Using the Pentacam for Biometry after Keratorefractive Surgery: the BESSt Formula

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The Pentacam

- High Definition scans: 25,000 elevation points measured

2013 ASCRS,
Study Design

1) Development of the BESSt Formula

Developed on the outcomes of 170 eyes (WF LASIK-EK)
Myopia (123) Hyperopia (47)

Regression analysis
Variables of GOF (n; K) adjusted to achieve closest fit with the History Method-derived Ks → BESSt Formula.

The Gaussian Optics Formula (GOF)

\[ F_{\text{tot}} = F_{\text{ant}} + F_{\text{post}} - \frac{d}{n} \times (F_{\text{ant}} \times F_{\text{post}}) \]

\[ F_{\text{tot}} = \frac{1}{r_1}(n_1-n_0) + \frac{1}{r_2}(n_2-n_1) - \frac{d}{n_1}(\frac{1}{r_1}(n_1-n_0)\times(\frac{1}{r_2}(n_2-n_1))) \]

Methods

Data regarding:
Axial length (IOL Master, Zeiss™)
Anterior and Posterior corneal curvature and
Corneal thickness (Pentacam Scheimpflug Imaging, Oculus™)
Corneal Topography (KR 8100PA, Topcon)

Correlation GOF- v Topography-
derived Ks in untreated corneas

Mean Deviation from Topography:
-1.3 ±0.29 SD

\( r = 0.97 \)
\( r^2 = 0.95 \)
\( p < 0.05 \)

Michaels DD
Visual Optics and Refraction: A Clinical Approach
Corneas After Myopic Refractive Surgery

Correlation:

\[ r = 0.96 \]
\[ r^2 = 0.93 \]
\[ p < 0.05 \]

Mean Deviation:

\[-0.01 \pm 0.55 \text{ SD} \]

Abs. Deviation:

\[-0.41 \pm 0.36 \text{ SD} \]

Direct correlation between Myopia treated & apparent increase in corneal refractive index

…without further adjustments, the GOF-derived Ks correlate to, but also significantly underestimate corneal power.

GOF measures the full corneal power (anterior & negative posterior surface), rather than the power of the sole anterior surface, as standard keratometers do.

**ARTICLES**

Estimation of true corneal power after keratorefractive surgery in eyes requiring cataract surgery: BESSt formula

Edmondo Borasio, MedC BQ Ophth, FEBO,
Julian Stevens, MRCP, FRCS, FRCOphth, Guy T. Smith, FRCOphth
Study Design

Prospective application of the BESSt Formula

25 eyes post-Refractive surgery undergoing Phako+IOL

Myopia: \(-5.5\) D \(\pm\) 2.1 SD. [Range -2.9 to -8.6]

Hyperopia: \(+5.3\) D \(\pm\) 3.6 SD. [Range +1.7 to +8.5]

[Range: -8.6 to +8.5 D]

Outcomes Phako post Refr. Sx

Reported values represent mean deviations

* BESSt significantly more accurate (p<0.05) (SD in brackets)
### Mean Difference from Target

**Original group**  
(N = 13)

- **Myopic**  
  -0.08 ± 0.62 SD  
  0.03 ± 0.42 SD  
  -0.11 ± 0.78 SD

- **Hyper**  
  0.31 ± 0.72 SD  
  0.45 ± 0.67 SD  
  0.10 ± 0.72 SD

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**2nd data set**  
(N = 25)

<table>
<thead>
<tr>
<th>Difference From Intended</th>
<th>BESSt</th>
<th>Holladay2 Atlas</th>
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</thead>
<tbody>
<tr>
<td>≤0.50 D</td>
<td>60 %</td>
<td>52 %</td>
</tr>
<tr>
<td>≤0.75 D</td>
<td>76 %</td>
<td>60 %</td>
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<tr>
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<td>68 %</td>
</tr>
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<td>&gt;1.50 D</td>
<td>0 %</td>
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<th>Holladay2 Atlas</th>
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Source: www.besstformula.com
## 2007 BESSet formula (N = 25)

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<th>BESSet-M (Myopia) N=14</th>
<th>BESSet-H (Hyperop) N=11</th>
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### The BESSet® Formula

- Is a modified version of the Gaussian Optics Formula (GOF) for Paraxial Imagery
- The GOF is an optical formula which allows to estimate corneal power from:
  - Corneal Radius (ant & post)
  - Corneal Thickness

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### The BESSet® Formula Limitations

- Variation between Pentacam units
- The biometry formula the corneal effective power is entered into (SRK-T, Haigis, Hoffer-Q, Holladay II)
- Multifocality of ablations, especially hyperopia
The BESSt® Formula Limitations

BESSt v1.8 Formula

Is a modified version of the Gaussian Optics Formula (GOF) and Vergence formula.

It estimates Corneal and IOL power from:
- Ant & Post r (Corneal Radii after Ref Sx)
- Corneal Thickness (after Ref Sx)
- AL (After Ref Sx)

No need for pre-refractive surgery data

3rd Generation formulae:
SRK/T, HofferQ, Holladay 1

They underestimate the Effective Lens Position due to the centrally flattened cornea from the Myopic ablation.

They require double-K adjustment after laser refractive surgery:
- Double-K (pre-op K for Effective Lens Position; post-op K for IOL power)

In Virgin eyes
Ant r can be predicted WELL (86%) From Post r
Post r does NOT change after laser refractive surgery

After laser refractive surgery, Ant r becomes POORLY PREDICTABLE (39%) from Post r measurements.

Conclusions BESSt Formula

Limitation of the reproducibility of the Pentacam

Limitation of prediction of final lens position in variable anterior chamber depth eyes: double K issue

76 % eyes within 0.75 D of intended

It does NOT require pre-Refr. Surg. information