Letter to the Editor

Artefacts of ganglion cell complex analysis in eyes with vitreomacular traction syndrome

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Optical coherence tomography (OCT) is useful in the diagnosis and monitoring of macular disease¹. OCT offers high-resolution measurements of the ganglion cell complex (GCC), comprised of the ganglion cell layer (GCL) and the inner plexiform layer (IPL)². Ganglion cell analysis (GCA) is a tool in Zeiss Cirrus HD proprietary review software that measures GCC thickness, which used in diagnosis and monitoring of disease. However, its viability is limited by artefacts and the reproducibility of segmentation.

This letter illustrates a previously undescribed artefact related to vitreomacular traction (VMT) syndrome. VMT it is fairly common and often changes, either by spontaneous resolution or following surgery³. As the fovea is an important landmark in automated retinal thickness assessment⁴, an improperly centred fovea, secondary to VMT, on the automated foveal localisation (AFL) tool may result in abnormal thickness map artefacts that lead to difficulties in managing pathology⁵.

We investigated 62 scans of otherwise healthy eyes affected by VMT, collected consecutively from a retinal clinic between October 2012 and January 2017. All participants had given written consent for their de-identified images to be used for research and chairman's approval was granted from the Royal Victorian Eye and Ear Hospital Human Research and Ethics Committee.

Upon inspection of VMT GCA scans, we noted that some GCA maps had abnormal patterns that seemingly indicate eccentric thinning of the ganglion cell complex, despite eyes being free from any other retinal pathology. Upon inspection of the corresponding horizontal B-scans of abnormal GCA images, we observed that segmentation of images was often false (Figure 1). The purple line typically delineates the inner border of the GCL and the yellow line the outer border of the IPL. In such instances, there is an eccentric localisation of the AFL, relative to the

anatomical fovea, and an assumed pattern of GCC thickness is displayed by the software. That is, the GCC is always absent at the site of the AFL and increases in thickness radially outwards; visual inspection of the scans often shows this segmentation to be false.

In normal eyes, the thinnest section of the macula is the foveola, an anatomical feature utilised by the AFL tool. In VMT, vitreous adhesion affects the contour of the macula, resulting in the foveola no longer being its thinnest part. The automated software consequently misidentifies an eccentric location as the foveola. However, it appears that a standardised pattern of GCC thickness is assumed by the GCA software, in which the GCC is absent centrally in the normal fovea, and initially increases in thickness radially outwards. Therefore, GCA is unable correctly to perform segmentation, producing these artefactual patterns of abnormality. When the AFL determines the foveal centre to be away from the true location, this pattern is projected onto the OCT at the site of the presumed foveal centre, with a central GCC thickness of zero, in spite of it being visible on inspection.

We found that through manipulation of AFL to the anatomical location of the foveola, some of the abnormal GCA maps could be rectified as segmentation was then performed correctly (Figure 2). Interestingly, in scans of normal eyes, unaffected by VMT, these artefacts could be recreated by manually shifting the AFL eccentrically. Therefore, we know that this artefact is caused by eccentric placement of the AFL.

In practice, the findings of this study behave clinicians, when confronted with one of the GCA patterns described, to inspect the cross-sectional OCT scan at the fovea as well as both the automated foveal localisation and segmentation of the software. If

there are signs of VMT, or the AFL is eccentric, then the GCA map should be used with caution in the knowledge of possible artefacts induced.

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FIGURE LEGENDS

Figure 1: Incongruence of automated foveal localisation with visual inspection of optical coherence tomography B-scans.

Figure 2: Examples of rectification of artefact by automated foveal localisation manipulation. The green numbers indicate the magnitude of the manipulation in the horizontal and vertical planes and the red number indicates the direction of the manipulation.

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