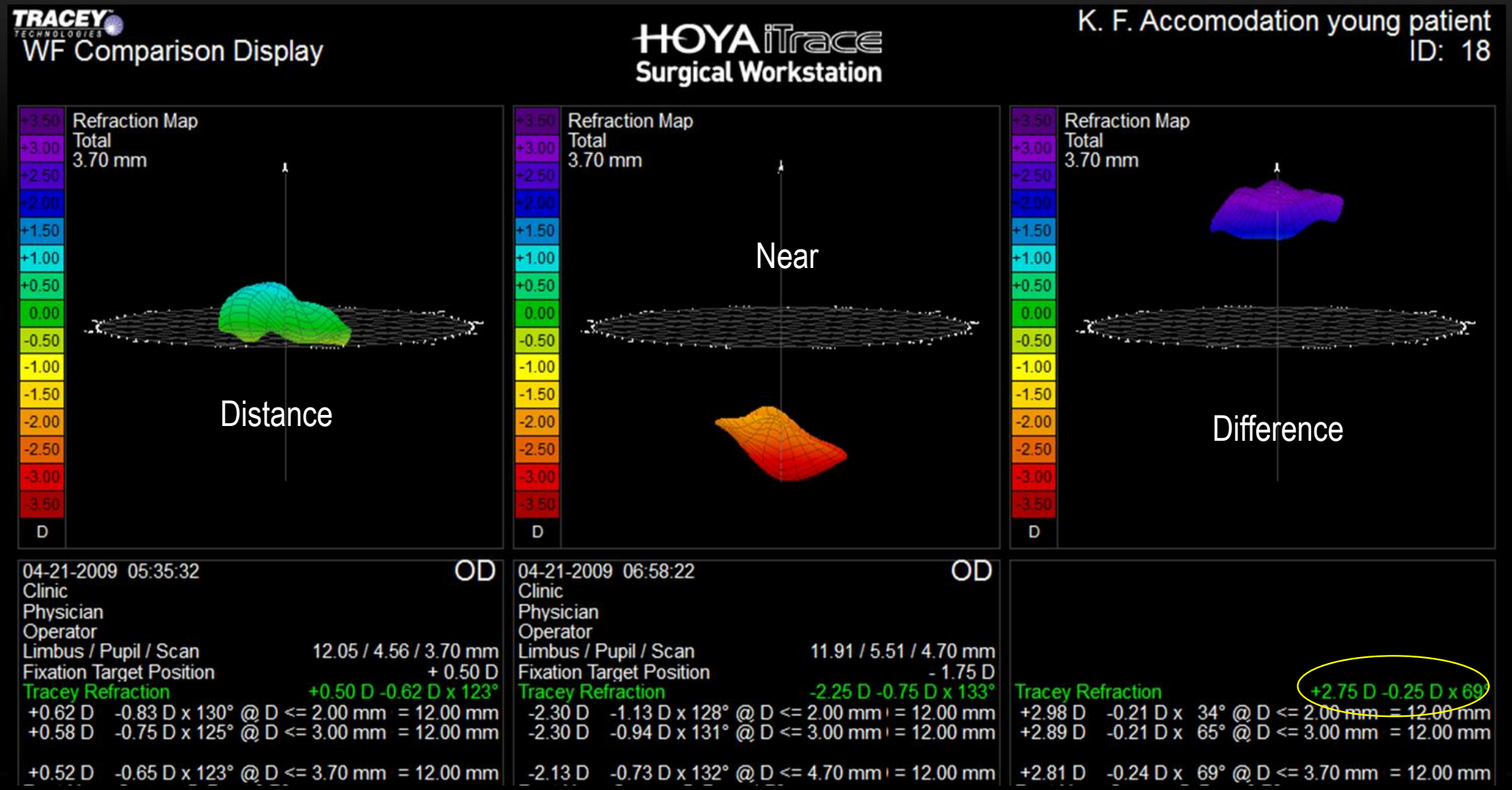
- 6 presbyopia patients underwent bilateral laser anterior ciliary excision.
- iTrace measurements were performed at distance and 40 cm to assess accommodative ability.

LASER ANTERIOR CILIARY EXCISION

- Theory: scleral excisions in 3 physiologically critical zones partially restores biomechanics of the accommodative system.
- Procedural objective:
  - Restore mechanical efficiency of the natural accommodative mechanism.
  - Improve biomechanical mobility to achieve accommodative power
- Procedural Methods:
  - Nine excisions per quadrant
  - 600µm spot size in mathematical diamond matrix pattern using Er:Yag laser with fiber optic probe
  - Each matrix performed in four oblique quadrants

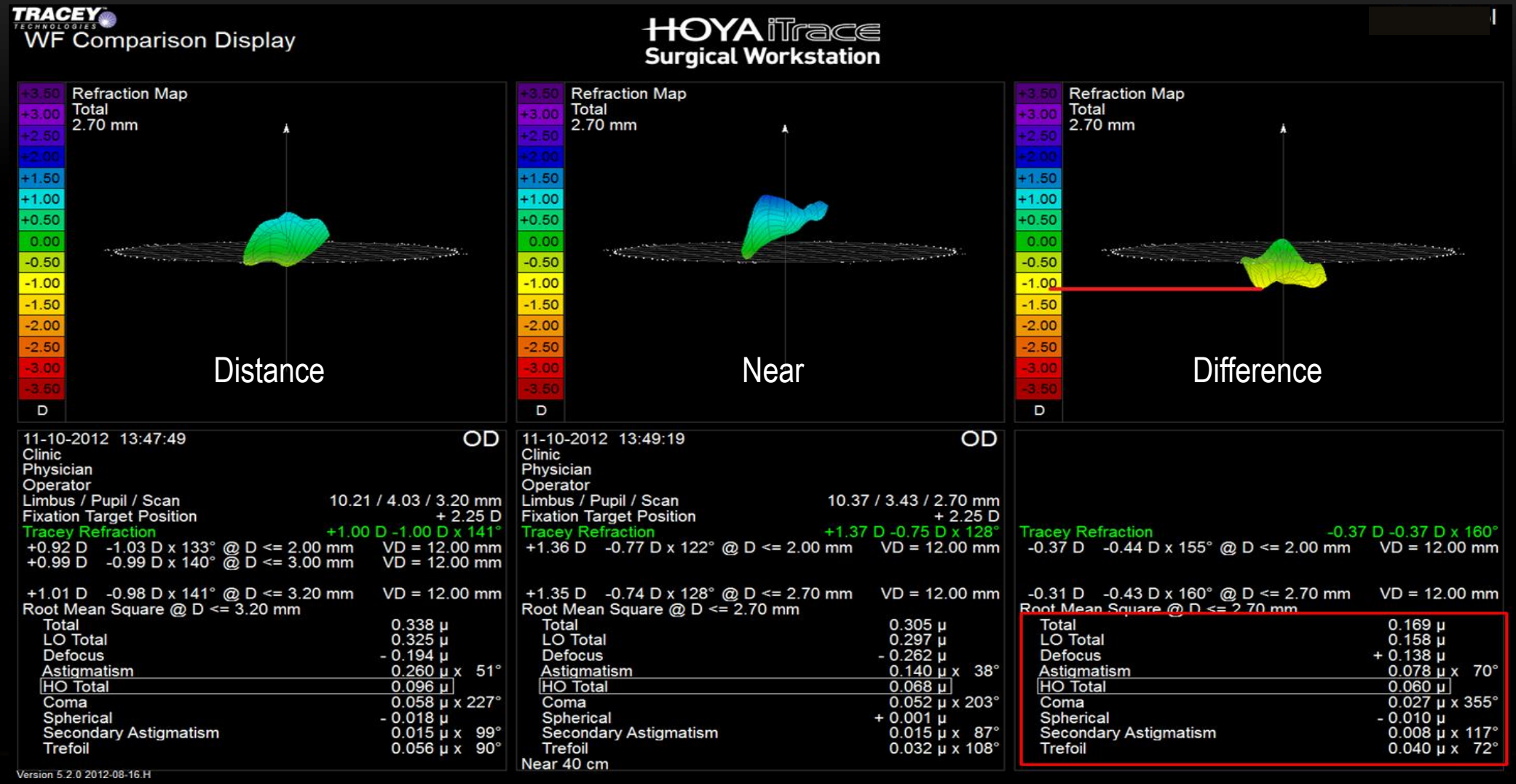


OBJECTIVE MEASUREMENT OF TRUE ACCOMMODATION



- The iTrace (Houston, TX) objectively measures refraction and HOAs.
- A refractive difference between distance and near refraction demonstrates true accommodation.

OBJECTIVE MEASUREMENT OF PSEUDOACCOMMODATION



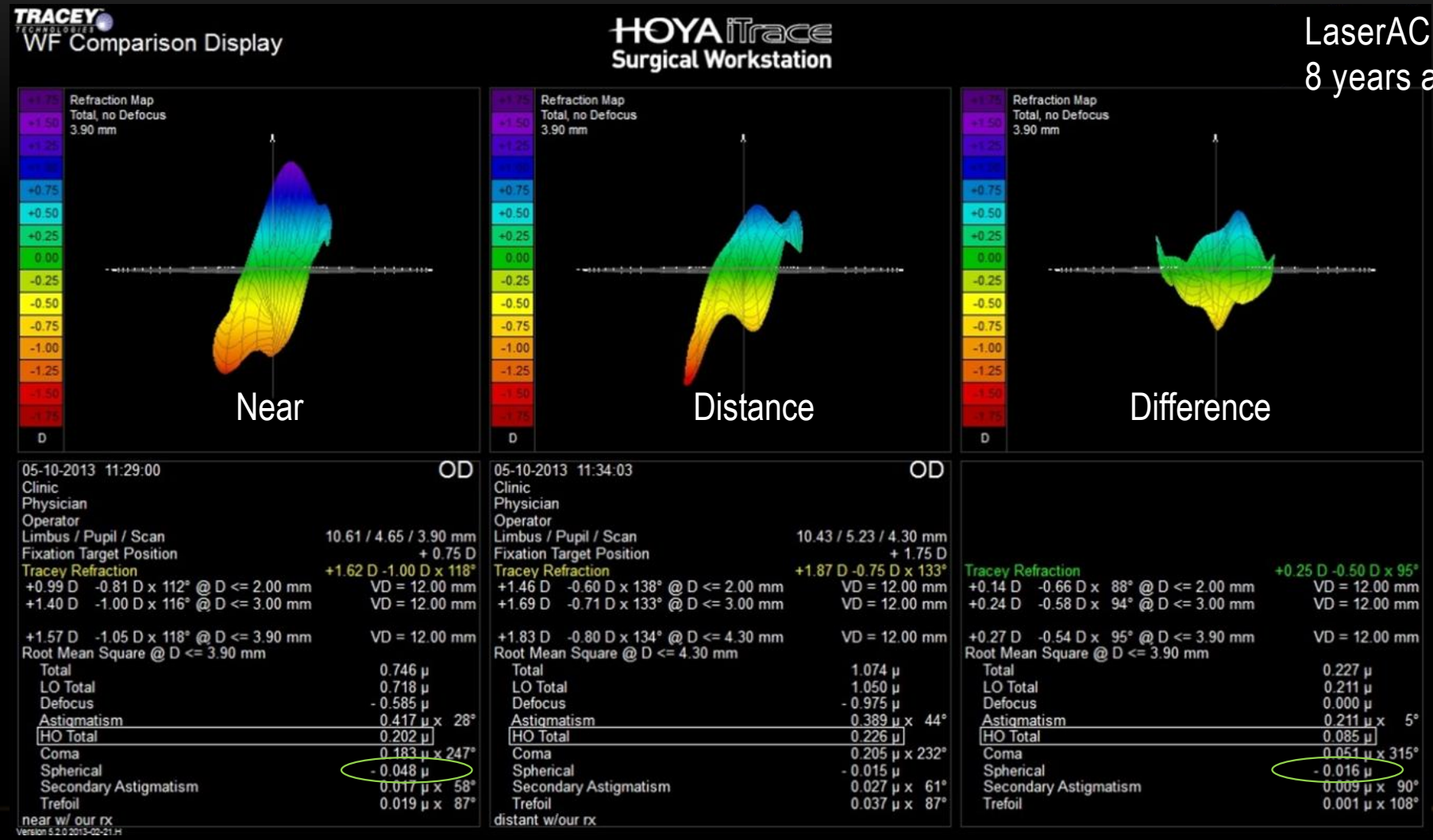
The iTrace compares HOAs at distance and near to determine the change in aberrations: total eye, coma, spherical aberration, trefoil, and secondary astigmatism.

DYNAMIC WAVEFRONT ANALYSIS OF ACCOMMODATION

- Six patients S/P laser anterior ciliary excision were evaluated:
  - 3 short-term patients (0-6 months)
  - 3 long-term patients(6-8yrs)
- ITrace difference maps were created for each patient

Difference Distance to Near BCVA	Mean Rx	Total Aberration	Total HOA	Spherical Ab	Coma	Trefoil
N = 6	0.04	0.15	0.11	-0.011	0.06	0.0005
SD	± 0.03	± 0.08	± 0.07	± 0.021	± 0.05	± 0.007

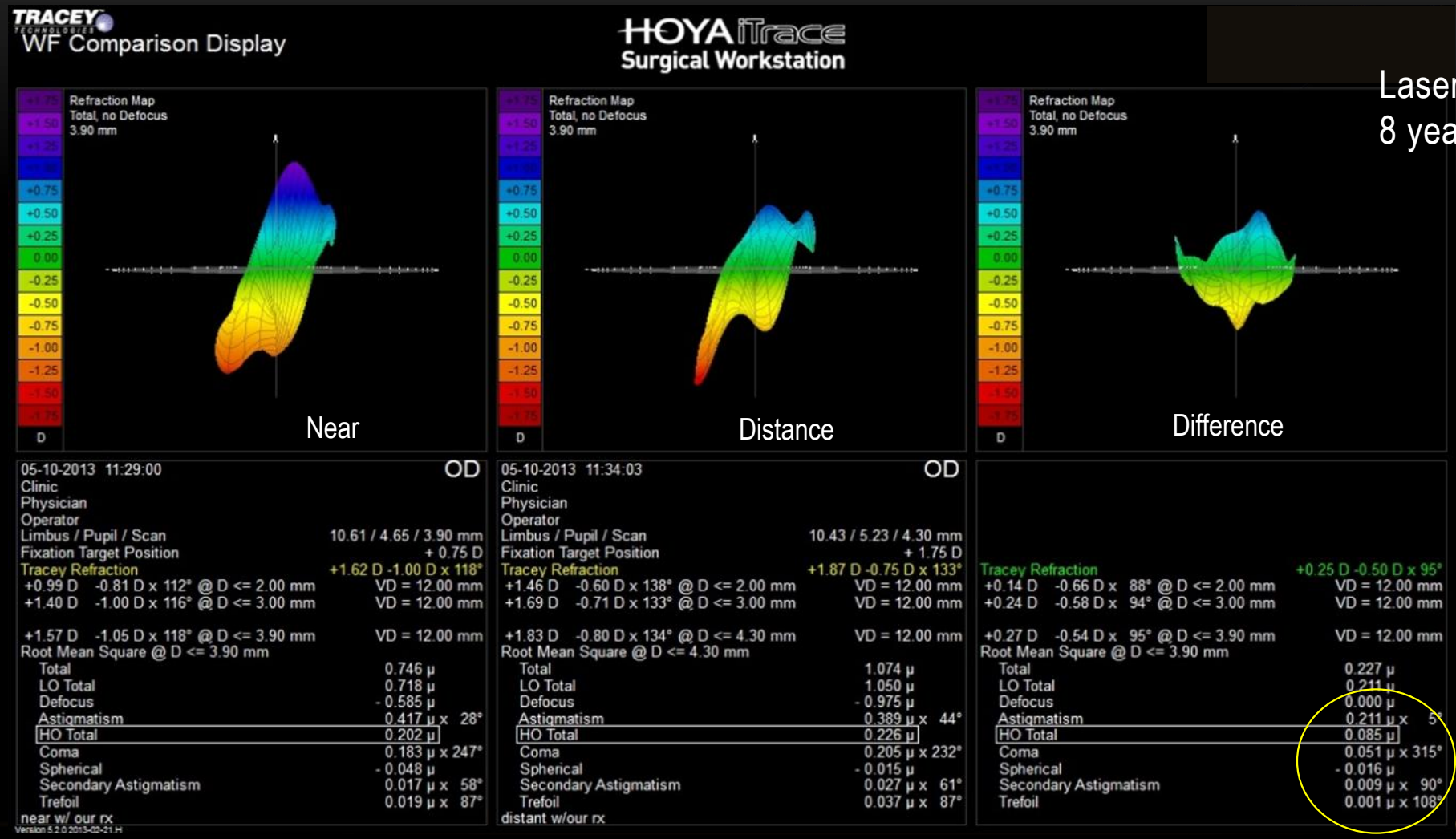
SPHERICAL ABERRATION AND DEPTH OF FOCUS



LaserACE patient
8 years after procedure.

- Specific HOA have a greater impact on depth of focus, visual acuity and quality
- SA shifts toward negative values during accommodation

SPHERICAL ABERRATION AND DEPTH OF FOCUS



LaserACE patient
8 years after procedure.

- Note the reduction in hyperopia while viewing the 40 cm target and change in spherical aberration.

CONCLUSIONS

- Ray-tracing technology can objectively measure dynamic accommodation and is a critical device to differentiate true accommodation from pseudo-accommodation
- Specific optical correlations were identified during dynamic accommodation pre-op/post-op LaserACE which may explain the improvement in dynamic accommodative capacity and visual acuity in these patients