

IOP-Induced Lamina Cribrosa Deformation and Scleral Canal Expansion: Independent or Related?

Sigal IA, Yang H, Roberts MD, Grimm JL, Burgoyne CF, Demirel S, Downs JC.

Ocular Biomechanics Laboratory.

PURPOSE: To study the association between the intraocular pressure (IOP) -induced anterior-posterior lamina cribrosa deformation (LCD) and scleral canal expansion (SCE) .

METHODS: 3D eye-specific models of the lamina and sclera of the eyes of three normal monkeys were constructed. Morphing techniques were used to produce 768 models with controlled variations in geometry and materials. Finite element analysis was used to predict the LCD and SCE resulting from an increase in IOP. We analyzed the association between LCD and SCE for the population as a whole, and for subsets.

RESULTS: For some conditions, such as deep and stiff lamina, the association between LCD and SCE was strong and consistent with the concept of "the sclera pulls the lamina taut" as IOP increases. For other conditions, such as shallow and compliant lamina, there was no association. Further, for other conditions, such as for thin and stiff sclera, the association was opposite to the tautening. Although most of the models had similar response to IOP, some cases had peculiarly large LCD and SCE. The properties of the lamina cribrosa (LC) greatly influenced its response to variations in IOP; for example, deep laminas tended to displace anteriorly, whereas shallow LCs displaced little or posteriorly.

CONCLUSIONS: The association between LCD and SCE varied greatly depending on the properties of the lamina and sclera, which shows that it is critical to consider the characteristics of the population when interpreting measurements of LCD and SCE. This work is the first systematic analysis of the relationship between LCD and SCE.

Invest Ophthalmol Vis Sci. 2011 Nov 21;52(12) :9023-32. Print 2011.

PMID: 21989723 <http://www.ncbi.nlm.nih.gov/pubmed/21989723>