Loss of Scleral Compliance during Aging

Dr. Rafael Grytz
Devers Eye Institute
Ocular Biomechanics Laboratory
Portland, USA

Day: 26.07.2012
Time: 15:00 Uhr
Location: IA 6/21

Glaucoma is the second leading cause of blindness. The risk to develop glaucoma is significantly increasing with age. We hypothesize that the changing elastic properties of the aging sclera contributes to the age-related susceptibility to glaucoma. This study aims to determine the age-related alterations in the elastic response of 40 posterior scleral shells from human donors, 20-97 years old. Posterior scleral shells were subjected to intraocular pressure elevations from 5 to 45 mmHg and the resulting full-field displacements were recorded using laser speckle interferometry. Eye-specific finite element models were generated based on experimentally measured scleral shell surface geometry and thickness. The elastic response of each scleral shell was fitted using a microstructure-based constitutive formulation, incorporating the anisotropic architecture and crimp form of scleral collagen fibrils. Inverse numerical analyses were performed to identify the intrinsic material and micro-structural parameters for each eye by matching model deformation predictions to experimental measurements. The inverse results indicate that the age-related loss of scleral elasticity is due to both: (i) a higher initial stiffness and (ii) the decreasing stretch at which the collagen fibrils uncrimp and stiffen. These changes may be due to increased collagen cross-linking and loss of the elastin-driven recoil. The loss of elasticity should lead to larger high frequency IOP fluctuations (e.g. ocular pulse amplitude) in the elderly.