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Engineering an end to post-vitrectomy cataracts

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Objective: To report the result of the ability of a biocompatible photopolymerizable gel to prevent cataract formation after vitrectomy.

Purpose: To develop a biocompatible photopolymerizable gel to seal off the crystalline lens against oxygen diffusion to avoid cataract formation after vitrectomy and to test its capability *in vitro* and *in vivo*.

Methods: A composite gel was formulated to meet preset criteria: viscoelasticity; spreadability; smoothness; ability to polymerize *in situ*; optical clarity; cohesiveness to remain adherent to lens capsule; iso-osmolarity; biocompatibility; oxygen impermeability; refractive index close to lens; surface energy >40 dyne/cm to avoid protein and cell adhesion; elastic modulus >40 N/m² to preserve lens accommodation, and biodurability. The gel was tested on *ex vivo* porcine lenses for its ability to prevent cataract formation. The gel was also tested *in vivo* by injecting pigs' eyes after 25-gauge vitrectomy. Lens clarity was compared with vitrectomized but uncoated control eyes for up to 3 months.

Results: Ninety different permutations of the ingredients were tested for their conformity to the required criteria. The optimum results were obtained by mixing 100 mg/mL PEG (6000 Da) with 10 mg/mL of HA (viscosity 5200 mP.sec) and photoinitiating under green LED source with Eosin Y/triethanolamine/N-vinylpyrrolidone added to PEG-polymer solutions to complex with the acrylate groups on the PEG molecules in a 1.2/1 ratio. The resultant clear (265-800 nm) gel had perfect spreadability, leveling, coverage, durability and cohesiveness with a thermally stable (25-37 °C) refractive index of 1.33, surface energy of 66 dyne/cm, and elastic modulus of 41.4 N/m². The gel resists protein and cell adhesion, and reduces oxygen diffusion 34 times. The biogel also proved to be biocompatible with porcine lenses in the *ex vivo* studies and significantly delayed the development of lenticular opacities without any apparent side effects.

Conclusion: Formulated biogels can limit oxygen diffusion to crystalline lens. This technology can eliminate tedious head-down positioning and cataract formation after vitrectomy surgery.

Biography

Shlomit Schaal is a clinician-scientist and a vitreo-retinal surgeon specializing in the surgical and medical management of complex vitreo-retinal diseases, such as age-related macular degeneration, diabetic retinopathy, retinal detachment and retinal vascular diseases. She completed her ophthalmology residency at Rambam Medical Center in Israel, her Ph.D. program at the Technion Institute of Technology, and her vitreo-retina fellowship at the University of Louisville. She is currently an Associate Professor at the University of Louisville, where she is the Director of Retina, the Director of Fellowship Program in Vitreo-Retinal Diseases and Surgery, and the Director of Diabetic Retinopathy Service. Dr. Schaal is an active member of the American Society of Retina Specialists, the Macula Society, the Retina Society, the American Academy of Ophthalmology, and the Association for Research in Vision and Ophthalmology.

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