What is Nanophthalmos?

- Simple microphthalmia
- The axial length = 14-16 mm
- Extreme hyperopia of +8 → +25
- The choroid and sclera are greatly thickened
- While all ocular structures are small in microphthalmia, in nanophthalmos the lens dimensions are generally normal
- Angle closure glaucoma is a major risk
- Retinal & Choroidal folds
- Crowding of ONH
- Choroidal effusion.................
What are the problems of Biometry in Nanophthalmos?

<table>
<thead>
<tr>
<th>AL in mm</th>
<th>Heigis only a0 optimized</th>
<th>Heigis a0, a1 &amp; a2 optimized</th>
<th>Hoffer Q ACD optimized</th>
<th>Holladay 1 SF optimized</th>
<th>Holladay 2 ACD optimized</th>
<th>SRK/T A-constant optimized</th>
</tr>
</thead>
<tbody>
<tr>
<td>18.00 - 19.99</td>
<td>0.50 D</td>
<td>0.50 D</td>
<td>0.50 D</td>
<td>1.00 D</td>
<td>0.50 D</td>
<td>2.00 D</td>
</tr>
<tr>
<td>20.00 - 21.99</td>
<td>0.25 D</td>
<td>0.25 D</td>
<td>0.25 D</td>
<td>0.50 D</td>
<td>0.25 D</td>
<td>1.00 D</td>
</tr>
<tr>
<td>22.00 - 23.99</td>
<td>0.25 D</td>
<td>0.25 D</td>
<td>0.25 D</td>
<td>0.25 D</td>
<td>0.25 D</td>
<td>0.25 D</td>
</tr>
<tr>
<td>26.00 - 27.99</td>
<td>0.25 D</td>
<td>0.25 D</td>
<td>0.50 D</td>
<td>0.25 D</td>
<td>0.25 D</td>
<td>0.25 D</td>
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<tr>
<td>28.00 - 30.00</td>
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<td>0.50 D</td>
<td>0.50 D</td>
<td>0.25 D</td>
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<td>0.50 D</td>
</tr>
<tr>
<td>Minus power IOLs</td>
<td>1.00 D</td>
<td>0.50 D</td>
<td>1.00 D</td>
<td>0.50 D</td>
<td>0.30 D</td>
<td>1.00 D</td>
</tr>
</tbody>
</table>

The chart above represents our experience with several popular posterior chamber intraocular lenses with axial length measured using the IOLMaster, with results displayed in terms of the best possible mean absolute prediction error. These data represent outcomes for patients with keratometry below 50.0 D and above 40.0 D and excludes cases of keratoconus, or prior keratorefractive surgery. For the reasons outlined above, your own individual results may vary, depending on the geometry of the intraocular lens used and overall accuracy of pre-operative measurements, such as keratometry, ACD and axial length.
Which formula?

- Hoffer Q formula was best for eyes shorter than 22 mm
- Holladay I formula performed best with eyes between 24 mm and 26 mm
- SRK/T formula was best for eyes longer than 26 mm
- The assumption that the anterior chamber depth (ACD) was a proportion of the AL and not a true measurement, led to IOL surprises with post-refractive patients. This is because the third-generation formulas do not account for effective lens position.

Which formula?

- The third generation formulas shorten the expected AC depth, thus predict the lens position to be too anterior leading to hyperopic error
- Hoffer Q attenuates the scaling of AC depth so that it leads to smaller hyperopic shift **EXCEPT** for nanophthalmic eyes where a myopic shift can result

*(Holladay et al, 1996)*
* Increased corneal curvature with posterior nanophthalmos

(Malik et al, 2008)

* 4 cases of nanophthalmos having AL range 14.8 – 15.3 mm & corneal curvature between 50.0 - 53.2 D

<table>
<thead>
<tr>
<th></th>
<th>K1</th>
<th>K2</th>
<th>AL</th>
<th>Hoffer Q/120</th>
<th>SRKII/120</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>50.37</td>
<td>51.21</td>
<td>15.17</td>
<td>76.0</td>
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<tr>
<td>2</td>
<td>50.01</td>
<td>51.14</td>
<td>14.91</td>
<td>80.0</td>
<td>40.0</td>
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<tr>
<td>3</td>
<td>52.7</td>
<td>51.21</td>
<td>15.17</td>
<td>75.5</td>
<td>38.5</td>
</tr>
<tr>
<td>4</td>
<td>52.7</td>
<td>53.2</td>
<td>14.91</td>
<td>79.5</td>
<td>38.0</td>
</tr>
</tbody>
</table>

Choice of Formula

- The Hoffer Q performed best for ALs from 20.00 to 20.99 mm, the Hoffer Q and Holladay 1 for ALs from 21.00 to 21.49 mm, and the SRK/T for ALs of 27.00 mm or longer

(Formula choice: Hoffer Q, Holladay 1, or SRK/T and refractive outcomes in 8108 eyes after cataract surgery with biometry by partial coherence interferometry.)

(Aristodemou et al, 2011)

- The source of error for postoperative refractive state prediction is due in part to the chosen formula, particularly in eyes with very long or very short AL

Nanophthalmos ???
Take home messages

- When performing cataract extraction in nanophthalmos, we all know the hazards and operative complications, but we should also consider the need for high power IOL, that may not be dissolved by the piggy back implantation due to shallow AC & high incidence of ACG.

- In addition it is always difficult to choose the suitable IOL formula for IOL power calculation especially in cases with steep corneas, which is not uncommon.