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## Correspondence: Cross-linking of donor corneas for penetrating keratoplasty

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It is with great interest that we read the recent publication by Huang et al. <sup>1</sup> on “Use of donors predisposed by corneal collagen cross-linking in penetrating keratoplasty of treating patients with keratoconus”, in which they presented data from a randomized controlled trial and showed that cross-linking donor corneas prior to penetrating keratoplasty for keratoconus resulted in improved vision with a moderate reduction in refractive error. We were pleased to see that these clinical observations supported our earlier laboratory based research, with which the authors may not be familiar, <sup>2</sup> but which we believe was the first publication to evaluate the concept of donor cross-linking prior to keratoplasty. In 2015, we performed *ex vivo* penetrating keratoplasty on thirty porcine corneas, with fifteen undergoing conventional keratoplasty and fifteen undergoing keratoplasty with cross-linked donor corneas. Some of the main findings from our study were that the post-operative wavefront astigmatism and higher order aberrations, more so than the mean keratometric astigmatism, were significantly reduced in the cross-linked procedure. Our theoretical expectation, based on the findings of the study, was that donor crosslinking would primarily reduce irregular astigmatism and higher-order aberrations induced by sutures. It is therefore unfortunate that these parameters were not evaluated by Huang et al. as they may have helped to explain the significant improvements in visual acuity that they observed following keratoplasty with cross-linked donor tissue, despite only modest changes in regular astigmatism.

As an aside to this, we also noted that (i) alignment and approximation of the sutured edges was much easier in the cross-linked group, since the tissue was more resistant to deformation and maintained shape during the passage of the needle, (ii) there was a slightly increased resistance to the passage of the needle and suture in the cross-linked group, but this did not affect the ease of surgery and (iii) achieving a watertight wound was easier in the cross-linked group, since there was less distortion on application of suture tension, and the wound was less affected by suture positioning and alignment. In fact, the only negative with the cross-linked donor keratoplasty procedure was that there was the tendency to override the host tissue if it was vertically misaligned or over tightened, as unlike conventional keratoplasty donors, the compressed edge did not broaden under tension, while the host edge deformed. In our manuscript, we fully acknowledged the limitations of our study and its uncertain applicability to the human surgical procedure, due to the biomechanical differences between human donor and porcine corneas.<sup>3</sup> As such, we would be very interested to know if Huang et al. made similar observations when performing the surgery *in vivo*.

1. Huang T, Ye R, Ouyang C, Hou C, Hu Y, Wu Q. Use of donors predisposed by corneal collagen cross-linking in penetrating keratoplasty for treating patients with keratoconus. *Am J Ophthalmol.* 2017; 184: 115-120.

2. Mukherjee A, Hayes S, Aslanides I, Lanchares E and Meek KM. Donor cross-linking for keratoplasty: a laboratory based evaluation. *Graefes Arch Clin Exp Ophthalmol.* 2015; 253: 2223-2228.

3. Zeng Y, Yang J, Huang K, Lee Z, Lee X. A comparison of biomechanical properties between human and porcine cornea. *J Biomech.* 2001; 34: 533–537.