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Letters to the Editor

Letter to the Editor: Radial and Tangential Retinal Magnifications

The article "Radial and Tangential Retinal Magnifications as Functions of Visual Field Angle Across Spherical, Oblate, and Prolate Retinal Profiles" by Hastings et al.[1] gives a very thorough evaluation of how magnification changes across the retina for different retinal shapes. The nodal point is used as a reference for angle calculations, and although recent work has confirmed that this is an excellent point to use,[2–4] this is not directly due to paraxial properties. This is illustrated in Figure 1 using the Gullstrand-Emsley eye,[5] where at very small angles, a ray directed toward NP1 just in front of the posterior crystalline lens surface will reach the retina at the same angle, but as though it came from NP2. That paraxial ray also heads toward the center of the image spot, but as the visual angle increases, it is the chief ray that passes through the center of the physical pupil that indicates the main image location instead.[6,7] A line that joins the second nodal point and the image center is still approximately parallel to the input beam, but this now represents a direction rather than a ray. A discussion by Atchison and Smith[5] regarding defocused images specifically emphasizes the value of using central rays for magnification calculations, with nodal rays typically being blocked for smaller pupils. Aberrations may also affect the exact characteristics of the image spot, but the chief ray is normally a useful reference.

The nodal point scaling provides a simple concept when the retina is spherical, because visual angles are mapped linearly to increasing distances along the retinal surface.[4,6] Conversely, ophthalmoscopy and fundus imaging are perhaps assumed to convert the curved retinal surface to flat images using a similar mechanism in reverse. However, the fundamental optical characteristics of the eye come from rays that pass through the center of the pupil, and although angular scaling at the nodal point captures the essence of this optical system, this is because of its location and not because of its paraxial properties. The overall scaling for a particular eye is affected by deviations from the simple model due to things like the aspheric profiles of the optical surfaces and the retinal properties that are discussed in this article. These comments

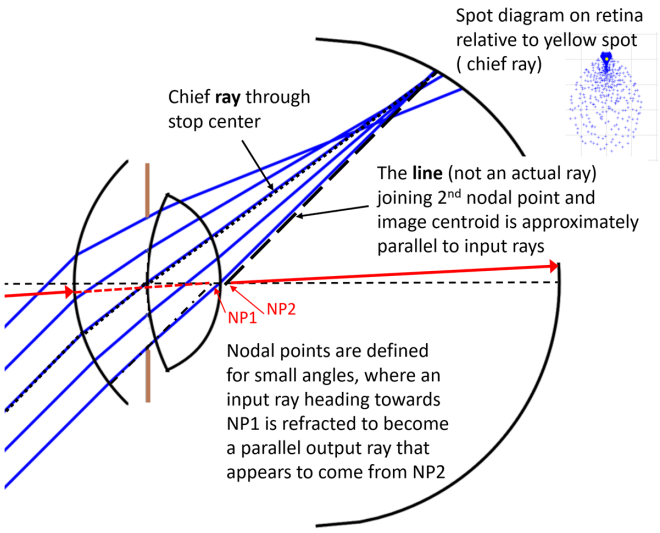

Figure 1. Rays entering a schematic eye at 45°. A single ray with parallel input and output portions requires a 6.4-mm diameter iris, and projections of those lines do not go exactly to the nodal points. An unrelated line drawn through NP2 at the input angle identifies the main image point.

do not detract from the main points of the article, but perhaps there is an opportunity for the wide-angle properties of the eye to be reevaluated further, particularly at very large angles, where there has been very little work despite some pseudophakic patients reporting bothersome shadows.[8]

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