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Physical Aspects of Photodynamic Corneal Collagen Crosslinking JULIA KORNFIELD, California Institute of Technology — Healthy vision depends on the stability of the shape of the cornea, which provides most of the lens power of the optical system of the eye. Diseases in which the cornea progressively undergoes irregular deformation over time (e.g., keratoconus) can be treated clinically by inducing additional protein-protein crosslinks using a photosensitizing drug and a tailored dose of light. Unfortunately, the treatment moving through clinical trials is toxic to cells in and on the cornea. A path to a safer treatment is offered by the nanostructure of the corneal stroma—reminiscent of a HEX phase in block copolymers with 30nm diameter collagen cylinders spaced 60nm center-to-center in a hydrogel matrix of proteoglycans and water. We show that using a photosensitizing drug that sequesters itself in the collagen fibrils can minimize the toxicity of therapeutic protein-protein cross-linking. Photorheology and transport measurements are used to quantify the parameters of a simple physical model that is useful for optimizing clinical protocols.

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