

mentioned, “For the nominal equi-biconvex acrylic IOL summarized in Table 1, the graphs in Figures 4A and 4B were generated for a 2.5 and 5.0 mm pupil for 4 conditions: (1) angle $\kappa = +5.0$ degrees with pupil centered on optical axis, (2) angle $\kappa = +2.5$ degrees, near the mean for emmetropia, (3) angle $\kappa = 0.0$ degree with pupil centered on visual axis, and (4) angle $\kappa = -2.5$ degrees. Angle κ 's were implemented as actual nasal pupil decentration to the optical axis of 0.0, 0.17, 0.34, and 0.5 mm, respectively.”

After carefully reading it again and again and comparing it with existing knowledge and also Figure 1 in the same article, I believe it should be, “For the nominal equi-biconvex acrylic intraocular lens summarized in Table 1, the graphs in Figures 4A and 4B were generated for a 2.5 and 5.0 mm pupil for 4 conditions: (1) angle $\kappa = +5.0$ degrees with pupil centered on the **visual axis**, (2) angle $\kappa = +2.5$ degrees, near the mean for emmetropia, (3) angle $\kappa = 0.0$ degree with pupil centered on the **optical axis**, and (4) angle $\kappa = -2.5$ degrees. Angle κ 's were implemented as actual **temporal** pupil decentration to the **visual axis** of 0.0, 0.17, 0.34, and 0.5 mm, respectively.”

It would be important for the authors to clarify whether this was a typographical error or the graphs in Figures 4A and 4B were actually generated as it has been typed. I thank the authors for presenting a fundamental but objective approach to study and understand the functioning of an intraocular lens in the eye in addition to their previous groundbreaking work on the same subject.

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Reply: We appreciate the kind comments by Dr. Roop about our article and the opportunity to clarify angle κ , which is quite confusing to most clinicians. Angle κ is formed by the visual axis and the pupillary axis at the nodal point.¹ The pupillary axis must be extended to the nodal point to produce this angle. The visual axis is the reference for angle κ so if the pupillary center is concentric with the visual axis, angle κ would be zero, as we stated in the article. We believe Dr. Roop incorrectly thought the optical axis was the reference.

Clinically, measuring any angle of the eye becomes more complicated because the only instrument that directly measures ocular angles is the synoptophore.² More commonly, apparent chord lengths are measured, as seen with the slitlamp or optical biometers such as the IOLMaster (Carl Zeiss Meditec) and Lenstar (Haag-Streit). These instruments report the apparent chord distance (μ) as seen

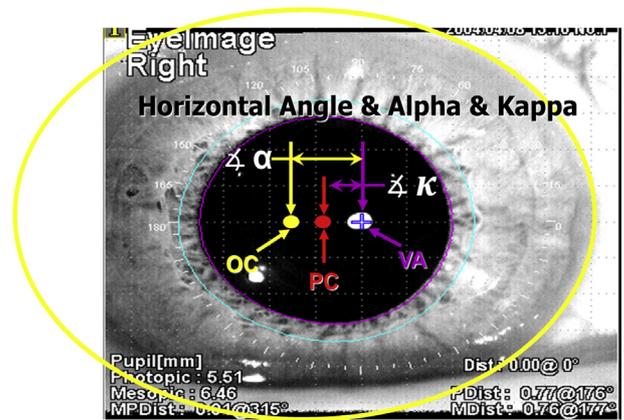


Figure 1. Photograph of right eye showing apparent clinical locations of the visual axis (Purkinje image I which is the subject-fixed coaxially sighted corneal light reflex), pupillary center, and optical center of the cornea. Angle κ is the angle between the pupillary axis and the visual axis and chord μ is the apparent chord length between the visual axis and the pupillary center. Angle α is the angle between the visual axis and optical axis, which passes through optical center of the cornea (OC = optical center, PC = pupillary center, VA = visual axis).

through the cornea between the visual axis (Purkinje I) and the apparent pupil center shown in the Figure 1.³ Because the cornea acts as a simple magnifier, exaggerating this distance by magnifying and displacing the apparent pupillary image, the nominal value for chord μ on these instruments is 0.33 mm, corresponding to the nominal angle κ of 2.5 degrees.^A The apparent chord μ is approximately twice the actual nasal decentration of the pupil relative to the visual axis at the iris plane, which is 0.17 mm as reported in our article.

A large positive angle κ (chord μ greater than 0.44 mm as measured with optical biometers) is an important risk factor for negative dysphotopsia. Additional patient risk factors include an extremely small photopic pupil, a higher than average intraocular lens (IOL) dioptric power, and a small axial space between the anterior IOL and posterior iris (<0.5 mm). We hope this clarifies the definition of angle κ (chord μ) and makes it clinically useful.— *Jack T. Holladay, MD, MSEE*

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