Use of a novel contact lens to improve fundal optical coherence tomographic images in keratoconus

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Conflict of interest: A/Prof Symons declares that his eponymous lens was developed from his original concept and that Peter Harrington of Ocular Instruments Inc. contributed to the design. A/Prof Symons does not have a financial relationship with Ocular and does not have a financial interest in this lens. Peter Harrington is an employee of Ocular.

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The use of a novel contact lens to aid optical coherence tomographic imaging of the ocular fundus in keratoconus patients is described in this case report. It is anticipated that this lens will be beneficial for imaging in other tectonic corneal disorders by reducing the aberration caused by irregular astigmatism.

A 38-year-old Caucasian female presented for evaluation of reduced vision in the left eye. At the age of five she had a low-grade astrocytoma of the optic chiasm debulked, with the exception of unresectable tumour of the left optic nerve. She was diagnosed with keratoconus at 29 and refused penetrating keratoplasty.

On examination, her best corrected visual acuities were 6/12 with +1.00/-3.00x75° in the right eye and 6/15 with +1.75/-7.5x110° in the left eye. With pinhole, visual acuities reached 6/9 bilaterally. Automated perimetry, Placido disc based corneal topography (Orbscan, Bausch& Lomb, NY, USA) and optical coherence tomography (OCT) (Spectralis, Heidelberg Engineering, Heidelberg, Germany) of the maculae and peripapillary retinal nerve fibre layers were ordered. Automated perimetry demonstrated a possible right homonymous hemianopia. Corneal topography (Figure 1) demonstrated bilateral large paracentral cones, consistent with the diagnosis of keratoconus.

Image degradation rendered OCT images of little diagnostic benefit. Therefore, OCT were repeated with a single element quartz (n=1.46) ocular contact lens (Symons Image Enhancing Lens, product code: OSIE, Ocular Instruments Inc., Bellevue, WA, USA) designed to negate aberrations due to the keratoconic cornea. The lens has a central thickness of 1.0mm, a net dioptric power of zero and incorporates a 20mm

diameter flange to facilitate clinical control of eye movement. The anterior surface of the lens has a high performance anti-reflection coating that minimizes reflection intensity at a wavelength of 830nm. The patient's eyes were anaesthetized with topical oxybuprocaine and Hypromellose 0.3% (Genteal gel, Novartis, Basel, Switzerland) was used as an optical medium between the cornea and the posterior surface of the lens. High quality OCT images were captured with this lens (Figure 2), demonstrating normal macular anatomy and borderline retinal nerve fiber layer.

It was concluded that the progressive visual loss was related to worsening keratoconus rather than progressive optic neuropathy.

Visual function may be reduced by optical consequences of tectonic corneal dystrophies such as keratoconus. In the case described, the optical imperfections of the keratoconic corneas also impaired the OCT signal to levels of diagnostic futility. Previous studies demonstrate that refractive errors may alter OCT signal strength. Hwang and co-workers have demonstrated that contact lens induced astigmatism reduces OCT signal strength,¹ and Uzunel et al.² also shown that keratoconus may reduce OCT signal strength and image quality. Although a subset of keratoconic patients studied by Sahebzada *et al.*,⁵ wore their refractive contact lenses while OCT scans were performed, previous studies have not determined the impact of diagnostic fundal contact lens use on OCT measurement quality in patients with keratoconus.

Our case demonstrated that neutralization of the anterior irregularity of a severely keratoconic cornea with a fundal contact lens was sufficient to overcome the keratoconus induced degradation of the OCT signal.

Interestingly, studies comparing OCT measurements in normal and keratoconus patients yielded inconsistent results, with keratoconus patients having either reduced² or increased⁴ macular thickness compared to controls. The degree to which these results were influenced by the use or lack thereof of patients' regular contact lenses

during OCT scanning is unknown. Further investigation using a fundal contact lens neutralising the effect of the anterior corneal curvature may aid in determining the degree to which keratoconus is associated with altered macular anatomy.

To our knowledge, this is the first report of a specially designed contact lens aiding OCT imaging of the ocular fundus. Potential users of this lens are recommended to have a second eye-care professional available to stabilize the fundal contact lens during use.

The lens of the OCT instrument is expected to come within a few millimeters of the flange of the contact lens.

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