A variety of ocular axes and their relationship to the point of fixation have been defined over the years. Although some of these definitions are theoretical, others are practical and are of relevance to measure in a clinical environment. With the advent of aspheric and multifocal intraocular lenses (IOLs) and the development of wavefront-guided and topography-guided treatment profiles for laser refractive surgery centration of IOLs and ablation patterns, respectively, understanding these concepts has become even more relevant for clinicians. The literature is scattered with several definitions of ocular axes and angles that have been used inconsistently and interchangeably.

In optical systems, the elements are rotationally symmetrical. Each surface has a center of curvature. In aligning these optical elements within an optical system, care is taken to ensure that the center of curvature of both the anterior surface and posterior surface lie symmetrical on a line passing through the geometric center of this system. This common line is referred to as the optical axis.

In the human eye, the optical axis is a theoretical construct. Because of the physiological variables of globe tilt and crystalline lens decentration and tilt, the surfaces of the cornea and the crystalline lens are not rotationally symmetric.\(^1,2\) Their center of curvature does not lie on a common line and moreover, the fovea is physiologically displaced inferotemporally to the intersection of the theoretical optical axis within the retina\(^3\) (Figure 1).

Assuming the human eye is a well-centered optical system, placing an illumination source with its optical axis would produce 4 well-centered images formed by reflections at the different ocular interfaces (air–cornea [PI], cornea–aqueous [PII], aqueous–lens [PIII], and lens–vitreous [PIV]), which are referred to as Purkinje-Sanson images. The PI and PII interfaces have a similar size and are usually overlapped (PII is not typically seen). The PIII interface is the largest, and PIV is usually inverted with respect to the others.

With the eye looking at a fixation target, the visual axis is defined as the line connecting the fixation point to the first and second nodal points and the fovea (Figure 2). Because the visual axis actually represents the true path of light through the human eye, it could have been the ideal reference axis for centration in clinical conditions, except for the fact that the nodal points are theoretical representations with no anatomic landmarks. Without the tools to locate the nodal points, the visual axis cannot be applied clinically.

The pupillary axis is an anatomically defined axis that is perpendicular to the cornea, passing through the center of the entrance pupil. Although it can be located clinically by centering the coaxially sighted PI reflex on the patient's pupil,\(^3\) it varies in location as a result of the influence of pupil size on centration of the entrance pupil.\(^5\)

The line of sight is the line joining the fixation point and the center of the entrance pupil (Figure 3). Although
Le Grand and El Hage refer to the angle between the pupillary axis and line of sight as angle kappa, Uozato and Guyton define this as angle lambda. The position at which the line of sight intercepts the cornea has been referred to as the corneal center. In other words, the coaxially sighted corneal light reflex is the corneal intercept of the line joining the fixation point to the corneal center of curvature. Recently, Chang and Waring further qualified the coaxially sighted corneal light reflex as subject fixated and nonsubject fixated and propose that the subject-fixated coaxially sighted corneal light reflex be the clinical marker for centration of devices and for refractive treatments.

In this issue Chang et al. (pages 412–419) compare the visual and refractive outcomes after myopic laser in situ keratomileusis where the ablation patterns were shifted between the pupil center and coaxially sighted corneal light reflex. Although the debate continues on how best to center the refractive treatments on the cornea, the understanding of the various concepts can help us unify these discussions.

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**REFERENCES**


