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CONFLICT OF INTEREST DISCLOSURES: SEE THE ORIGINAL article for any disclosures of the authors.

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Elastin Content and Distribution in Endothelial Keratoplasty Tissue Determines Direction of Scrolling

EDITOR:

WE WELCOME THE RECENT PUBLICATION BY MOHAMMED and associates,[1] which demonstrates the surgical implications of the corneal elastic system in scrolling in endothelial keratoplasty. We have pioneered the characterization of the corneal elastic system in normal human[2] and keratoconic[3] corneas and in knock-out mouse models of Marfan syndrome.[4] The current article adds to our knowledge by showing the presence and depth distribution of elastin in the posterior cornea, which provides further confirmation that the corneal elastic system (predominantly elastin and fibrillin) is an integral part of the cornea.

We have previously shown the nanoscopic 3-dimensional distribution and arrangement of elastic fibers in the human cornea using an electron microscopy elastic stain for amorphous elastin and fibrillin[2] and the high-resolution technique of serial block face scanning electron microscopy. We also showed that the concentration of elastic fibers, as a function of depth, was highest in the 8 μm region of the stroma immediately above the Descemet membrane and fell significantly distal to this region. Transmission electron microscopy morphologic observations in the same study also revealed that true elastic fibers containing fibrillin sheaths and amorphous elastin cores were restricted to the corneal peripheral region, limbus, and trabecular meshwork (TM) while thinner, predominantly fibrillin-1 fibers, previously described by Hanlon and associates,[5] were only present in low densities in the central posterior cornea. Since our previous studies, we have now characterized the human elastic fiber system using a range of antibodies including elastin and fibrillin-1,[6] and we have clarified the association and distribution of elastin- and fibrillin-1-containing fibers within the corneal elastic fiber system.

We note that in this study by Mohammed and associates[1] a band of homogenous elastin immunofluorescence was identified above the Descemet membrane. We would be interested to know if the authors examined the elastin concentration between the posterior peripheral and central regions; if so, were any differences detected?

We initially proposed the potential implications of the elastic fiber system in glaucoma[2] and we have now revealed that the posterior elastic fibers in the corneal stroma are indeed linked with the TM.[6] The results in the current article fit nicely with our results, as the authors show that these fibers contain a high concentration of elastin that is continuous with the TM. Interestingly, it is known that full-thickness keratoplasty has been shown to cause high incidence of glaucoma when compared to partial-thickness deep anterior keratoplasty. A surgery that preserves the peripheral posterior component of the corneal elastic system would seem to be crucial.

Once again, we welcome this article for highlighting the elastic properties of the cornea, which has clear surgical implications, including the formation of big bubble in keratoplasty and scrolling.

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REPLY

WE THANK LEWIS AND ASSOCIATES FOR THEIR COMMENTS in relation to our paper and for pointing out the corroboration of aspects of their work by our results. We also congratulate them on their contribution to this field of research. They have neatly summarized results of their previous publications, which have essentially been referenced in our paper. The presence of elastin fibers in the human cornea has been known for several decades,[1] but their localization and distribution are being defined and refined. Our paper on the extension of the pre-Descemet layer (Dua's layer, PDL) into the trabecular meshwork[2] has focused attention on this relationship, and it is rewarding to see that corroboration for this is coming from other independent work, such as mentioned by the authors.[3] Clinical evidence of the elasticity of PDL and Descemet membrane (DM) comes from the behavior of these tissues in lamellar keartoplasty, but the distribution of elastin fibers, as demonstrated in our study, offers the precise explanation for this behavior. The contribution of elastin fibers to the corneal stromal microarchitecture most likely provides the basis for observations made in relation to the passage of air during air-assisted lamellar surgery such as deep anterior lamellar keratoplasty and pre-Descemet endothelial keratoplasty.[4]

With regard to the specific question posed on any differences in elastin concentration between the posterior peripheral and central regions, we have preliminary data to show that there is indeed a difference. This is in relation to the distribution of elastin in DM, which is more diffuse and spread over a wider area at the periphery, unlike the distinct band in the center (Figure). However, in the PDL it remains more or less as in the center of the cornea.

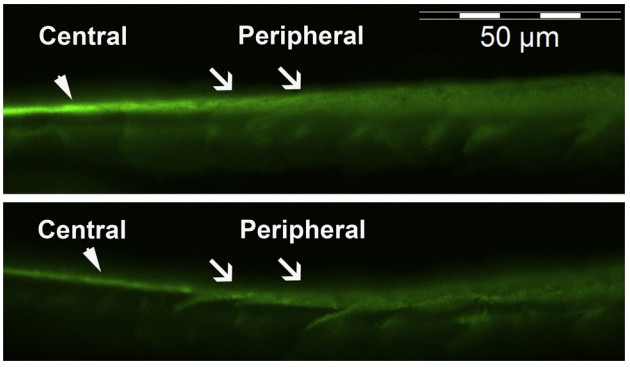

FIGURE. Two representative samples (Top and Bottom) of cryo-sections of Descemet membrane (DM) stained for elastin (Primary antibody: polyclonal rabbit anti-human primary antibody against elastin [5 mg/mL final concentration; Abcam, Cambridge, UK]; secondary antibody: donkey anti-rabbit IgG AlexaFluor 488 conjugate secondary antibody [Thermofisher Scientific, Loughborough, UK]. Mounted in fluorescent mounting compound [Dako-Agilent Technologies, Cheadle, UK]). A clear band of elastin is seen in the central DM (arrowhead). The staining area becomes wider and more diffuse at the periphery (arrows).

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