

Effect of Novel Polymer Interventions on Normal and Form-Deprived Myopic Eyes of Chicks

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Purpose: To investigate two different approaches for direct manipulation of scleral growth and/or strengthening involving polymers, either implanted or injected adjacent to the outer scleral surface.

Methods: (1) Strips of 5% poly-(hydroxyethyl methacrylate) (pHEMA) (0.5 x 3 x 10 mm) were hydrated in sterile PBS and implanted into 2-wk old chicks (n=6), against the outer sclera at the posterior pole of left eyes. A-scan ultrasonography measurements (main ocular components) of all eyes were taken prior to surgery (day 0) and at 3-4 day intervals out to 29 days. All chicks were sacrificed for histology. (2) 12 chicks were each injected monocularly with 0.15 ml of an in-situ polymerizing gel (main ingredient: polyvinylpyrrolidone (PVP)) at the posterior pole; eyes were measured by ultrasonography in 2-7 day intervals up to 22 days post-injection. For histology, 3 chicks were sacrificed at weekly intervals post-injection. (3) In 9 chicks, 1 eye was injected with the same polymer gel and then fitted with a diffuser 1 day later, with 3 chicks sacrificed at weekly intervals for histology. Ultrasonography was performed at 2-7 day intervals up to 25 days.

Results: Implanted pHEMA did not significantly affect ocular dimensions overall, including scleral thickness (day 29: treated = 170±6 um, fellow = 154±6 um). In contrast, while the axial lengths of PVP treated eyes were not affected, their scleras showed significant increases in thickness beyond 8 days (treated = 206±30 um, fellow = 136±7 um, day 22; p=0.0159). PVP treated form-deprived eyes showed no significant change in scleral thickness (treated = 143±3 um; fellow = 151±3 um), and they had longer axial lengths than their fellows, as typical with form-deprivation. No *in vivo* signs of either orbital/ocular inflammation were found. Nonetheless, fibrous tissue encapsulated pHEMA implants, and the injected gels of PVP-treated eyes were infiltrated with both cells and connective tissue matrix.

Conclusions: The results represent “proof of principle” that scleral growth can be manipulated without adverse inflammatory responses. Injectable compared with implantable polymers produce different scleral responses; PVP produces scleral thickening while pHEMA implants stimulate fibrous tissue formation adjacent to sclera. Since neither approach slowed ocular elongation, additional factors must influence scleral surface area expansion in the chick.

Support by NIH T32-EY07043 and NIH EY RO12392