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Characterization of Optical Systems for Intraocular Projection

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Abstract : Introduction: Over 12 million people are blind due to opacity of the cornea, the clear tissue forming the front of the eye. Current methods use plastic implants to produce a clear optical pathway into the eye but are limited by a high rate of complications. New implants utilizing completely inside-the-eye projection technology can overcome blindness due to scarring of the eye by producing images on the retina without need for a clear optical pathway into the eye and may be free of the complications of traditional treatments. However, the interior of the eye is a challenging location for the design of optical focusing systems which can produce a sufficiently high quality image. No optical focusing systems have previously been characterized for this purpose. Methods: 3 optical focusing systems for intraocular (inside the eye) projection were designed and then modeled with ray tracing software, including a pinhole system, a planoconvex, and an achromatic system. These were then constructed using off-the-shelf components and tested in the laboratory. Weight, size, magnification, depth of focus, image quality and brightness were characterized. Results: Image quality increased with complexity of system design, as did weight and size. A dual achromatic doublet optical system produced the highest image quality. The visual acuity equivalent achieved with this system was better than 20/200. Its weight was less than that of the natural human crystalline lens. Conclusions: We demonstrate for the first time that high quality images can be produced by optical systems sufficiently small and light to be implanted within the eye.

Keywords : focusing, projection, blindness, cornea , achromatic, pinhole
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