Reprinted from
American Journal of Ophthalmology
Vol. 107, No. 2, February 15, 1989

LETTERS TO THE JOURNAL

Ultrasonic Biometry in
hakia

llladay, M.D.,
as C. Prager, Ph.D.

of Ophthalmology, Hermann Eye Cen-
ty of Texas Medical School at Houston.

ck T. Holladay, M.D., Hermann Eye Cen-
iin, Houston, TX 77030.

ultrasonic axial length measure-
es with an intraocular lens implant
ortant when trying to identify the
ror in postoperative refraction.[1] It is
ely important for determining axial
metry for cataract surgery in the
when preoperative measurements
eye are unavailable.[2]

ne ultrasonic biometers currently in
esigned for measurements in cata-
s and have assumed an average
ity of approximately 1,550 m/sec.[3]
these units, the assumed velocity
cannot be changed, and none of
curate when an intraocular lens is
describe a simple method for accu-
ating the axial length in these situa-

ed time for a sound wave to travel
ngth of the eye equals the time to
igh the intraocular lens plus the
vel through the remaining ocular
can be expressed by the relation-
in equation 1.

$$\ldots + \frac{AL - T}{1{,}532}, \qquad (1)$$

where ET = elapsed time, T = center plastic thickness of intraocular lens, 2,718 = ultrasound velocity in meters per second of polymethylmethacrylate at 37 C, AL = actual axial length, and 1,532 = ultrasound velocity in meters per second of the aphakic eye.[4,5] Using the typical assumed tissue velocity of 1,550 m/sec found on most instruments, the apparent axial length would be the product of this assumed velocity and the elapsed time, as shown in equation 2.

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

where ALM50 is the apparent axial length at 1,550 m/sec.

Resolving equation 2 for the actual axial length (AL) yields equation 3.

$$AL = \frac{1{,}532}{1{,}550}\, ALM50 + T \left(1 - \frac{1{,}532}{2{,}718}\right). \qquad (3)$$

Computing the numeric value of the final term yields equation 4.

$$AL = \frac{1{,}532}{1{,}550}\, ALM50 + T\,(0.44)\,. \qquad (4)$$

Equation 4 states that the actual axial length in the pseudophakic eye can be obtained 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 adding 44% of the center plastic thickness of the intraocular lens. If the ultrasonic unit can be set to a tissue velocity of

---

AL welcomes letters that describe unusual clinical or pathologic findings, experimental results, and
ents or techniques. The title and the names of all authors appear in the Table of Contents and are
rough the Index Medicus and other standard indexing services. Letters must not duplicate data
ublished or submitted for publication. Each letter must be accompanied by a signed disclosure
d copyright transfer agreement published in each issue of THE JOURNAL.
st be typewritten, double-spaced, on 8 1/2 x 11-inch bond paper with 1 1/2-inch margins on all four
Instructions to Authors.) They should not exceed 500 words of text. A maximum of two
ite figures may be used; they should be cropped to a width of 3 inches (one column). Color figures
ed. References should be limited to five.
be referred to outside editorial referees for evaluation or may be reviewed by members of the
rd. All letters are published promptly after acceptance. Authors do not receive galley proofs but if
changes are extensive, the corrected typescript is submitted to them for approval.
uctions markedly limit the opportunity for an extended discussion or review. Therefore, THE
s not publish correspondence concerning previously published letters.

TABLE
CENTER THICKNESS OF INTRAOCULAR LENS*

LENS POWER (D)	DIAMETER OF LENS OPTIC	
	6 MM	7 MM
10	0.61	0.72
20	0.94	1.13
30	1.30	1.60

*Nominal values in millimeters for intraocular lenses made of polymethylmethacrylate.

1,532 m/sec, then the fraction becomes 1 (1,532/1,532) and actual axial length is obtained by simply adding 44% of the lens thickness to the meaured axial length using the aphakic tissue velocity. Empiric data verify these results.[4]

For example, suppose an apparent axial length in a pseudophakic eye of 22.0 mm were obtained with a tissue velocity of 1,550 m/sec with a 25-diopter intraocular lens that has a center thickness of 1.40 mm. The actual axial length would be obtained by multiplying (1,532/1,550) times 22.0 mm to get the apparent aphakic axial length (21.74 mm), then adding 44% of the 1.40-mm lens thickness (0.62 mm), yielding 22.36 mm. Notice that if the lens thickness effect had been ignored, the error would be 0.62 mm using 1,532 m/sec and 0.36 mm using 1,550 m/sec, resulting in an error of 1 to 2 diopters in the predicted refraction.

Nominal center plastic thicknesses for 6- and 7-mm optic diameter polymethylmethacrylate lenses for three dioptric powers are shown in the Table. Exact thicknesses can be obtained from the lens manufacturer and depend on optic diameter and configuration, for example, biconvex, meniscus, and convexoplano.

References

1. Holladay, J. T., Prager, T. C., Ruiz, R. S., Lewis, J. W., and Rosenthal, H.: Improving the predictability of intraocular lens power calculations. Arch. Ophthalmol. 104:539, 1986.
2. Holladay, J. T., Prager, T. C., Chandler, T. Y., Musgrove, K. H., Lewis, J. W., and Ruiz, R. S.: A three-part system for refining intraocular lens power calculations. J. Cataract Refract. Surg. 13:17, 1988.
3. Binkhorst, R. D.: The accuracy of ultrasonic measurement of the axial length of the eye. Ophthalmic Surg. 12:363, 1981.
4. Freudiger, H., Artaria, L., and Niesel, P.: Influence of intraocular lenses on ultrasound axial length measurement. In vitro and in vivo studies. Am. Intraocul. Implant Soc. J. 10:29, 1984.
5. Jansson, F., and Kock, E.: Determination of the velocity of ultrasound in the human lens and vitreous. Acta Ophthalmol. 40:420, 1962.