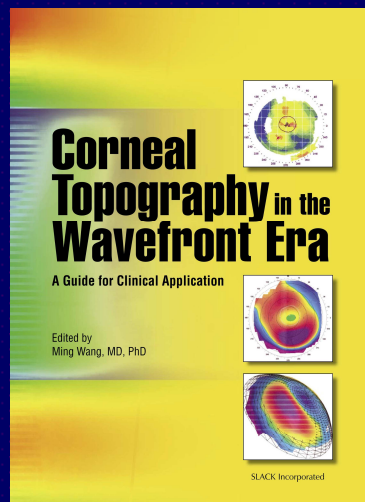


3-Point Touch: Identifying Ectasia

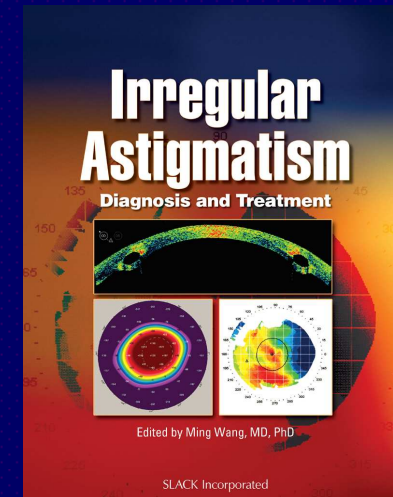
Ming Wang, M.D., Ph.D.

Medical Director of Refractive Surgery, Aier Eye Hospital Group, PR China
Clinical associate professor of ophthalmology, University of Tennessee
Director, Wang Vision Institute, Nashville, TN, 37203, USA



**Corneal Dystrophy
And degenerations**
A molecular genetic approach

Ming Wang ed
Published by AAO



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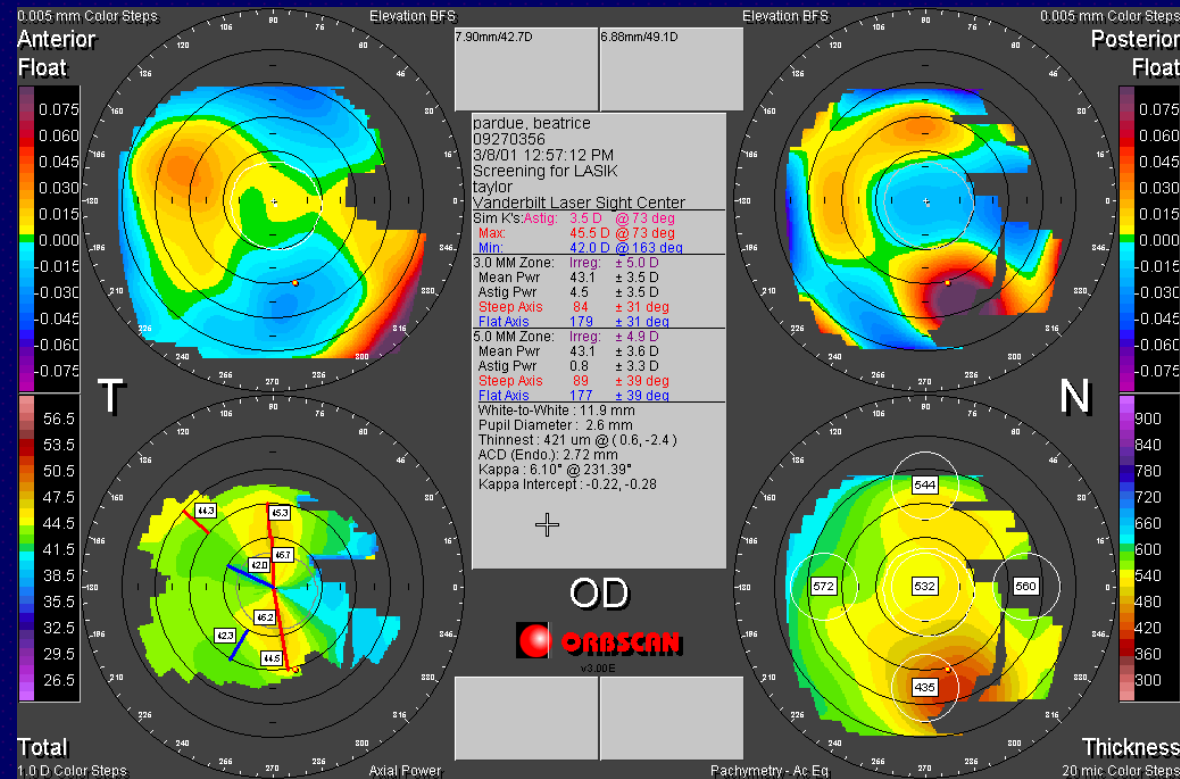
Ectatic Changes

- When the cornea becomes ectatic, the “first surface to go” is the posterior surface.
- Early elevations may occur posteriorly with NO change in the front surface elevation or curvature.
- Pachymetry changes can occur in the same location;
- Anterior corneal elevation/curvature changes can occur at the same location as well (albeit later).

Posterior Changes

- Posterior corneal changes are the most difficult to validate with current technology
 - Placidos can't do it
 - Tomographers CAN do it but with questionable accuracy

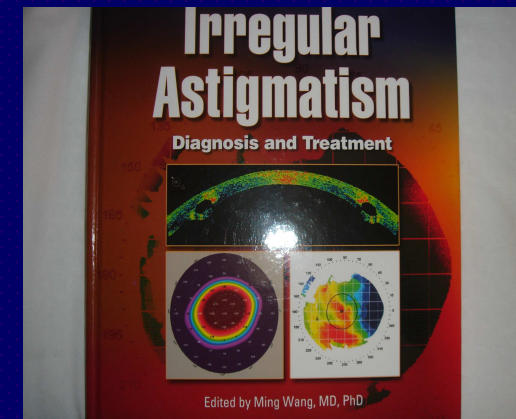
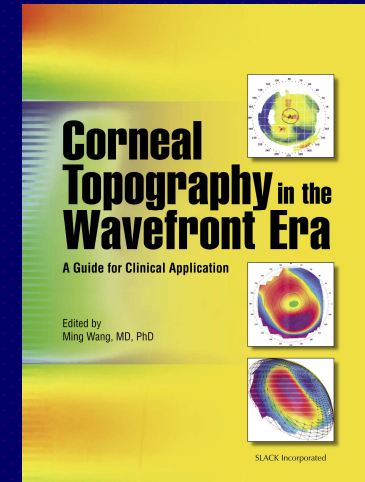
Posterior corneal changes occur **earlier** than any anterior changes



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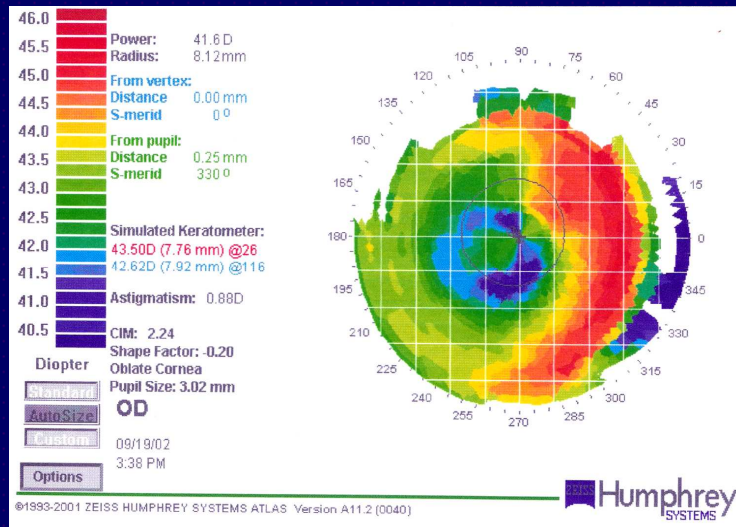
Current and topo technologies

- Placido disk (e.g., Humphrey);
- Scanning slit (e.g., Orbscan);
- 3-D topo (e.g., AstraMax);
- **Scheimpflug imaging (e.g., Pentacam);**
- Ultrasound (e.g., Artemis);
- Topo-wavefront combined
- Tracey, OPD, Orbscan-Zyoptix, Meil-80/CRS Master, Allegro analyzer/topolyzer T-CAT, Waveprint/Humphrey;
- Anterior segment OCT.

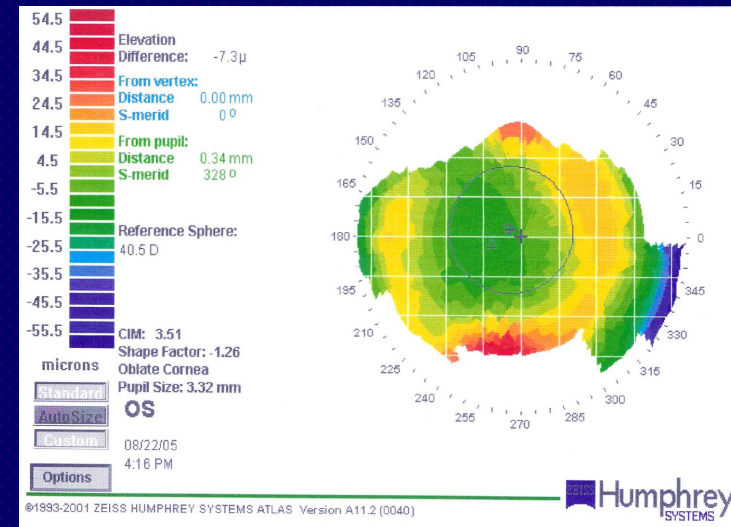


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Placido: axial vs. elevation maps



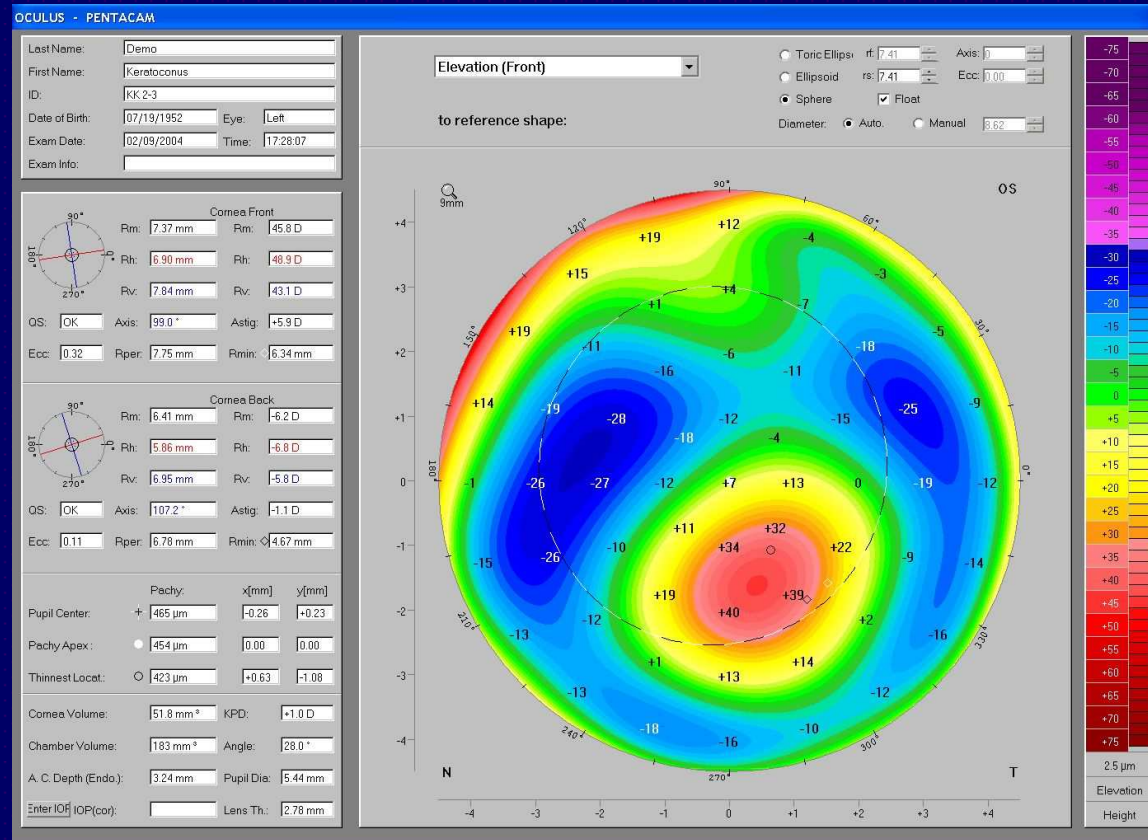
Curvature (D) map
(*primary* data, accurate)



Elevation (um) map
(*Derived* from curvature,
not as accurate)

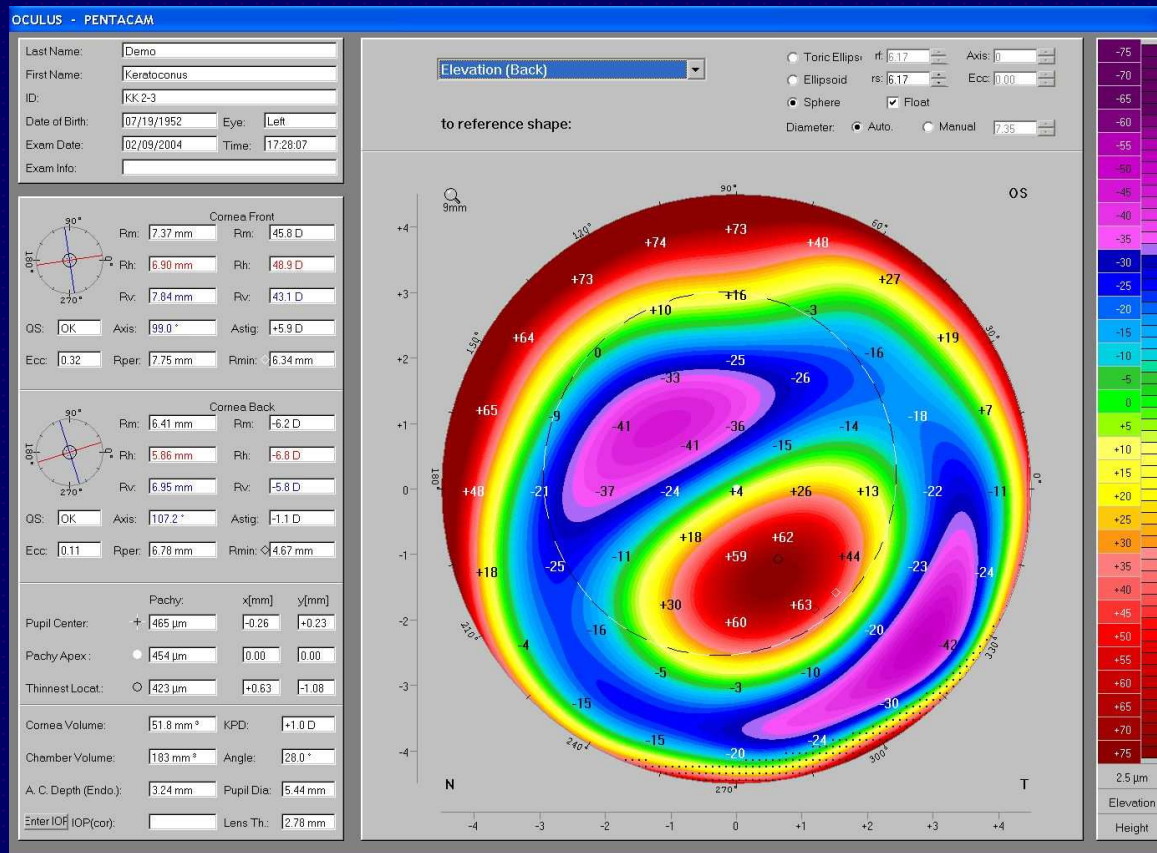
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Scheimpflug imaging: Pentacam elevation map



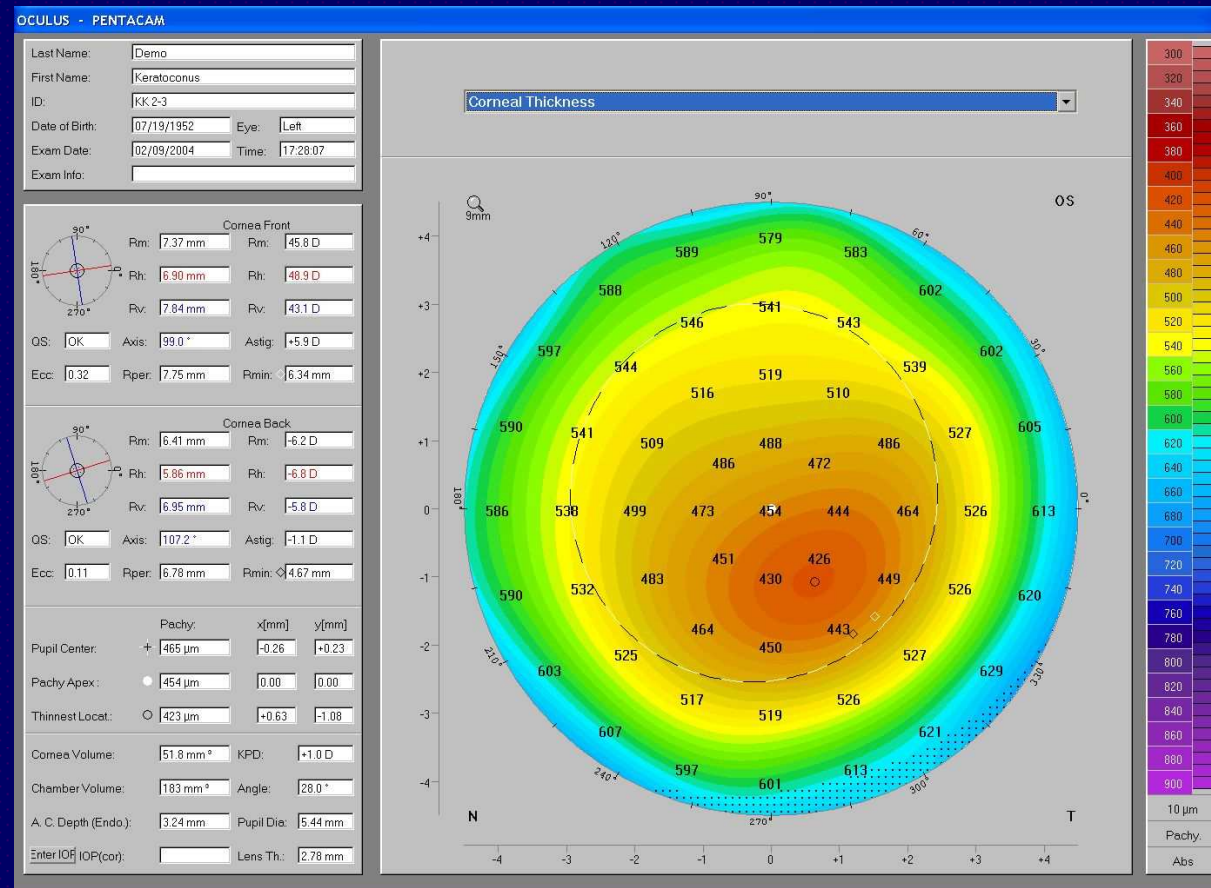
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Scheimpflug imaging: Pentacam posterior elevation



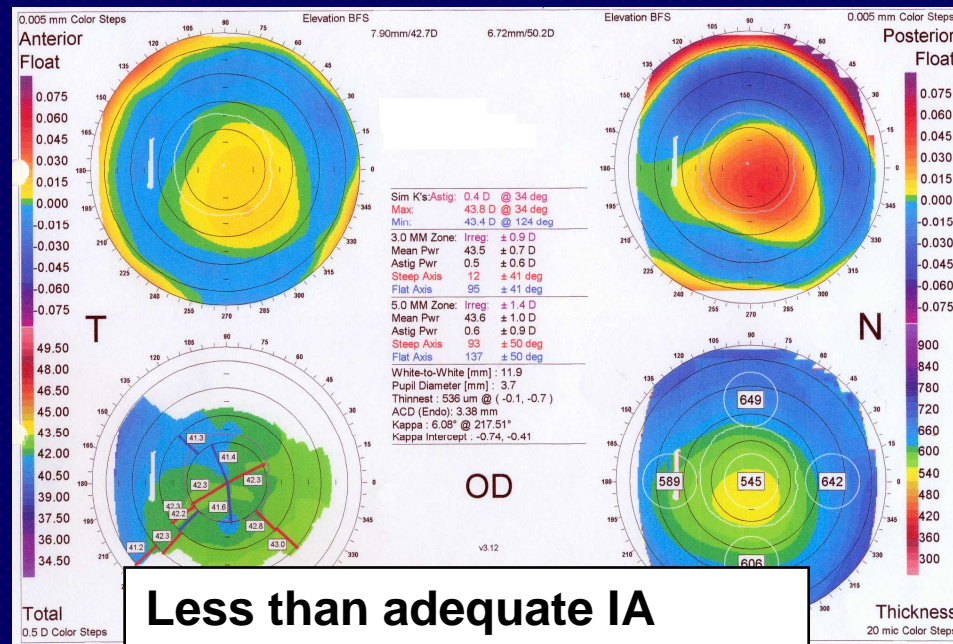
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Scheimpflug imaging: Pentacam pachymetry



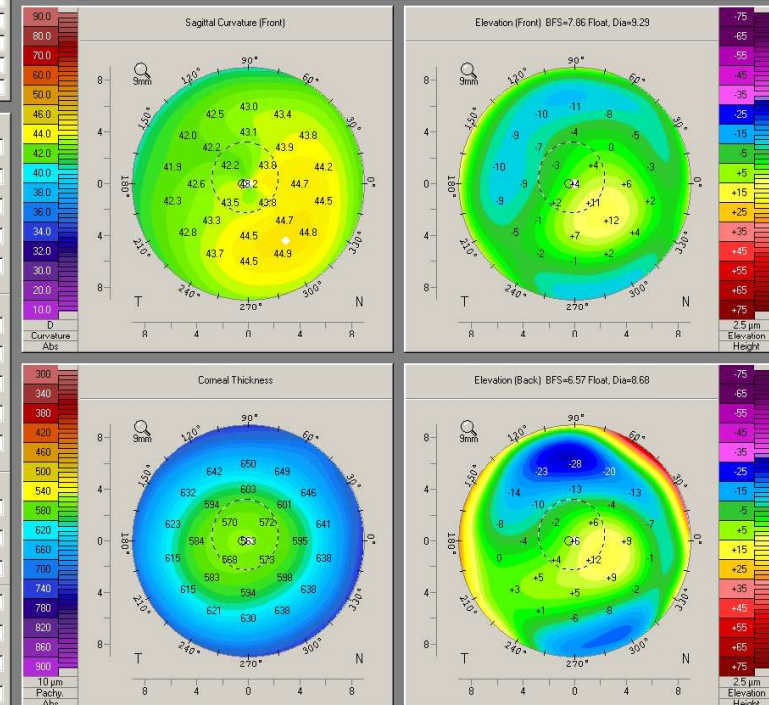
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Pentacam Vs. Orbscan OD

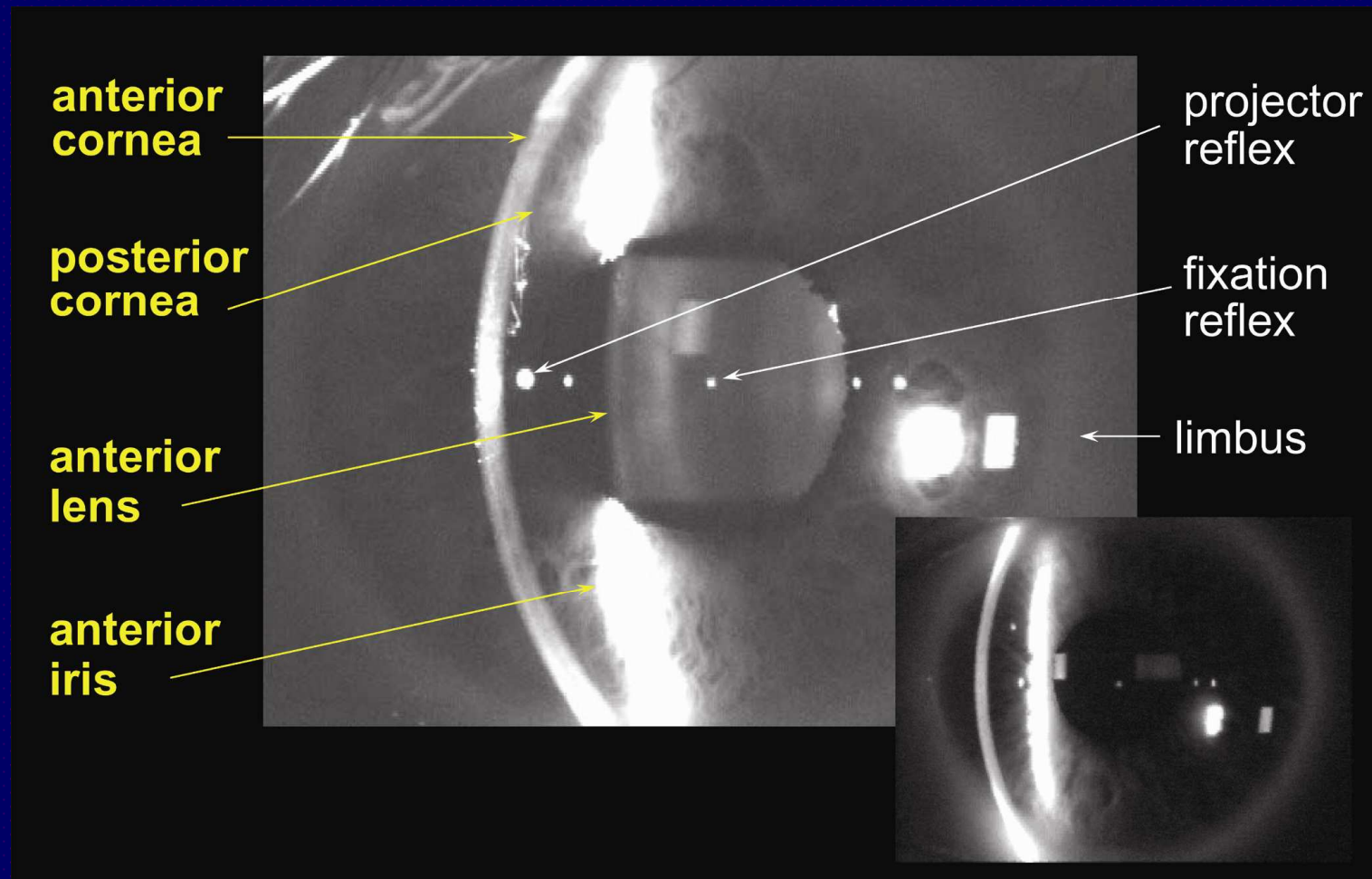


Less than adequate IA pattern despite Placido Disc

Better alignment of elevation on Pentacam

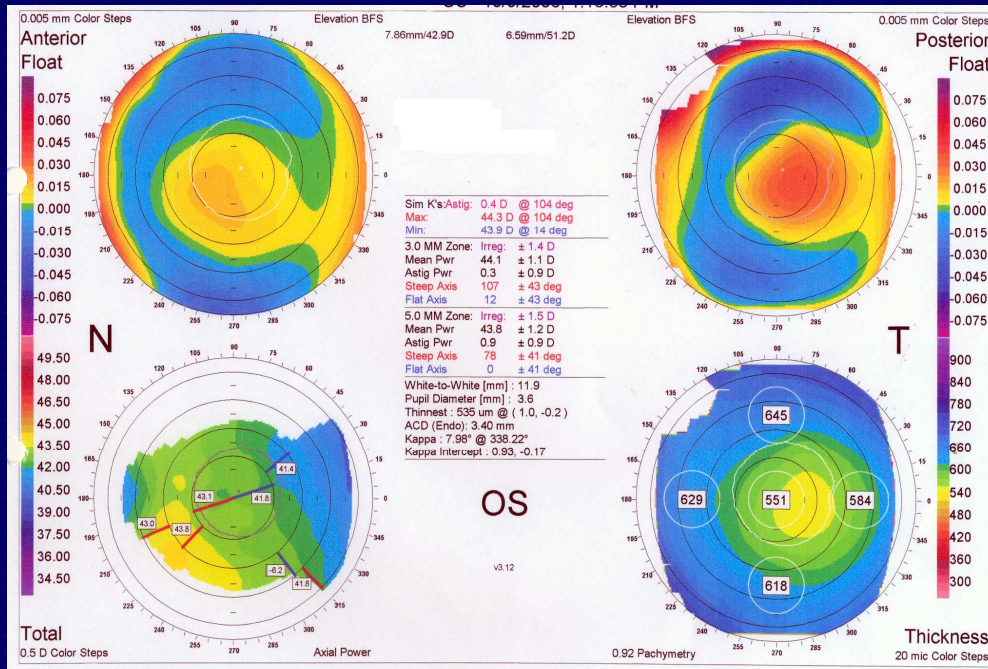


Scanning slit: Orbscan



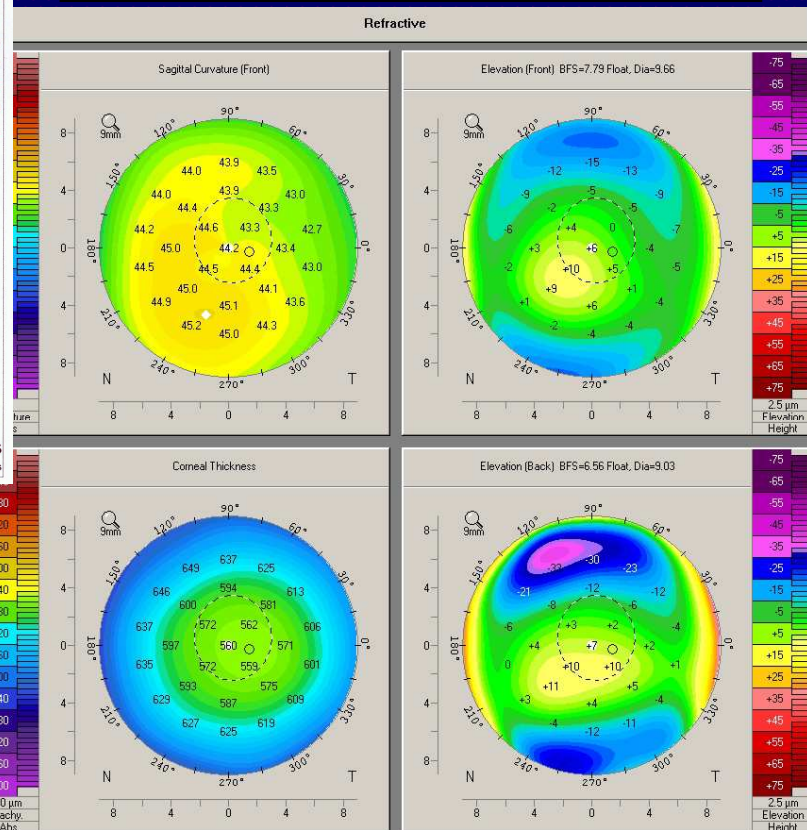
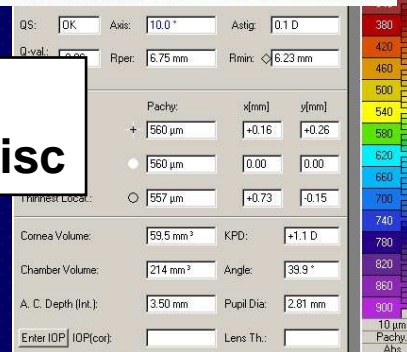
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Pentacam vs. Orbscan OS



Better alignment of elevation on Pentacam

Less than adequate IA pattern despite placido Disc



Ming Wang, MD, PhD

Theodor Scheimpflug, 1888

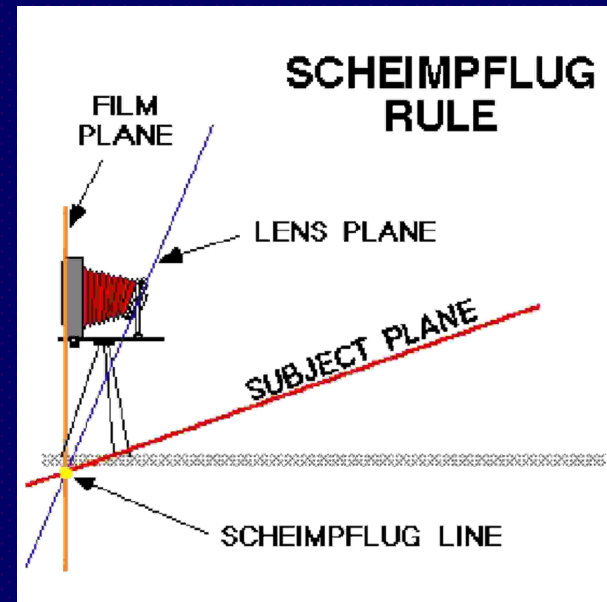
1. Austrian, invented a photographic apparatus in 1904, for military for accurate **imaging over a wide focal range** (e.g., architectural documentation of skyscraper facades);
2. 1970, Prof Hockwin, Germany, a cataract researcher, adapted Scheimpflug for **sagittal plane imaging** of anterior segment of the eye.



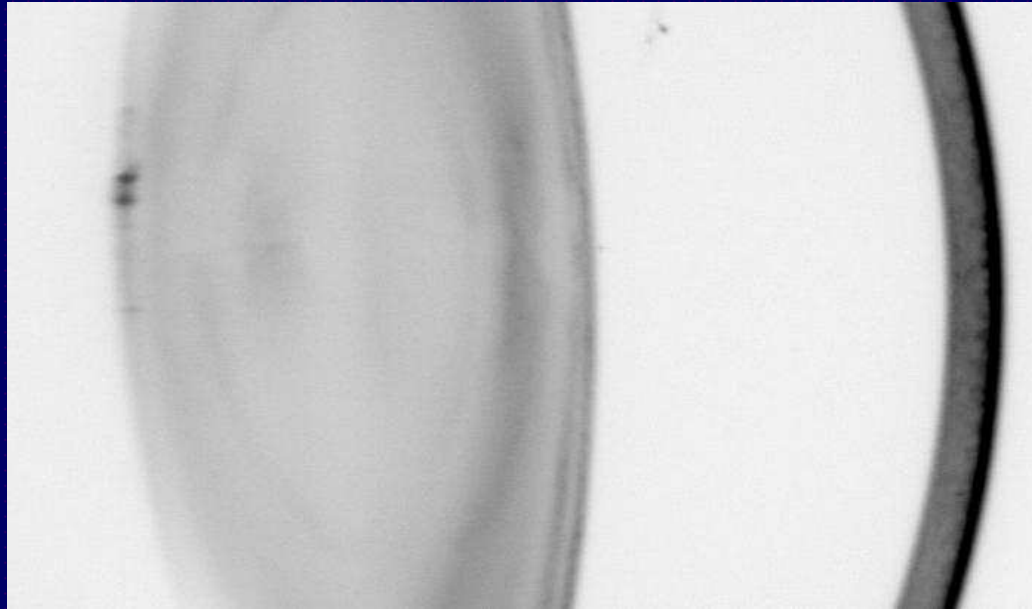
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Scheimpflug Rule

- In conventional cameras, object (film) plane, lens plane and subject plane are parallel to each other;
- In Scheimpflug cameras, these planes are **not parallel** but intersect in a straight line. When film plane and subject plane intersect forming a 90-degree angle, halved by the lens plane, a 1:1 image to subject ratio is achieved;
- Advantage of Scheimpflug: images along the optical **axis** of the eye can be assessed*.
- * Harold Merklinger: Scheimpflug's patent. Photo Techniques, Nov/Dec, 1996.

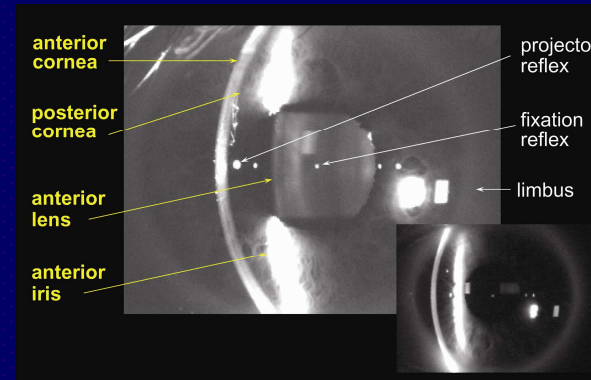
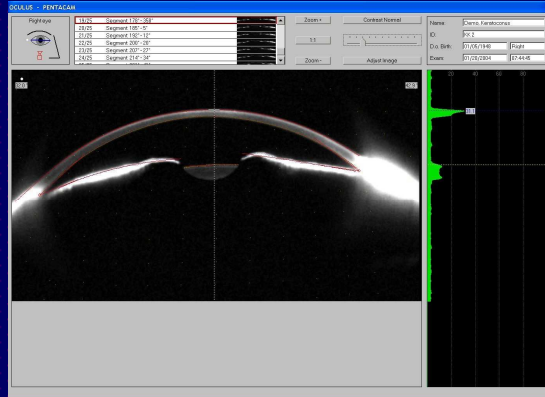


Scheimpflug image



Ming Wang, MD, PhD

Scheimpflug vs Orbscan vs placido



Advantage of Scheimpflug rotating slit over scanning slit:

1. Angle between image and camera is always 90 degree (maximal cross sectional area spread – high **sensitivity**);
2. Common reference point hinged in the middle (**reliability**, This is absent in scanning slit). It is particularly important for **posterior surface** (since it has less intense illumination than anterior surface to begin with (hence lower s/n ratio);

Disadvantage: curvature is derived data (less accurate).

Orbscan compensated this by adding a placido (curvature)

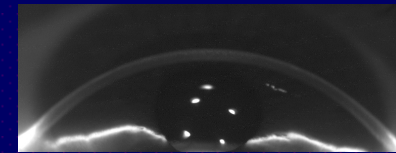
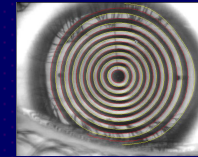
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Primary vs derived data

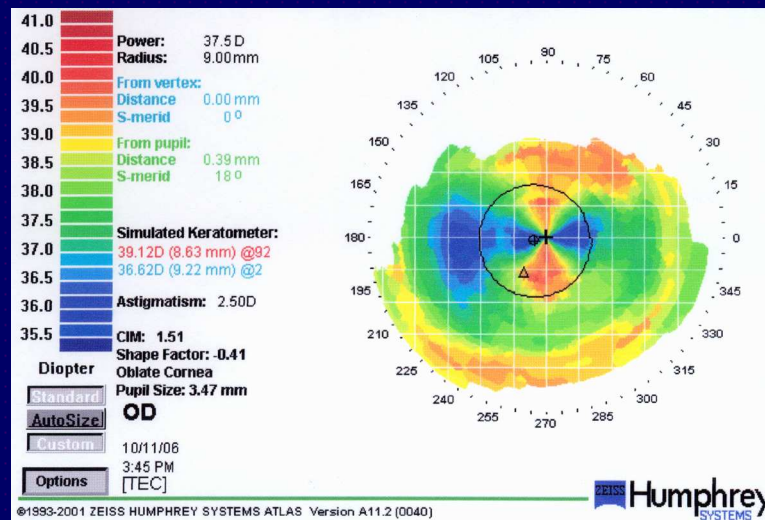
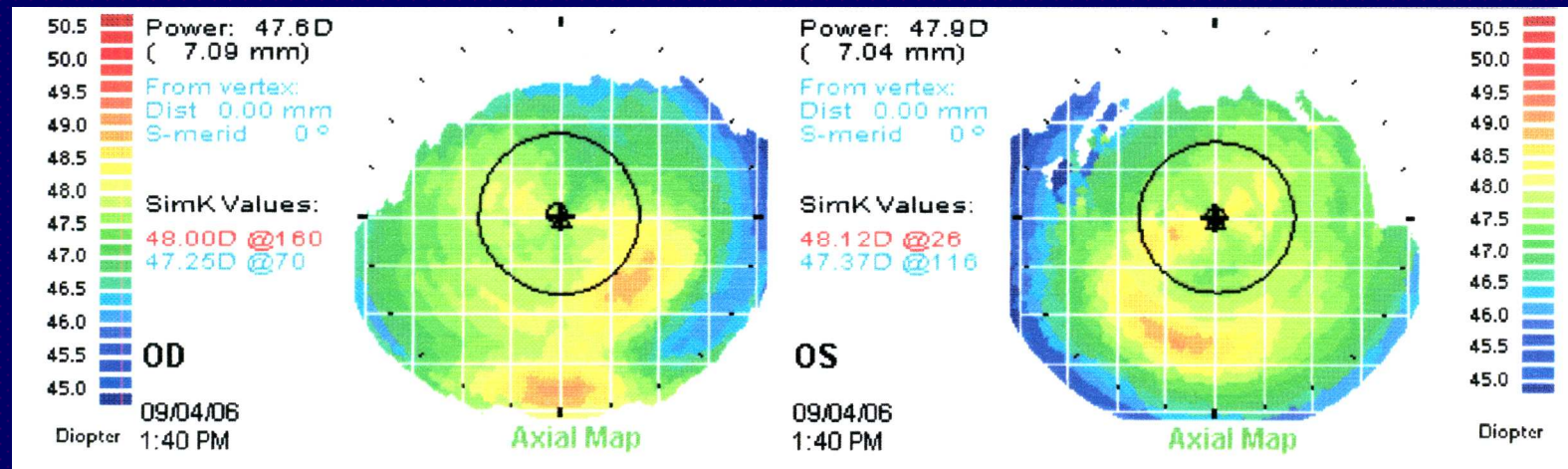
- Elevation to curvature: first derivative (loss of initial absolute height/position info);
- Curvature to elevation: integration (generating an arbitrary constant (height))

Primary vs. derived data

- Primary data: directly measured by the device, more **accurate**, e.g.:
 - Curvature data in placido disc systems (Humphrey);
 - Elevation data in scanning slit systems (Pentacam);
- Secondary data: derived from primary data, less accurate, e.g., the reverse of the above, e.g.:
 - Elevational data from Humphrey;
 - Curvature (D) data scanning slit system such as Pentacam.



Questionable Cases: FFKC?



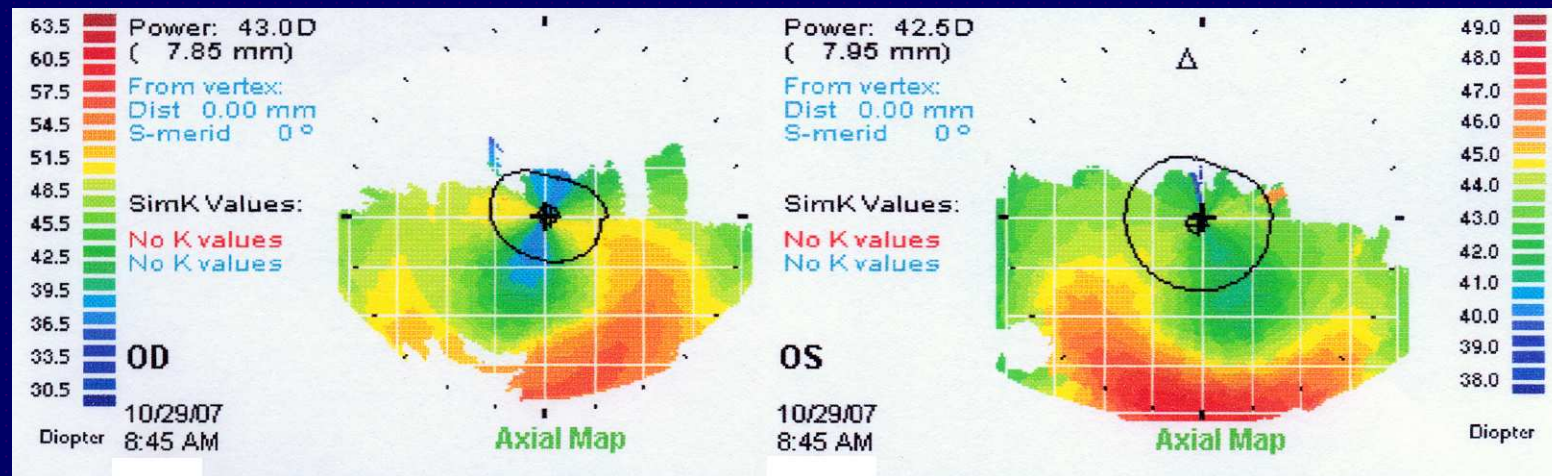
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3-Point Touch

- When pathology on the posterior, anterior elevation, and pachymetry or curvature map coincide, this is called a “three-point touch”;

Case I: Patient with moderate PMD

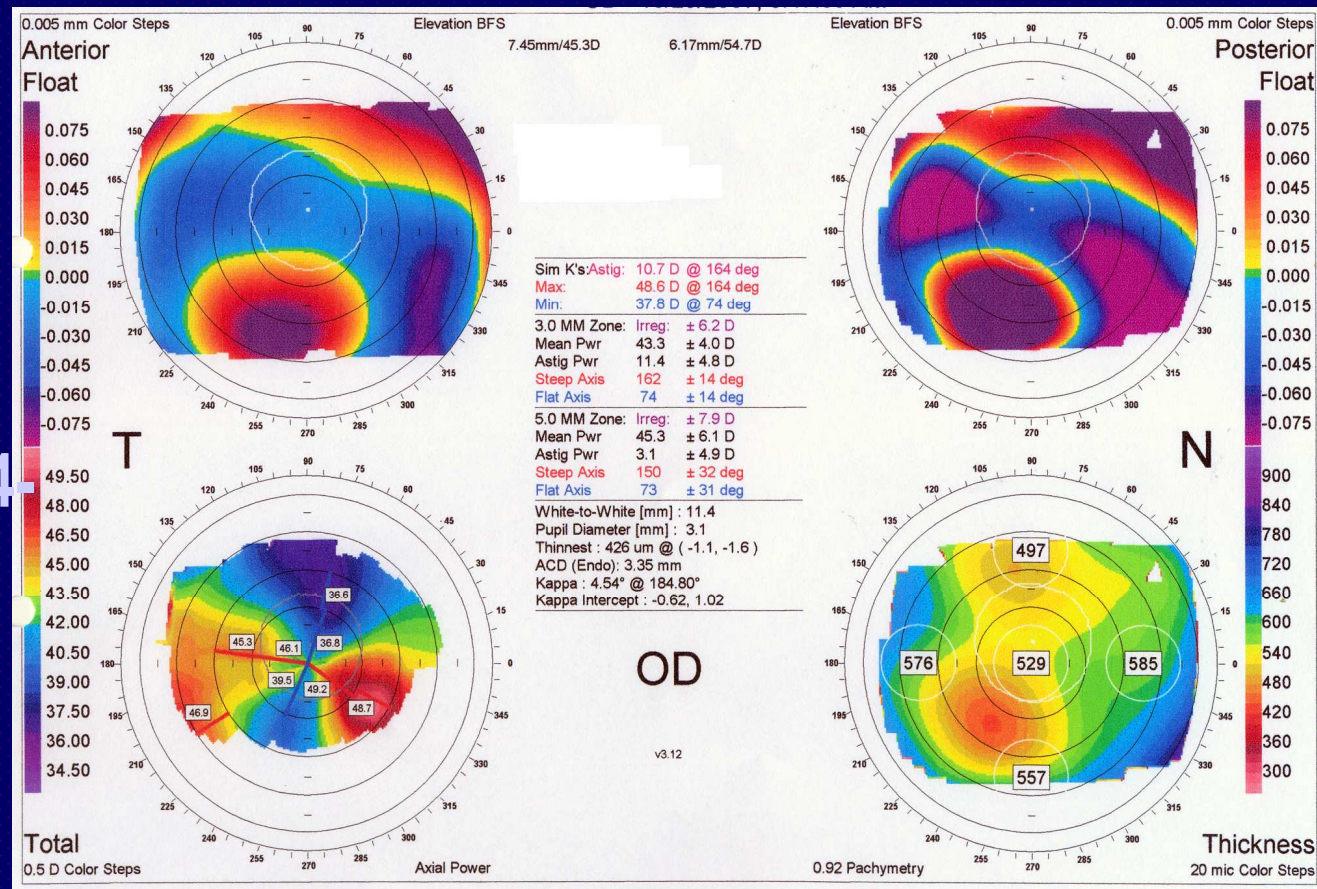
In this case, the curvature map is characteristic of early PMD OU.



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Case I: Will you do keratorefractive procedure?

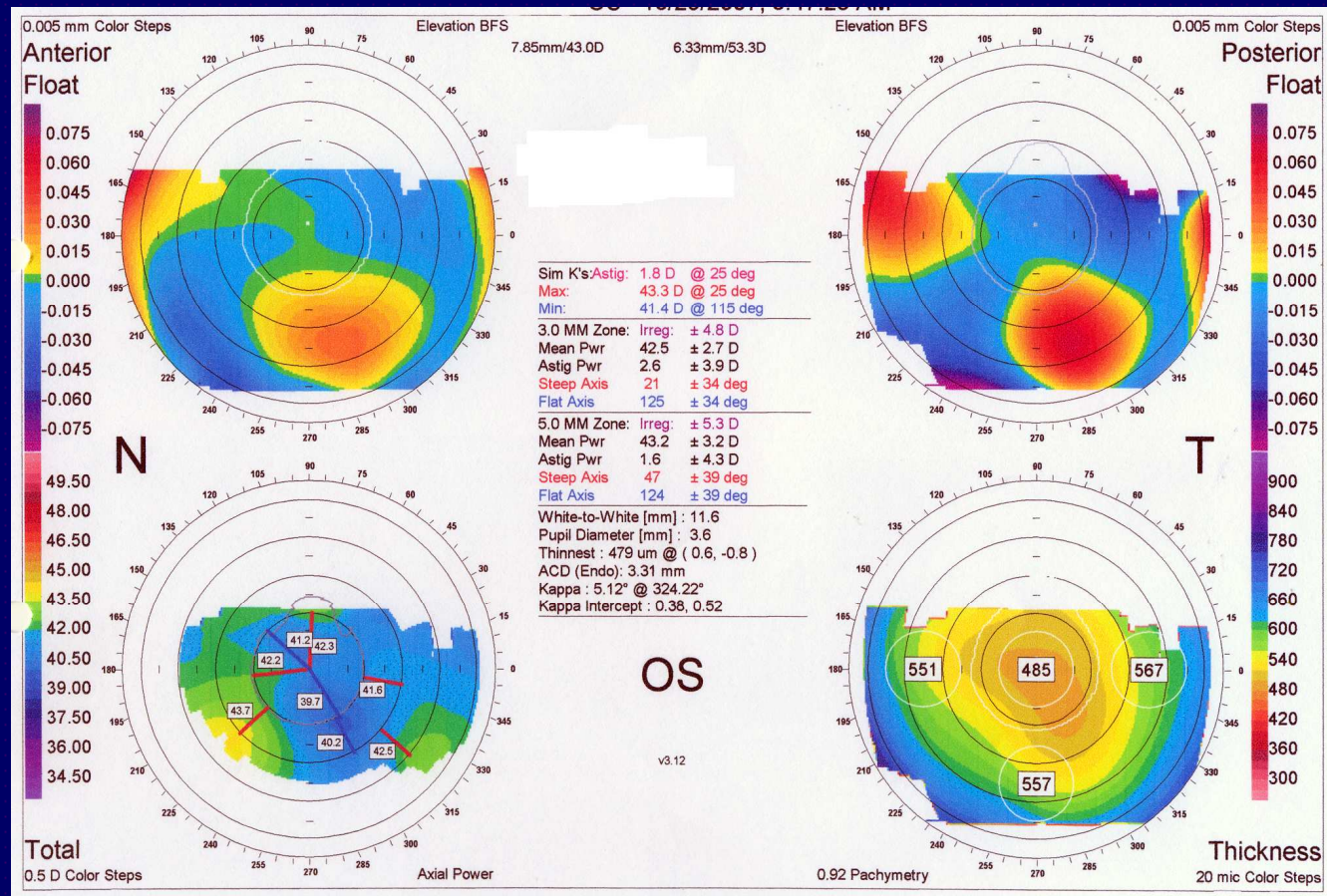
Curvature maps shows PMD pattern, and the elevation maps agree, 4 point touch.



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Case I: Will you do keratorefractive procedure?

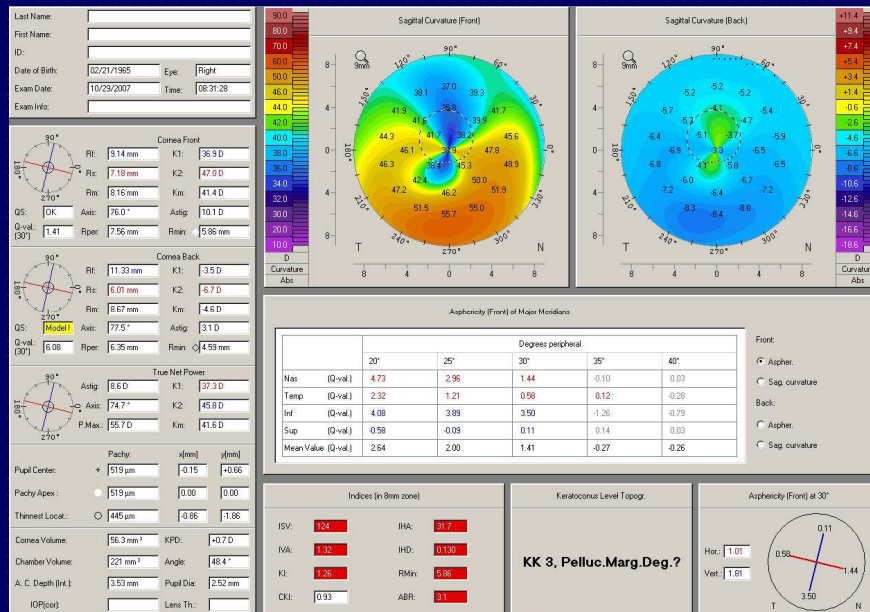
Pachymetry map and curvature map are less characteristic, but do indicate irregularity associated with PMD because of 3-point touch.



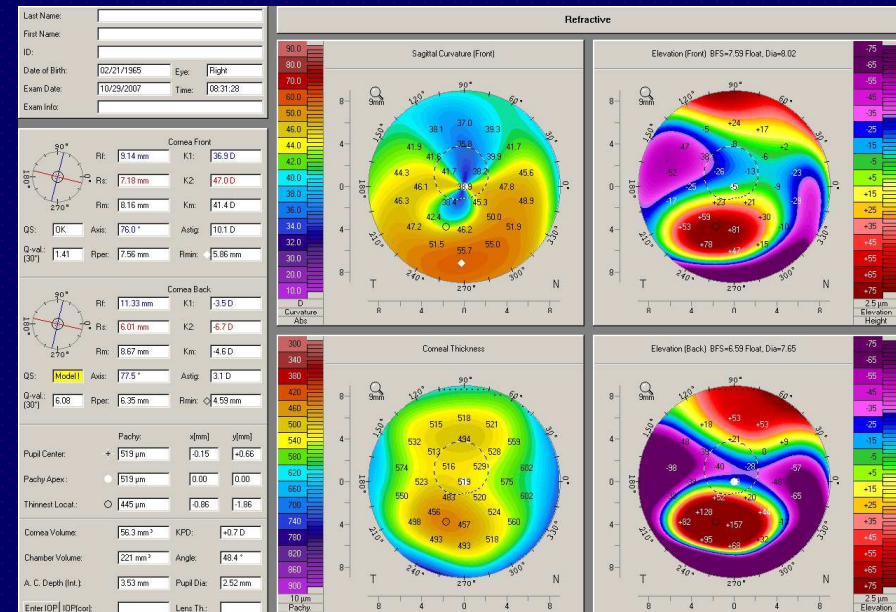
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Pentacam detection of FFKC

- Improved sensitivity



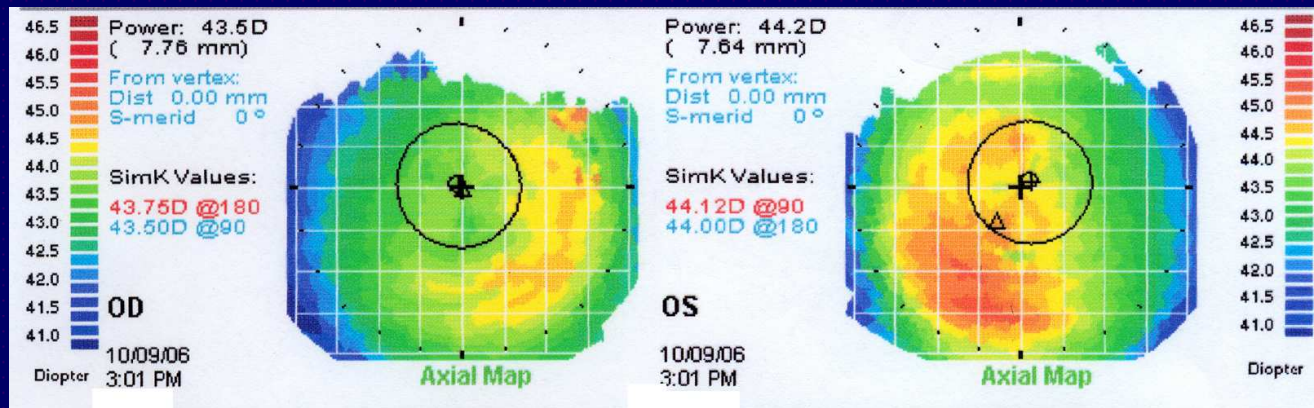
Various Indexes are Flagged (RED)



Characteristic Elevation, Curvature and Thickness Maps

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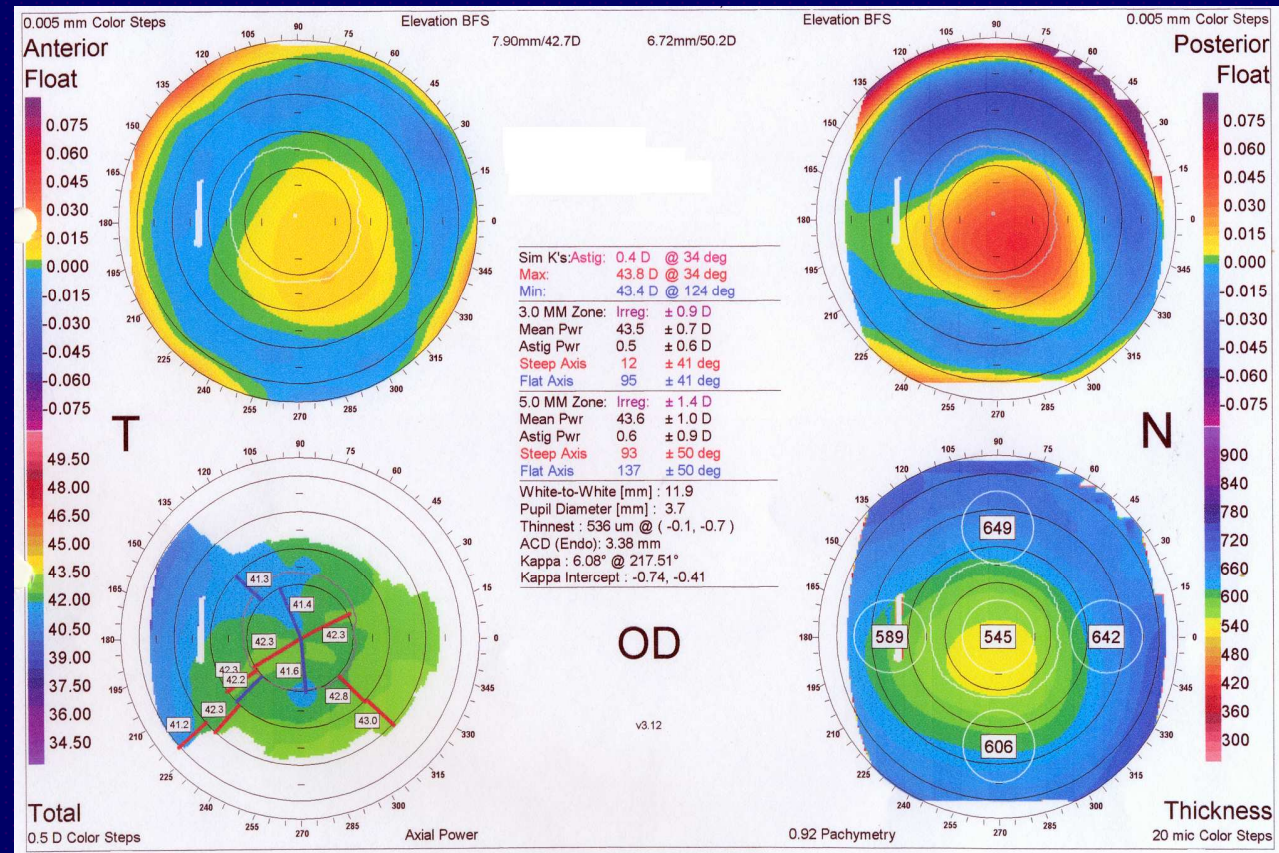
Case II: Will you do keratorefractive procedure?



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Case II: will you do keratorefractive procedure?

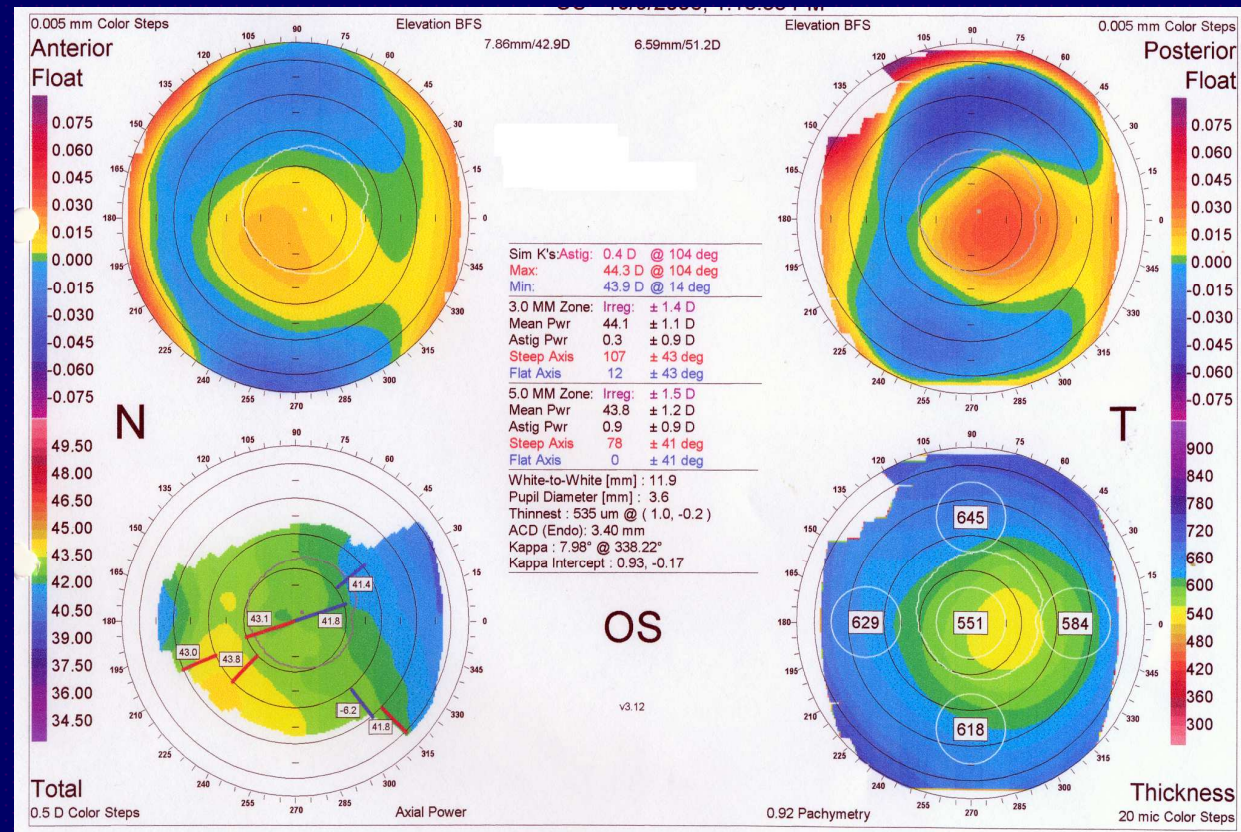
- 2-point touch?



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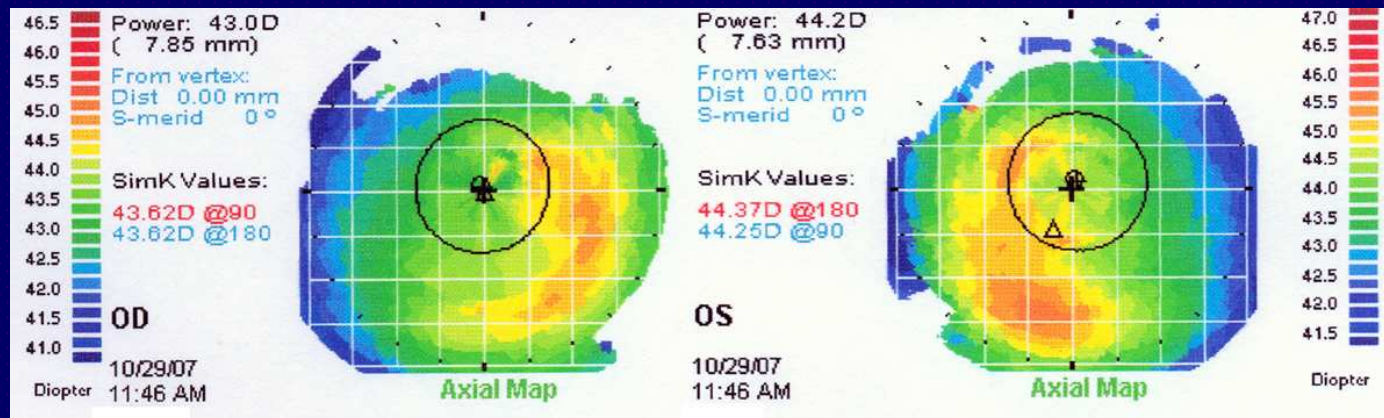
Case III: Will you do keratorefractive procedure?

- The amount of displacement? Threshold? 2-point touch?



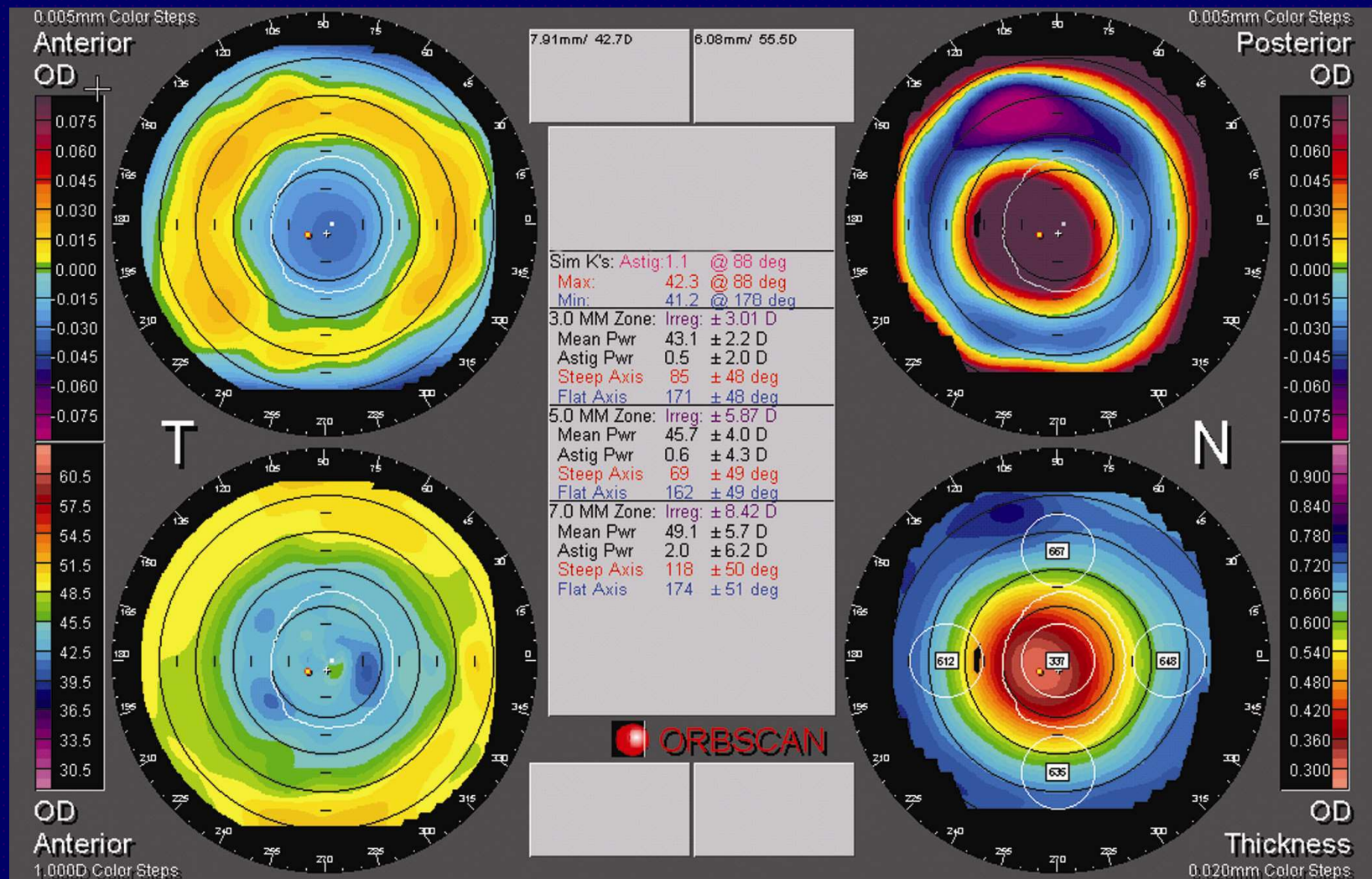
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Case II: Will you do keratorefractive procedure?

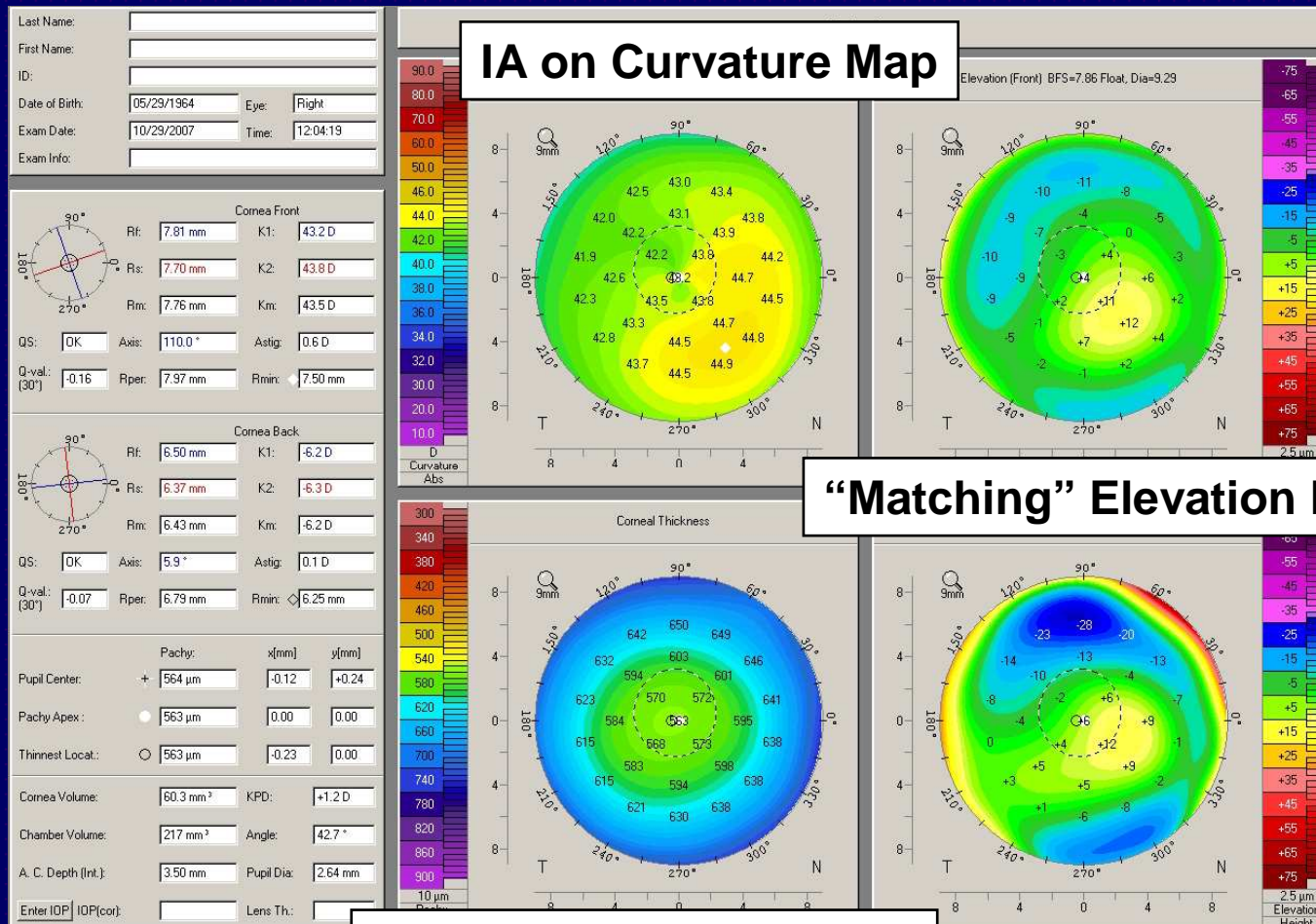


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Will you enhance? Is it myopic regression or gross anterior movement of the whole (front and back) cornea?



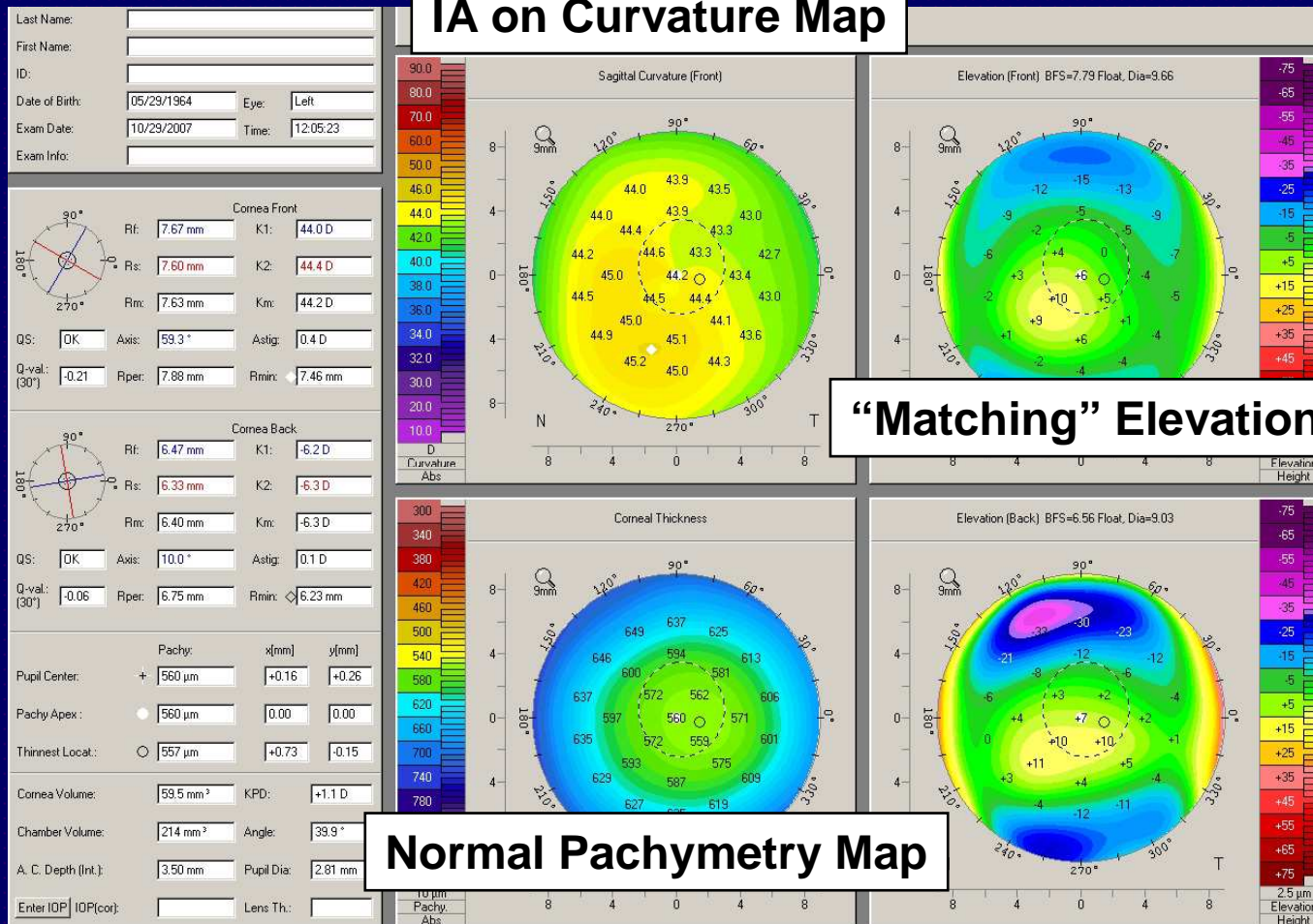
Will you do keratorefractive procedure? 2-point or **3-point touch**?



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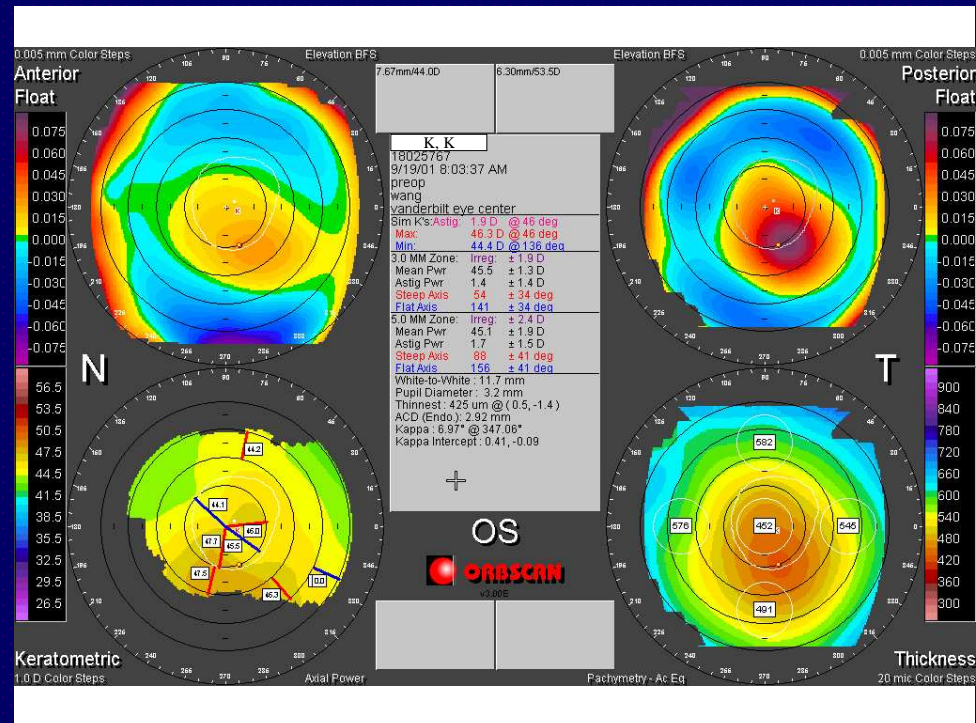
The other eye, will you do keratorefractive procedure?

IA on Curvature Map



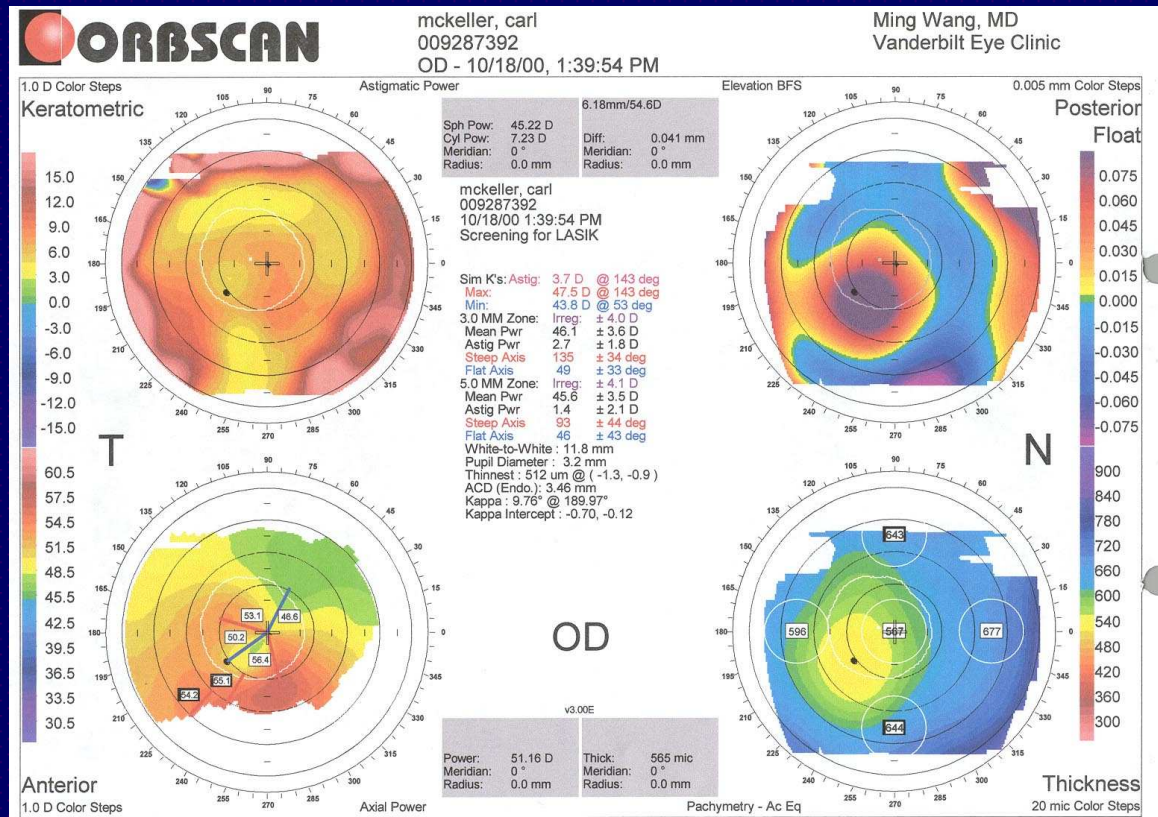
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Will you do keratorefractive procedure?



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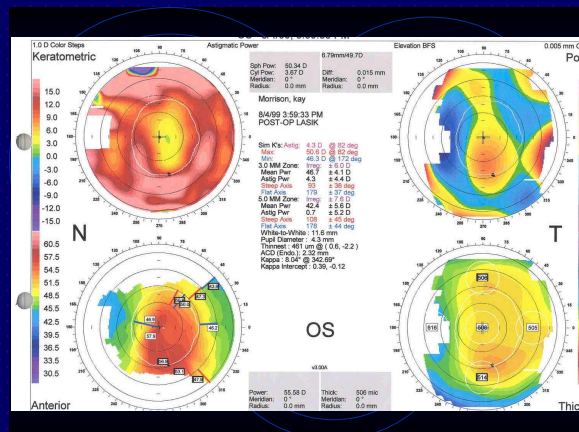
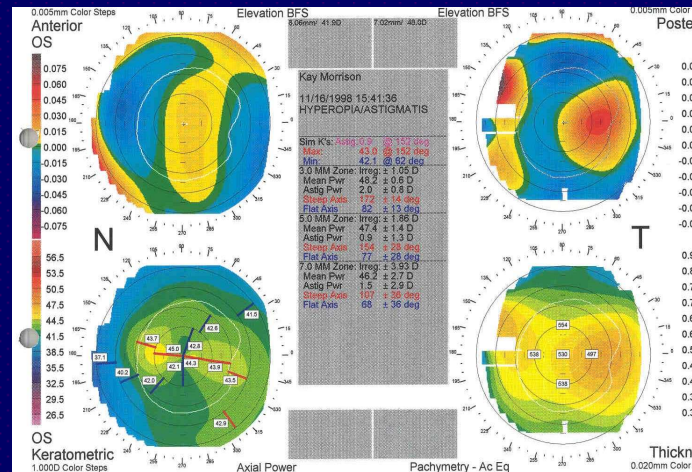
Will you do keratorefractive procedure?



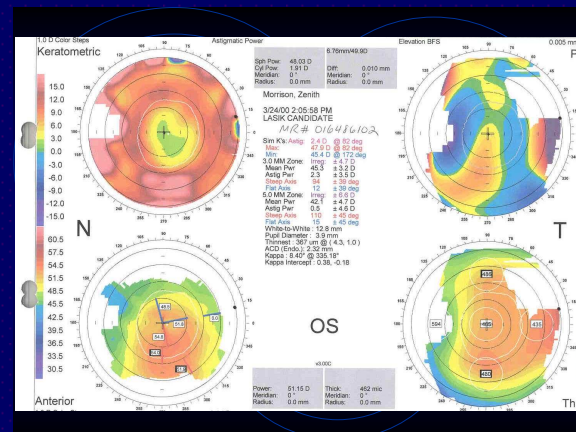
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Would you also have done keratorefractive procedure also? Resistant to H-L treatment. Why? **Preop** existing posterior decentered apex!!!

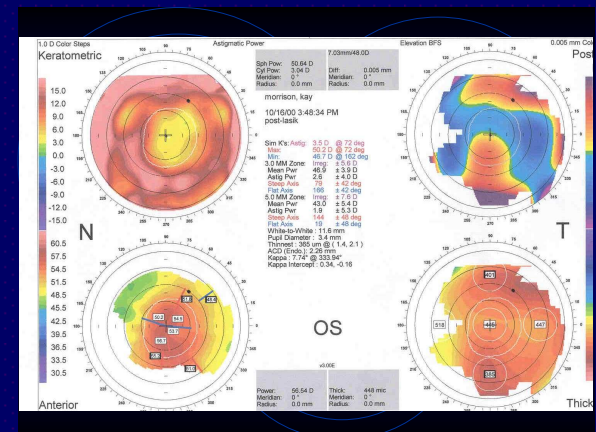
Preop



After +4 D H-L

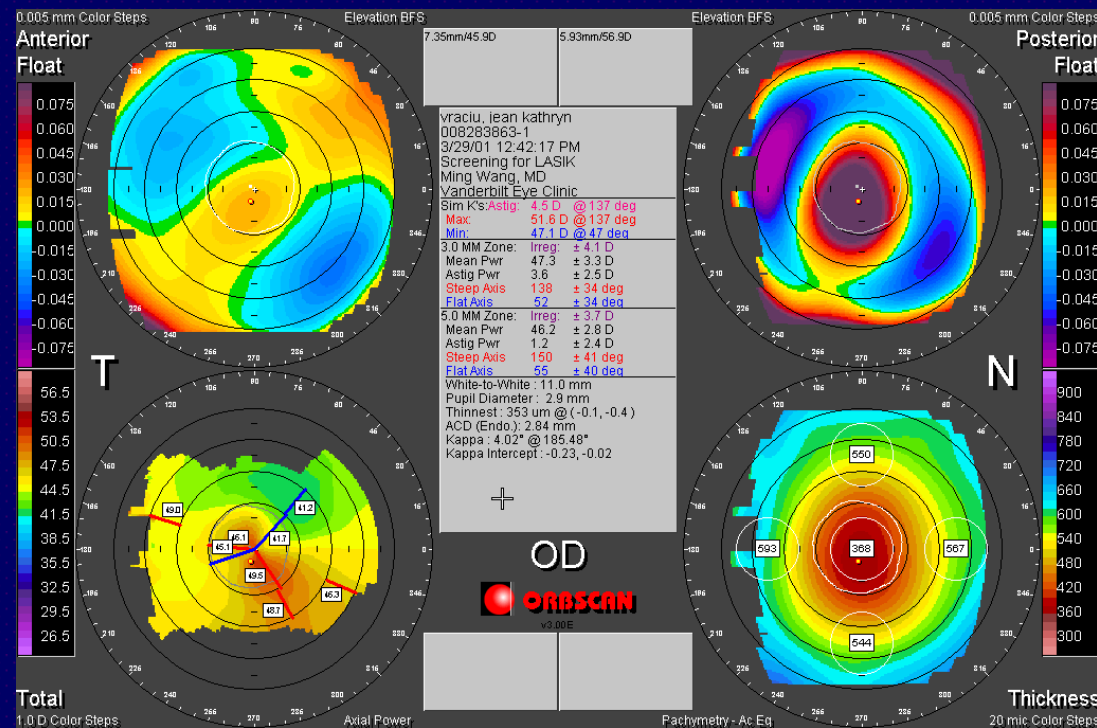


Regressed to +3, after enh



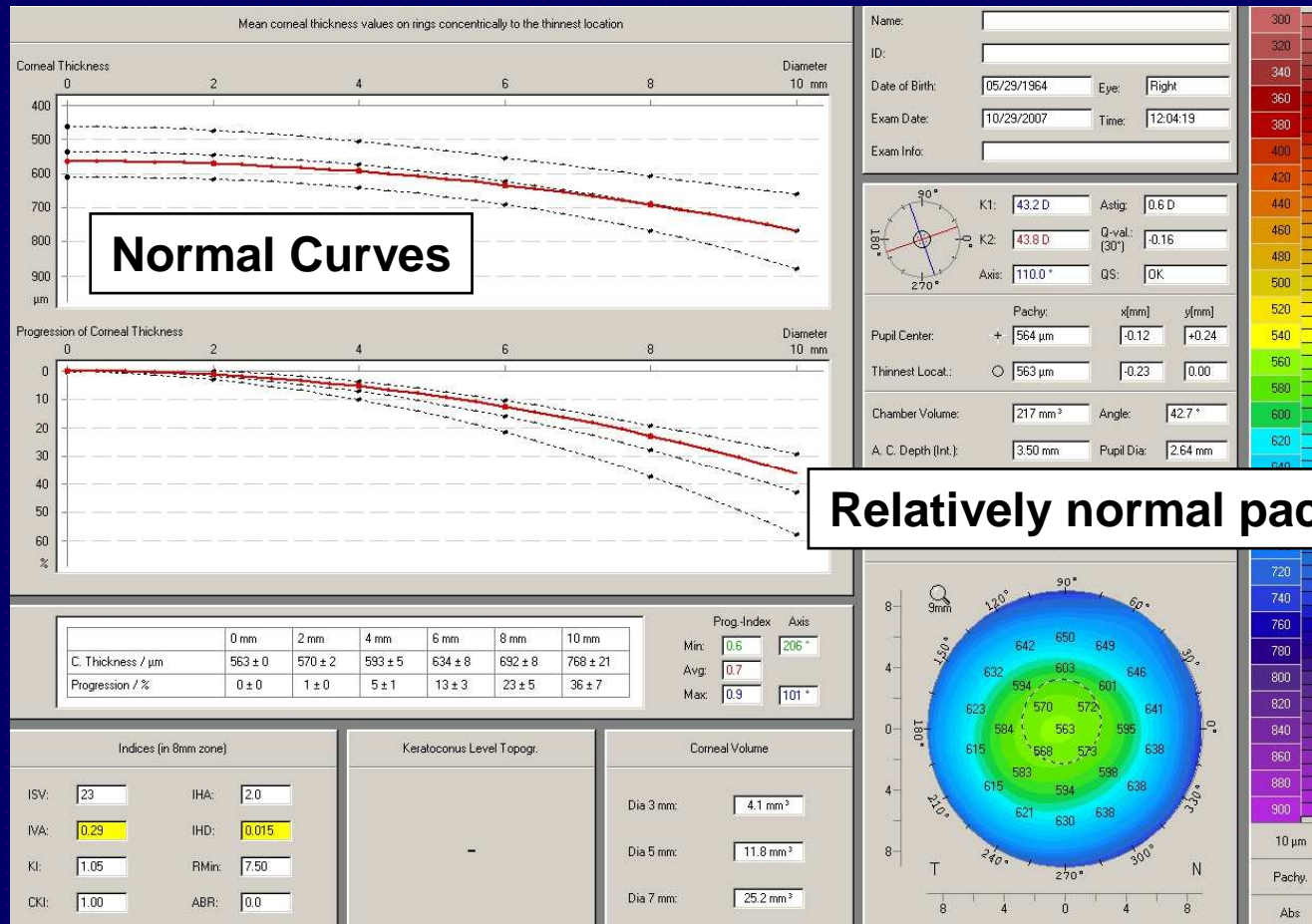
Again reg to +2, after enh

**Will you do keratorefractive procedure?
Posterior changes are **pronounced** than
anterior.**



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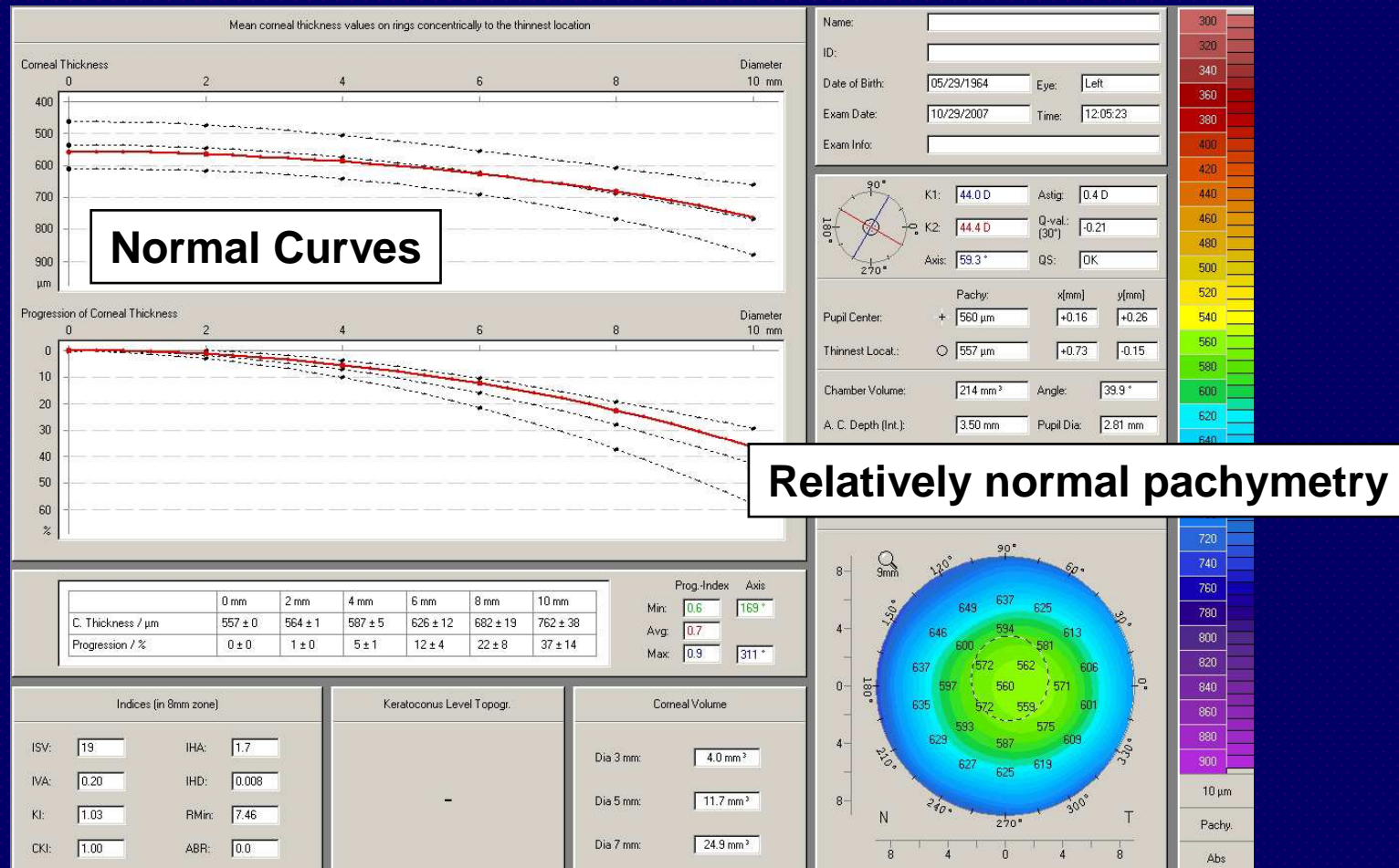
Keratoconus Screening OD



No red flags

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Keratoconus Screening OS



No suspicious index values

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Summary

3-point touch to identify FFKC

Matching of locations of anterior and posterior
elevation / corneal thickness / and anterior
curvature