LETTERS TO THE JOURNAL

Accurate Ultrasonic Biometry in Pseudophakia

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In 1989, we explained an accurate method for measuring the axial length in a pseudophakic eye with a polymethylmethacrylate intraocular lens.[1] Since then other intraocular lens materials, such as silicone, have been used with ultrasonic conduction velocities that are remarkably different from polymethylmethacrylate. We produced a general formula that can determine the exact axial length in any pseudophakic eye, if the ultrasonic conduction velocity and thickness of the intraocular lens are known.

From our previous work[1] the expression for the actual axial length (AL) can be expressed as

$$AL = \frac{1,532}{1,550} \ ALM50 + T\left(1 - \frac{1,532}{2,718}\right).$$

where $1,532$ = ultrasonic velocity in meters per second of the aphakic eye,[2] $1,550$ = average tissue velocity used in most ultrasonic biometers for the cataractous eye,[3] T = center thickness of the intraocular lens, and $2,718$ =

conduction velocity through polymethylmethacrylate at eye temperature (35 C).[1] Computing the value of the final term yields equation 2:

$$AL = \frac{1,532}{1,550} \ ALM50 + T\,(0.44).$$

Equation 2 states that the actual axial length in a pseudophakic eye with polymethylmethacrylate can be figured by multiplying the apparent axial length measured at $1,550$ m/sec (ALM50) by the fraction $1,532/1,550$, which converts to the aphakic tissue velocity, then by adding 44% of the center thickness of the polymethylmethacrylate intraocular lens. If the ultrasonic unit can be set to a tissue velocity of $1,532$ m/sec, then the fraction becomes 1 $(1,532/1,532)$, and actual axial length is figured by adding 44% of the polymethylmethacrylate lens center thickness to the measured axial length by using the aphakic tissue velocity. Because the average polymethylmethacrylate lens is approximately 1.00 mm thick, one adds 0.44 mm to the apparent axial length measured at $1,532$ m/sec.

Generalizing equation 2 for an intraocular lens of any material would yield

$$AL = \frac{1,532}{1,550} \ ALM50 + T\left(1 - \frac{1,532}{IOL}\right),$$

where the intraocular lens is the conduction

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velocity of the lens material at eye temperature. For silicone, the ultrasonic velocity is 980 m/sec.[4] Substituting in equation 3, by using silicone velocity, we have

$$AL = \frac{1,532}{1,550} \; ALM50 + T \left(1 - \frac{1,532}{980}\right).$$

Computing the numeric value of the final term yields

$$AL = \frac{1,532}{1,550} \; ALM50 - T \,(0.56).$$

Because the ultrasonic velocity of silicone is slower than the aphakic eye, we must subtract 56% of the silicone lens thickness from the apparent measured axial length at 1,532 m/sec. Because silicone has a lower index of refraction than polymethylmethacrylate, the curvatures of the silicone lens are steeper for the same power and result in thicker lenses. The nominal thickness of a silicone lens is approximately 1.50 mm, and 56% is 0.84 mm. To determine the actual axial length of an eye with a silicone intraocular lens, one measures the apparent axial length at the aphakic velocity (1,532 m/sec), then subtracts 0.84 mm from the apparent axial length. Empiric data verify these results.[5]

Equation 3 can be used to determine the actual axial length in an eye with any new intraocular lens material if the ultrasonic velocity and the nominal central lens thickness are known.

References

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