In today’s ever demanding world, we are continually looking for methods to improve the efficiency and accuracy of contact lens fitting.

Recent advances in instrumentation have significantly improved the precision and comfort for an ophthalmologist to measure and manage hard to fit corneas.

The ability to measure the anterior surface of cornea is an essential component for the success of contact lens fitting. In the modern times topography guided contact lens (CL) fitting is used mainly for irregular corneas as these are the challenging cases.

Depending on the severity, an irregular cornea can functionally reduce visual acuity of a patient. In mild irregular corneas spectacles or standard soft contact lenses help in improving the visual acuity (VA). However in advanced cases these measures fail to improve VA. In such situations special contact lenses have provided respite to patients.

**Limitations of Traditional Contact Lens Fitting Methods**

Taking measurements with a keratometer is insufficient and limited to the central 3 mm. In addition the mires of a keratometer are unreadable for advanced irregular corneas. They do not take into consideration the asphericity of the cornea nor the asymmetric nature of most corneal asphericity.

Diagnostic contact lens fitting has relied on the analysis of fluorescein patterns. Unfortunately, the ability to visualize fluorescein is limited to approximately 20 microns. If the corneal clearance is below 20 microns, the area evaluated will appear to be aligned to, or bearing on, the corneal surface when this may not be the case.

**Modern Technologies for Good Contact Lens Fitting**

Advanced technologies such as computerized corneal topography and corneal Scheimpflug imaging tomography allow us to achieve virtual contact lens fitting based upon numerous parameters of lens-to-eye relationship.

Topography assisted contact lens fitting has more complete data collection, results in reduced chair time and reduces patient discomfort.

Corneal topography has been shown to be an important tool in studying both normal and irregular corneas and has gained worldwide clinical acceptance

There are a number of ways to represent topography data-

- **Numeric**, with powers displayed over the surface point where it was collected;
- **Wire-mesh representation**, allowing 3D modelling;
- **Colour-coded contour maps**, allowing an easier interpretation.

Topographical contour maps can present in different ways:

- **Axial (Sagittal) Maps**- These maps are set up with algorithms that assume the cornea is spherical, which makes them less accurate for peripheral corneal evaluation. They have good repeatability and are considered the most useful and

**TABLE 1: Speciality Lens Choice Based on Topography**

<table>
<thead>
<tr>
<th>Type of Abnormality</th>
<th>Average Numerical Value</th>
<th>Type of Lens</th>
</tr>
</thead>
<tbody>
<tr>
<td>Keratoconus</td>
<td>2 mm average K</td>
<td>Rose K</td>
</tr>
<tr>
<td>Pellucid marginal</td>
<td>4 mm average K</td>
<td>Dyna Intra Limbal Lens</td>
</tr>
<tr>
<td>degeneration</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post-graph or refractive</td>
<td>8 mm average K</td>
<td>Post Graph lens</td>
</tr>
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Diagnostics: Topography Guided Contact Lens Fitting

Tangential maps- Based upon instant radius of curvature, making them more accurate for diagnostic and lens fitting purposes. These maps best identify corneal pathology such as keratoconus. They reveal a more exact location of a corneal defect when compared to an axial map.

Corneal Height (Elevation) Maps- These are created based on how the height of cornea compares to the reference sphere. Measuring the corneal surface with small elevations or depressions provides a more detailed corneal assessment.

Refractive Maps- These convert the curvature into a corresponding refractive reading. They are considered the least useful for contact lens fitting. They account for spherical aberration of the cornea. It is most useful when assessing the visual performance of post-refractive surgery patients or the end result of refractive surgery (difference display).

Numerical View - This map arranges individual keratometric findings to depict curvature readings of the eye. This view is extremely useful when fitting specialty contact lenses. Corneal topographic software calculates the “average keratometric” value. Table 1 indicates the initial GP lens designs for various pathological corneas.

Profile View - This view graphically represents the individual axes of the cornea to help depict the three-dimensional nature of the cornea. It presents a side view of the major axes of the cornea and can help determine if a toric contact lens is required. It can also present sodium fluorescein patterns with a profile view to assist in contact lens fitting.

Nearly all corneal topography devices incorporate contact lens fitting software. This software will range from pre-loaded designs of current lens manufacturers’ stock lenses to those topography units that allow the clinician to create their own contact lens design.

The software helps to determine residual astigmatism, correcting contact lens power for vertex distance and computing lens power and axis when an over-refraction is entered.

The software program can show us different fitting techniques and the position of the lens, as well as the amount of clearance between the posterior lens surface and the cornea. These measures can be calculated along any meridian of the cornea. Analysis of such data allows to see central, peripheral, and edge clearance for 360 degrees.

Figure 1: Corneal Irregularity Measurement (CIM) of a post RK patient

Figure 2: Keratograph Placido image, axial curvature map showing with-the-rule astigmatism
Contact Lens

degrees. This graph is highly valuable in designing lenses with optimal lens-to-cornea relationships and is far more accurate compared to observing fluorescein patterns.

**Statistical Indices in Corneal Topography**

The following indices present a clear picture of the cornea and further assist in selecting the best contact lenses. These also help in detecting and monitoring changes in ocular disease.

*Shape Factor (SF)*: It is the measurement of corneal asphericity. When the cornea is less spherical or more elliptical in any meridian, it resembles a prolate shape. A negative SF usually indicates a post-refractive surgery eye with the center flatter than the periphery.

*Eccentricity values (e)*: They are based on the mathematical description of an ellipse where 0.0 represents a circle with no flattening and 1.0 represents the maximum flattening in the periphery. Average corneas usually have an eccentricity of about 0.55 (e = 0.55).

Different corneas may have the same central radius of curvature (Sim K or keratometry) but display a different rate of peripheral flattening or eccentricity. Therefore, if you choose base curves based on the central keratometric reading, you should know that peripheral flattening determines the contact lens-to-cornea relationship.

Contact lens modules take these differences into consideration when they preselect the best contact lens to fit the aspheric cornea. These contact lens nomograms calculate the overall fitting relationship, the diameter of the contact lens, the optic zone and the peripheral curve configuration to determine the best contact lens fit.

*Corneal Irregularity Measurement (CIM)*: It is a number or index which represents the irregularity of the corneal surface. The higher the irregularity index, the more difficult it is to fit the corneal surface with a contact lens. It often can predict irregular astigmatism or visual distortions. Higher CIM values indicate that ocular pathology such as keratoconus or other pathological cases is more probable. Figure 1 shows the CIM of a post RK patient. The general population exhibits the following distribution ranges:

- Normal 0.03µm to 0.68µm
- Borderline 0.69µm to 1.0µm
- Abnormal 1.1µm to 5.0µm

*Pathfinder Corneal Analysis*: The Atlas Corneal Topographer (Carl Zeiss Meditec, Inc.) uses special software that combines the above indices (CIM, SF) to determine the probability of irregular corneas. This helps practitioners qualitatively and quantitatively measure the probability of keratoconus. It also helps in fitting GP lenses. It determines whether a GP or soft toric lens fits poorly on the cornea.

The images below (Figure 2, 3 and 4) depict how the topographical software helps confirm the contact lens to be dispensed.

These simulated patterns captured must be then confirmed with the actual fluorescein patterns on the slit lamp. Sindt C and colleagues conducted a study to evaluate virtual fittings of keratoconus. They found that 74% of eyes showed a good match between theoretical and actual fluorescein patterns.

In addition to the physical fitting characteristics of a virtually fit lens, the software can also assist in determining its optical
power properties when you enter refractive data and vertex distance. Changes in base curve radius resulting from the required optical power can immediately be calculated.

Ninety percent of keratoconus fittings require GP lenses, and a proper fitting process requires a careful assessment and evaluation of fluorescein patterns. The most useful aspect of topography is indicating where the cone displacement is located, the size of the cone, whether there is any significant astigmatism outside of the cone, and providing some idea about where the contact lens is probably going to sit, as well as defining the initial diagnostic lens selection.⁵

Different mapping machines may give different pictures and even different operators may produce different maps. Various scales also give an array of pictures, so it is important when comparing maps to make sure the scale is the same in both maps.

Advances in instrumentation have significantly improved the diagnostic and fitting success for irregular corneal management. One should utilize topography-based softwares that enable virtual contact lens fitting and aim at replacing keratometry based contact lens fittings. Ultimately this can improve efficiency.

References