

Optical Properties of a Radially Tensioned Liquid-Filled Flexible Lens.

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The focal length of the lens of the mammalian eye is adjusted (accommodated) by changing the lens curvature due to radial stretching by means of ciliary muscles. Some types of damage to the eye, resulting from trauma, disease or ageing (e.g. cataract), can render the lens unserviceable while leaving the ciliary muscle intact. This opens the possibility of designing a replacement lens, the focal length of which is controlled by the tension in the ciliary muscles. Two different lens modeling approaches were derived expressing the shape of such a lens as a function of the properties of the lens materials and applied radial tension (displacement). Ray tracing is then used to correlate lens shape variability with the changes of its optical parameters (focal length and associated aberrations). Several variable focus-lenses were fabricated and experimentally evaluated to prove model predictions. A good agreement is reached.