Aiming for IOL Power Success ASCRS 2021

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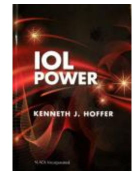
“**IOL POWER**” book by Slack ▶



I. AXIAL LENGTH MEASUREMENT

The *Ossoinig* Immersion is proven to consistently produce an axial length measurement that is 0.26 mm longer than that using the applanation technique- that may indent the cornea, creating an artificially shorter reading. An 8 mHz non-focused transducer is recommended - can be attached to most US machines. An Ossoinig shell (cup) is placed between the lids and filled with Goniosol [cut 50% with Dacriose]. The probe is placed into the fluid and aimed in an axial direction. Optical biometry methods are easier and matched to equal Immersion. (See below)

A. Ossoinig cups (#303-82) Order: Hansen www.HansenLab.com 319-338-1285 $36@ 16-18-20-22-24 mm

i. Prager Shell: Order from: ESI, Inc. www.ESI.com 763-473-2533 tab@eyesurgin.com

B. Direct read out of oscilloscope is optimal compared to “black box” readouts without scan.

C. Axiality determined by obtaining simultaneous maximum corneal and retinal spikes.

D. Always measure the axial length of both eyes [Standard of Care Issue].

E. Consider STAPHYLOMA in problem case with AL >25 mm, need B-scan or Optical biometer.

PO Rx affected by AL

AL	ERROR
20 mm	= 3.75 D/mm
23.5 mm	= 2.35 D/mm
30 mm	= 1.75 D/mm

F. ULTRASOUND SPEED

In 1974,[8] I computed the average US speed of a Phakic eye = 1555 m/sec and an Aphakic eye = 1534 m/sec.

BUT AL affects this: e.g. 20 mm Phakic = 1560 m/sec & 30 mm Phakic = 1550 m/sec. (Aphakic *NOT affected by AL*)

WHY? Short eyes are made up of smaller % of fluid axially (short AC, shorter vitreous, thicker lens), ∴ Velocity faster.

1. How to correct for this: PHAKIC EYE: Measure all eyes at 1532 m/sec and add to it a CALF factor of + 0.37 mm.
   a. APHAKIC EYE: Measure at 1532 m/sec and only add + 0.05 mm
   b. PSEUDOPHAKIC Eye: Measure at 1532 m/sec and add Holladay CALF of:
      PMMA [+ 0.424*(T_L) + 0.037] Silicone [- 0.563*(T_L) +0.037] Acrylic [+ 0.243*(T_L) + 0.037] T_L = IOL Thickness
   c. OR use Average Velocities for 23.5 mm eye: PMMA 1556 m/sec Silicone 1487 m/sec Acrylic 1549 m/sec
   d. Piggyback Lens Eye: $AL = AL_{1532} + T_1 *(1\text{-}1532/V_1) + T_2 *(1\text{-}1532/V_2) + 0.037$ Where T_1 and V_1 are the thickness and velocity of one IOL and T_2 and V_2 are of the other lens
2. If AL not measured at 1532 m/sec, AL can be converted by formula:
   V_{meas}= Velocity you used, $V_{correct}$ = correct or new Velocity

$$AL_{corrected} = AL_{measured} \times \frac{V_{correct}}{V_{measured}}$$

Basically divide old AL by old V and multiply by new V.

3. Scleral Buckle after RD: Use AL-1 mm for ACD prediction and AL for IOL power calculation, “Dbl-AL"
4. SILICONE OIL filled Eye
   a. FIRST PROBLEM: Almost impossible to measure with US: MUST: USE OPTICAL BIOMETER.
   b. SECOND PROBLEM: Refractive index of silicone acts like a minus lens was placed in the vitreous and will cause the eye to become hyperopic by 2-3 D (Plano-convex IOL) or 3-6 D (Biconvex IOL) [Concave IOL best]. Therefore the IOL power must be increased if silicone will be left in the eye.
   c. Due to 1&2 above, I recommend waiting and performing secondary IOL using Holladay Rx Formula.
   d. Advise all retinal surgeons to routinely perform AL measurement prior to placing Silicone.

*Not FDA Approved

*Optopol REVO

*Heidelberg

G. OPTICAL BIOMETERS

IOLMaster Lenstar Aladdin Nidek ALscan Galilei G6 *Tomey IOLM700 Alcon Argos

IOLMaster 1999
Lenstar 2009 Proven
Aladdin 2013 Proven
Nidek AL-Scan Proven
IOLMaster 700 Proven
Alcon Argos Proven
Tomey OA-2000, Proven, Pentacam AXL, To be Tested: Galilei G-6, Heidelberg Anterion, H-S Eyestar, Optopol.

*EyeStar

II. CORNEAL POWER [K]

For every 1.00 D change in Rx must change IOL by 1.25 D.
For every 1.00 D change in IOL, get 0.87 D change in RX.

A. The manual keratometer should be standardized often. This is done with steel calibration balls from the manufacturer.

B. K reading errors = diopter for diopter error in IOL power. ***Hard CL’s must be kept out > 2 weeks (Lawsuit!)***

C. Average K reading is always used; Cylinder is ignored. It has NO effect on IOL spherical power

D. Ignore surgical change in corneal power unless a study of your cases reveals a consistent trend.

E. PK: Do secondary IOL after corneal transplant heals when the true K reading is able to be obtained.

G. Refractive Surgery Eyes

Scheimpflug Cameras: Oculus Pentacam, Ziemer Galilei, CSO Sirius (Italy)

1. Over 30 methods to calculate K or fudge the IOL power.
2. ARAMBERRI DOUBLE-K METHOD: Use Pre-op K to predict the ACD and PO calculated K for the IOL power.
3. IANCHULEV OR REFRACTION METHOD:↓} Alcon WaveTec ORA microscope system proven accurate.

DOWNLOAD FREE HOFFER/SAVINI LASIK TOOL at www.IOLPowerClub.org Click on Tool

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III. ANTERIOR CHAMBER DEPTH

- A. All formulas require an AC depth (ACD) = Corneal thick + Endo to IOL surf dist + 10% T_L (Pl-cvx) or 50% T_L (Bicvx)]
- B. ACD (ELP) is not the ultrasound pre-op anatomical AC depth reading; it is the axial position of the IOL (estimated).
- C. ACD is individual to each IOL style and can be predicted by the formula or is the average of a PO series.
- D. The A constant in SRK formulas and the Surgeon Factor (SF) in the Holladay formula are used to predict ELP.
- E. Hoffer Q formula uses pACD and the Q formula to develop the predicted ELP for an individual eye.
- F. Decrease IOL ~1.00 D when shifting from bag to sulcus placement (0.50 to 1.50 D depending on power of IOL).
- G. Expect ~ 1.25 D/mm shift in IOL Position.

PERSONALIZATION IS IMPORTANT

IV. FORMULAS

A. Historical Theoretic: Fyodorov (1967) Colenbrander (1972) Hoffer® (1974) R Binkhorst (1975)

B. Historical Regression: SRK® [1980) SRK® II [1988)

"*SRK and SRK II formulas are outdated and are no longer recommended; use the SRK/T for IOL power*." John Retzlaff, M.D.1990 (coauthor of SRK).

C. Modern Theoretic:

1. <u>Holladay® 1</u> [1988]: Basic theoretic formula which calculates the corneal height (1st used by Olsen) added to the corneal thickness (0.56) and an IOL/surgeon specific constant (the SF), to calculate the ELP.
2. <u>*SRK/T*</u> ® [1990]: Basic theoretic formula (Holladay) using Olsen method for predicting ACD & A-constant.
3. Hoffer® Q [1992]: Basic Hoffer formula [1974]. Uses Q formula to predict ELP which is dependent upon AL and K, using a personalized pACD. As accurate as the Holladay 1 formula and superior in short eyes.
4. <u>*Holladay® 2*</u> [1996]: [Unpublished] Intended to improve short eye calculation. <u>Requires: Rx, Age, CD, Pre ACD, LT</u>. My study[11] 317 eyes: Less accurate in eyes 22.0-26.0 mm, equal to Hoffer Q (<22 mm). ? better in eyes <18 mm.
5. Haigis® [2000] Uses a0, a1, a2 for ELP. Optimize only a0 = Hoffer Q. Better if optimize all 3 using 350 PO eyes.
6. <u>Olsen</u> [2014] Ray-tracing using new C-factor. v II (2014): Not yet tested in large series.
7. <u>Hoffer® H-5</u> [2015] Holladay 2/Hoffer H upgraded to 5th Generation by taking into account <u>gender</u> and <u>race</u>.
8. Barrett Universal II (2014) Online. 10. RBF No large studies yet show it to be superior; other new systems,
9. <u>Kane: uses new modulators and artificial intelligence; showing to be most accurate formula so far.</u>
10. <u>*Hoffer® QST*[11]</u> [2020] Updates by using Pre-ACD & AL algorithms + Artificial Intelligence. .

V. COMPUTER DATABASE PROGRAMS

1. Holladay® IOL Consultant. Uses Double-K only for Holladay 2 formula, not for Hoffer Q Holladay 1 or SRK/T.
2. Olsen PhacoOptics uses Olsen C-constant and Ray Tracing, 3 .ASCRS Website Calculator.

VI. BIFOCAL IOL POWER

AL has no effect on Add power, K has minimal but ACD has real effect on add power[5-6].

VII. CLINICAL RULES

1. Be sure Surgeon knows more about lens calculation than their Technicians do.
2. Be wary of transcription errors, e.g. AL and K readings. Calculate an average K quickly and use it from then on.
3. If you are accurate, aim for emmetropia but ask the patient what <u>they</u> want. If they want other, have them sign for it.
4. IOL power for a monocular cataract in a bilateral high myope: carefully discuss the options of monocular emmetropia and the necessity of wearing a contact lens on the other eye versus lifelong myopia.
5. A 7 D error at 3 days is 7 D at 3 yrs: <u>*DO IOL EXCHANGE QUICKLY*</u>! USE Piggyback IOLs: Error Minus X1; Plus X1.5

Optical Biometers
- Work in 95% of eyes.
- Setup Must Have IR set to 1.3375 or Hoffer Q No Good
- BEST in Silicone Oil eyes

<u>Best Modern Formulas 2021</u>
HOFFER QST (Savini/Taroni)
BARRETT Universal II
KANE
EVO, PEARL DGS, PANACEA, OLSEN, RBF
<u>Barrett, EVO, Hoffer QST & Kane may be best overall.</u>
HOLLADAY 2 ONLY with AL Adjustment
<u>NEVER USE SRK I or II Regression Formulas</u>

Hoffer QST Website
<u>www.HofferQST.com</u>
NÆSER/SAVINI Toric Calcs
LASIK/PRK/RK Eye Calcs
Research & Optimization
Equal or Better than the best

Bibliography:

MANY PAPERS & CHAPTERS CAN BE DOWNLOADED FROM *JCRS*, *ResearchGate.com* and *IOLPowerClub.org*.

1. Hoffer KJ Axial dimension of the human cataractous lens. Arch Ophthalmol 1993; 111:914-918; Errata 1993; 111:1626
2. Holladay JT, Hoffer KJ Intraocular lens power calculations for multifocal intraocular lenses. *Am J of Ophthalmol*. 1992;114:405-408.
3. Hoffer KJ The Hoffer Q formula: a comparison of theoretic and regression formulas. J Cat Refract Surg 1993; 19:700-712; Errata 1994; 20:677 and JCRS 2007;33:2-3
4. ------------ Ultrasound velocities for axial length measurement. J Cat Refract Surg 1994; 20:554-562.
5. Holladay JT Standardizing constants for ultrasonic biometry, keratometry, and intraocular lens power calculation. JCRS 1997;23:1356-1370.
6. Hoffer KJ Clinical results using the Holladay 2 IOL power formula. J Cat Refract Surg 2000; 26:1233-7.
7. Hoffer KJ, Savini G.(Chapter 2), Multifocal Intraocular Lenses: Historical Perspective. In: Alio J, Pikkel J (Eds): "Multifocal IOLs" 2014
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9. Hoffer KJ, Savini G Clinical results of the Hoffer H-5 formula in 2,707 eyes: Intnl Ophthalmol Clin. 2017;57(4):213-219.
10. Hoffer KJ, Savini G. Effect of gender and race on ocular biometry. Intnl Ophthalmol Clin. 2017;57(3):137-142.
11. **Hoffer QST Website: <u>www.HofferQST.com</u> Free calculations [Næser/Savini Toric Calcs] [LASIK Eye Calcs]**