Common Misconceptions in Interpreting Corneal Topography

Cynthia Roberts, Ph.D.
Professor of Ophthalmology and Biomedical Engineering
Martha G. and Milton Staub Chair for Research in Ophthalmology
The Ohio State University

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Three Top Misconceptions

- What is the Difference between Power and Curvature when both are measured in Diopters?

- How do I interpret a Pachymetry Difference Map after Refractive Surgery? Isn’t the largest difference where the maximum ablation occurred?

- What is the best reference surface for elevation: best-fit-sphere or toric asphere?

1. Refractive Power

- Incoming light rays are refracted by the first surface

- The angle of refraction is dependent on the incoming angle of incidence
Power vs Curvature for a Sphere and two Ellipses


Power vs Curvature

Spherical Aberration

Optical power Axial diopters Tangential Curvature

Power and Curvature are directly proportional ONLY in the central paraxial region
Total Corneal Power derived from anterior and posterior corneal surfaces

- Ray Tracing through BOTH surfaces
  - Snells’ Law Refraction:

Post-LASIK

- Tangential (Instantaneous)
- Axial
- Elevation (BFS)
- Refractive Power
2. **Pachymetry Map**

- Measurement is normal to anterior surface (which is altered with refractive surgery)

- The normal measurement is reflected to a 2 dimensional plane for display

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**Reflection of Normal Measurement to 2D Map**

*After Refractive Surgery:*

1. Anterior surface is altered
2. Line of Sight may be altered

3. **Pachymetry Difference Map is NOT valid**
What happens with Subtraction?

- Post-op minus Pre-op Pachymetry Map
- Simulation of translation of 0.4mm and a rotation of 5°


Tangential vs Pachymetry Difference Maps

- 155 eyes of 155 patients who underwent SMILE
- Vector Difference in Pre and post-op Pupillary offset significantly correlated with decentration from pachymetry maps

What Map Should be Used?

Tangential (Instantaneous) Curvature

Measurement is along the surface
No Reference-fit like with Elevation

3. Elevation

• Anterior or Posterior Surface

• Requires a Reference
  – Relative height
  – Can be compared to a plane
  – Can be compared to a sphere
  – Can be compared to an asphere

• “Best-fit” sphere is most often chosen
Height relative to a plane reference

What conditions?

Plane Reference

Best-Fit Sphere Reference
What About Toric Asphere?

- Part of the shape is buried in the reference
- An astigmatic cornea will NOT appear to be asigmatic since the reference is astigmatic
Summary

- Curvature measures shape, despite diopters, and a Snell’s Law refraction is required for power map.

- Pachymetry Difference Maps after Refractive Surgery are not accurate if a shift in angle kappa has occurred.

- What is the best reference surface for elevation?: Depends on Application!

Thank You!