Keratometry and Topography

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- **Keratometer / Ophtalmometer**
- **Samuel Hankins MD 1880 France**
- **Four Variables : object size, image size, distance between real and reflective image, radius of reflective surface**
- **Javal-Schiotz and Bausch and Lomb Principals**
- **Keratometer**
- **Objective measurement**
- **Measures approximately the central 3mm of corneal curvature**
- **Spherical measurement**
- **Mire quality**
- **Accurate (0.25D or more on irregular K's)**
- **Very cost effective**
- **Widely used today**
- **Normal Kerotometer Mires**
- **Irregular Keratometry Mires**
- Keratometer

The normal range of the keratometer is

36.00D to 52.00D (9.39mm to 6.49mm)

- **Topographical Keratometry**
- **Topogometer--Soper 1962**
- **Movable fixation light**
- **Identifies corneal apex**
- **Locates displaced apex**
- **Identifies irregular astigmatism**
- Normal Cornea Prolate
- **Corneal Topography**
  Prolate Cornea

- **With the Rule Astigmatism**
  - **Horizontal meridian is least curved**
  - **Vertical meridian is most curved**

K's 42.00@180 / 43.00@90

Rx -3.00 -1.00 x 180

- **Against the Rule Astigmatism**
  - **Horizontal meridian is most curved**
  - **Vertical meridian is least curve**
  - **K's 44.00@180 / 42.00@90**
    Rx -3.00-2.00X90
- Against the Rule Astigmatism
- Oblique Astigmatism
- **Irregular Astigmatism**
  - **Principle meridians are not perpendicular**
  - **In certain cases they are distorted**
  - **E.g. keratoconus, trauma, post surgical**
  - **K's 42.00@10 / 44.00@70**
    2+ Distortion
    Rx -3.00-3.50x15 20/30
- **Irregular Astigmatism**
- **Post Refractive Surgery**
  Oblate Cornea
- **Placido's Disk / Keratoscope**
  - **Antonio Placido MD Portugal 1880**
  - **Allvar Gullstrand 1896 photos and algorithm**
  - **Wesley-Jessen 1950's curved disk reduced distortion, photo comparison**
- **Placido disk**
  - **Consists of a series of illuminated concentric rings that are projected to the eye**
  - **Reflected off the anterior surface of the cornea.**
  - **A digital camera captures the image**

- **Computer software detects the location of the rings and uses this information to calculate the shape of the cornea.**

Placido Disk ***Photokeratoscope***

Topographical Corneal Mapping

- **Precise Computer Aided Imagery**
- **Simplified operation**
- **3D image capture**
- **Database software**

Modern Topography Technology

- **Uses Placido Disk technology to evaluate corneal contour**
- **Demonstrates contour with a color image**
- **Measures 8.9 to 10 mm of corneal surface**
- **Programs offer many different views generates color maps**

Interpretation of data

- **Simulated K (SimK)**
- **The index of asphericity:**
- **Absolute**

Pre-set using same scale

Ability to compare maps and cornea curvatures

- **Normalized**

Each map has different color scales

Displays greater detail

Absolute Maps

- **Have a preset color scale with the same dioptric steps**
- **Dioptric minimum and maximum assigned to the same colors for particular instrument**
- **The absolute maps allow direct comparison of 2 different maps**
- **May not show subtle changes of curvature**
- **May be confusing with irregular corneas**

- **Normalized**
- **The color scale varies for each map**
- **The instrument software identifies the actual minimal and maximal keratometric dioptric value of a particular cornea**
- **The dioptric range assigned to each color generally is smaller compared to the absolute map**
- **Normalized maps show more detail**
- **Two different maps cannot be compared directly**
- **Axial maps**
- **Axial curvature**
- **(also termed Saggital curvature)**
- **Axial maps assume that all light rays are refracted to a focal point along the optical axis.**
- Normal Cornea
  Axial
- **Tangential maps**
- **Tangential and instantaneous curvature**
- **Also meridian curvature**
- **The topographer calculates curvature based on the tangent to the normal for a particular point on the cornea**
- **Usually tangential maps are sensitive to abrupt changes in curvature**
- Normal Cornea
  Tangential
- Plucids Marginal Degeneration
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- Penetrating Keratoplasty PKP
- **Penetrating Keratoplasty**
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- **Graft Tilt**
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- **Scheimpflug Camera**
- **Uses a rotating Scheimpflug camera to measure the anterior segment**

- **This allows you to view individual cross-sectional slices of the anterior segment**
- **Also 3-D anterior segment images**
- **Analysis of both the anterior and posterior surfaces of the cornea**
- **Pachymetry**
- **Examples**
- **Pentacam (Oculus)**
- **Anterior chamber depth**
- **It requires up to two seconds for data acquisition.**

Optical Coherence Tomography

- **(OCT) of the cornea is an optical method of cross-sectional scanning**
- **Based on reflection and scattering of light from the structures within the cornea**
- **Measuring different reflectivity from structures within the cornea by a method of optical interferometry**

Orbscan II

- **Uses a scanning optical slit design**
- **40 light slits at the 45° angle projected through the cornea**
- **High-resolution video camera captures the image**
- **The instrument's software analyzes 240 data points per slit**
- **Calculates the corneal thickness and posterior surface of the entire cornea.**
- **Orbscan currently uses partial reflective corneal topography and this optical slit design to increase acuracy**

Orbscan II

- **Measures both anterior and posterior surface elevation and curvature.**
- **Pachymetry**
- **Anterior chamber depth**
- **The acquisition time for the Orbscan II is 1.5 seconds**

Challenges to Accurate Corneal Mapping

- **Poor tear quality**
- **Very irregular cornea causing cross over**

- **Optical error ±0.25 D or 2-3 mm or ±0.50-1.00 D in irregular corneas**
- **Induced astigmatism**
- **Increased inaccuracy toward the periphery**
- **Different technologies are not directly comparable**