

## Magnifying Prismatic Lenses for Vitrectomy

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**Purpose:** Viewing the fundus at higher magnification during vitrectomy makes surgical procedures much safer; however, the scope of magnification of the peripheral fundus has been limited. For better visualization of the periphery of the fundus, we have developed two new contact lenses called magnifying prismatic lenses.

**Methods:** The magnifying 15° and 30° prismatic lenses are made of a glass with a high index of refraction ( $n = 1.883$ ). The lenses have a convex upper surface to provide a magnified view of the peripheral fundus.

**Results:** These magnifying 15° and 30° prismatic lenses provide an approximately 2× magnified view of the peripheral fundus. They also provide a more extensive view of the peripheral fundus than a regular (plano-concave) prismatic lens when the eye is tilted.

**Conclusion:** The magnifying prismatic lenses are useful for viewing into the peripheral fundus with higher magnification. **Jpn J Ophthalmol 2001;45:199–201** © 2001 Japanese Ophthalmological Society

**Key Words:** Floating lens, magnifying prismatic lens, vitrectomy.

### Introduction

Good visualization of the fundus is crucial for successful vitreous surgery, and a number of lenses and lens systems have been developed to assist in the visualization. Two of these include a plano-concave quartz fundus contact lens that attaches to the irrigator handle,<sup>1</sup> and a floating plano-concave lens supported by a lens ring that is sutured in place.<sup>2</sup> These lenses require supplementary prismatic lenses to view the peripheral fundus.<sup>2</sup> More recently, a panoramic wide-angle fundus viewing system was developed that has revolutionized fundus visualization.<sup>3</sup>

Although a combination of these lenses provides a view from the posterior pole to the peripheral retina, surgeons sometimes require an image of the fundus of higher magnification for precise surgical proce-

dures, such as the delamination of proliferative membranes and peeling of the internal limiting membrane. While surgeons can obtain magnified images of the fundus at the posterior pole using magnifying lenses,<sup>4</sup> they cannot obtain magnified images of the peripheral retina using these magnifying lenses. To obtain a magnified view of the peripheral fundus, we have developed a new contact lens system called a magnifying prismatic lens.

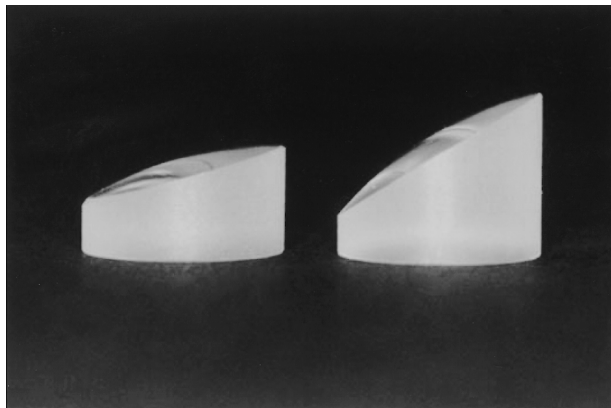
### Materials and Methods

The new system is either a magnifying 15° prismatic lens or a magnifying 30° prismatic lens. A special feature of the new lenses is the convex surface of the top surface (Figures 1 and 2). The lenses are made of a material with a high index of refraction ( $n = 1.883$ ), while the refraction index of quartz is 1.46. The new lenses can be sterilized in an autoclave.

Because the diameter of the lenses is 11 mm, they can be placed on the cornea using a regular lens ring as required in the conventional floating lens system.

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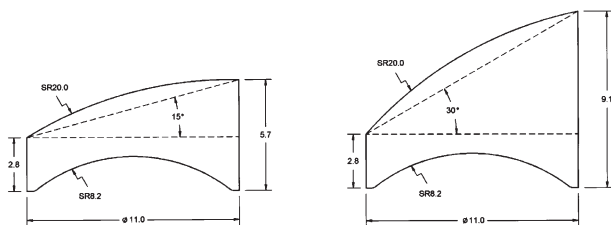


**Figure 1.** New magnifying prismatic lenses; a magnifying 15° prismatic lens (left) and magnifying 30° prismatic lens (right).

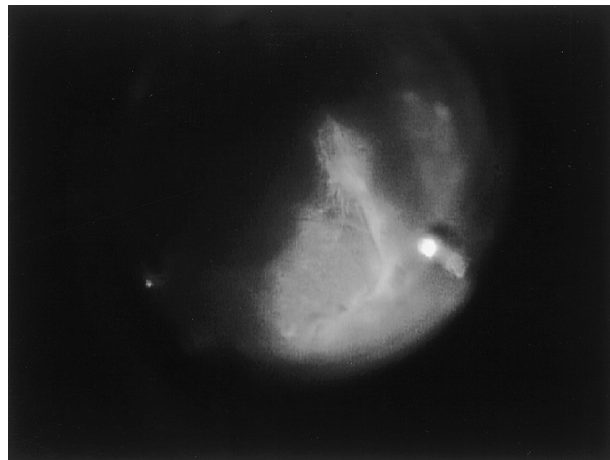
The meridional range of the view of the LeGrand model eye<sup>5</sup> fundus provided by the magnifying prismatic lenses or plano-concave prismatic lenses was calculated using a ray tracing method.

**Results**

Compared to a 15° prismatic lens made of the same high refractive index material, the magnifying 15° prismatic lens provides a 2.1× magnified view of the fundus (Figure 3). When the posterior pole is defined as located at 0° and the equator at 90°, the magnifying 15° prismatic lens provides a meridional view of up to 40° of the LeGrand model eye,<sup>5</sup> while a regular (plano-concave) 15° prismatic lens made of the same material provides a meridional view of up to 45° (Table 1). When the eye is tilted by 30°, the magnifying 15° prismatic lens provides a meridional view of up to 73°, while the regular 15° lens provides a meridional view up to 70°. Compared with the prismatic lens constructed of a high refractive index material, a 15° prismatic lens of quartz also provides a 2× mag-



**Figure 2.** Dimensions of new magnifying prismatic lenses; magnifying 15° prismatic lens (left) and magnifying 30° prismatic lens (right).



**Figure 3.** View of fundus by regular (plano-concave) 15° prismatic lens (top) and magnified view of fundus by new magnifying 15° prismatic lens (bottom).

nification but it provides a meridional view of up to only 25° in the upright position and a meridional view of up to 60° when the eye is tilted 30°.

The magnifying 30° prismatic lens provides a 2.3× magnified image and a meridional view of up to 53° in the upright position. When the eye is tilted by 30°, the magnifying 30° prismatic lens provides a meridional view of up to 83° while the regular 30° prismatic lens made of the same material provides a meridional view of up to 80°. The 30° prismatic lens made of quartz provides a meridional view of up to 66°.

**Discussion**

When delicate surgical procedures are required in the posterior pole, a magnifying lens is of great help to the surgeon.<sup>4</sup> Although higher magnification can

**Table 1.** Extent of Peripheral Fundus Visible with Magnifying Prismatic Lenses, Prismatic Lenses of Same Material and Prismatic Lenses of Quartz

Type of Lens	Refractive Index	Magnification*	Eyeball in Upright Position		Eyeball tilted by 30°	
			Range of Viewing (degree)	Angle of Viewing (degree)	Range of Viewing (degree)	Angle of Viewing (degree)
Magnifying 15° high refractive lens	1.883	2.1	0–40	40	45–73	28
15° high refractive lens	1.883	1.0	–25–45	70	25–70	45
15° quartz lens	1.46	2.0	–9–25	34	31–60	29
Magnifying 30° high refractive lens	1.883	2.3	28–53	25	68–83	15
30° high refractive lens	1.883	1.0	3–58	55	45–80	35
30° quartz lens	1.46	1.9	2–38	36	45–66	21

\*Magnification of fundus viewing is compared with that of 15° high refractive lens.

be achieved by increasing the magnification of the surgical microscope, the magnification is still not sufficient in some cases. An advanced feature of the newly developed magnifying prismatic lens is the magnified view of the peripheral fundus. The fundus is magnified by approximately 2× in the horizontal plane. To achieve the best image with high magnification, a combination of the magnifying prismatic lens and lower magnification of the surgical microscope is better than the combination of a regular prismatic lens and higher magnification of the surgical microscope.

The magnification in the direction of depth is equal to the square of the horizontal magnification, thus the new lens system provides approximately 4× magnification in the direction of depth. The higher magnification in the direction of depth provides marked improvement in intraoperative stereopsis, which, in turn, makes complicated surgical procedures, such as membrane delamination, much more precise and much safer.

In addition to an increase in magnification, the magnifying prismatic lenses provide a more extensive view of the peripheral fundus than a regular prismatic lens when the eye is tilted by 30°. Because the eye is often tilted during surgery to view more of the peripheral fundus, surgeons can obtain a more extensive view of the peripheral fundus without special techniques or special training.

The major drawback of the magnifying prismatic lenses is that the field of view of the fundus is narrower than that with the regular prismatic lenses or

the panoramic wide-angle fundus viewing system. Therefore, we do not recommend that surgeons perform vitrectomy solely with the magnifying prismatic lenses. We have found that the use of the magnifying prismatic lenses combined with a regular prismatic lens and/or wide-viewing systems results in a safer and more effective vitrectomy.

These lenses are available from the Hoya Healthcare Corporation, Tokyo. A similar magnifying lens with self-retaining silicon ring and the lens base has been developed by DORC (Zuidland, Netherlands) in collaboration with the authors (MO and YT) and is available from DORC.

The authors, except Mr. Futamura and Dr. Sanger, have no proprietary interest in the magnifying prismatic lenses. Mr. Futamura and Dr. Sanger are employees of the Hoya Healthcare Corporation, which is the company selling these products.

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