Glucoma is the leading cause of irreversible blindness worldwide. Glaucoma optic neuropathy results in the death of retinal ganglion cells, which are most densely populated in the macular region with 30% of the total number of these cells occupying only 2% of the retina’s area. On the basis of this anatomic relationship, Zeimer and colleagues reported large losses in total macular thickness in patients with known glaucomatous damage. Recent data suggest that glaucoma affects the macular thickness early in its course. Routine evaluations of macular thickness in glaucoma can thus complement other tests.

Optical coherence tomography (OCT), a noninvasive imaging technique that uses low-coherence light to obtain a high-resolution cross section of biological structures, is changing the fields of glaucoma and ophthalmology. The technology, first described by Huang and colleagues in 1991 has evolved dramatically ever since. The most significant leap forward occurred when the moving reference mirror of time domain OCT (TD-OCT) was replaced with Fourier domain analysis of wave signals, and as a result, significantly larger data sets could be acquired a shorter period of time. The advent of spectral domain OCT (SD-OCT) allowed the rapid acquisition of data cubes in the macula or encompassing the optic nerve complex, both of which now assist in glaucoma analysis. It is also noted that, although early studies employing TD-OCT showed peripapillary retinal nerve fiber layer (RNFL) measurements to have a better diagnostic yield compared with macular thickness, new SD-OCT commercial platforms have the ability to specifically segment the inner retinal layers that are damaged in glaucoma, namely the RNFL, retinal ganglion cells, and inner plexus layers (IPLs). Recent studies have shown macular thickness evaluation to be at least comparable to, or better than, RNFL measurements. In this issue of Taiwan Journal of Ophthalmology, Gupta et al in their review paper found that macular thickness is a highly reproducible measurement on SD-OCT with intra-visit and inter-visit coefficients of variation of <1%. Segmented layers, such as ganglion cell-inner plexiform layer (GCIP), also show good reproducibility. High reproducibility thus allows for easier detection of glaucomatous progression. They also mentioned that changes in total macular thickness loss in glaucoma thus reflect the loss of the RNFL, ganglion cell bodies, and IPL—tissues that are lost in glaucoma. SD-OCT permitted the measurements of larger areas of the retina with higher acquisition speed. This provided the ability of measuring retinal thickness with greater concentration of data points, and much less interpolation of data, thus providing a more reliable retinal (macular) thickness map. However, ophthalmologists must be aware of the quality of an OCT scan, as well as the strength of the signal. Factors that decrease signal strength include dry eyes, media opacities such as cataract, and axial length.

SD-OCT measurements are compared against an age-matched normative database and high myopes were not included in the normative database. This issue of Taiwan Journal of Ophthalmology, Chen et al found that myopia can be a confounding factor in the assessment of RNFL thickness attributed to its influence on the RNFL thickness and lead to misdiagnoses. While axial length increases, average macular thickness of both high myopic and glaucomatous eyes is relatively thinner than in healthy emmetropic eyes. This suggests that axial length should be taken into account when assessing the reliability of OCT data. They found that when using the non-highly myopic normative database for evaluating the superior/inferior (S/I) semicircle map, the sensitivity and specificity were 0.824 and 0.600, respectively, the sensitivity decreased to 0.706, and the specificity increased to 0.933 when the long axial length highly myopic normative database was used. However, the difference of the sensitivity was not statistically significant (p = 0.21), while the change of specificity was significantly (p = 0.024) higher when the long axial length highly myopic normative database was used.
In Gupta et al’s review paper, it is also noted that myopes present several challenges as they may have nonprogressive visual field changes due to a tilted optic nerve, optic nerve coloboma, or posterior pole staphyloma. In addition, peripapillary atrophy, retinal schisis, and vitreous traction results in unreliable RNFL measurements. Macular thickness maps in such eyes have been shown to be useful in glaucoma detection and management. Longer axial length is correlated with macular thinning, specifically thinning of the nuclear layers of the macula. They suggested that SD-OCT of the macula and optic nerve has greatly enhanced glaucoma care, but it is imperative for ophthalmologists to be aware of the potential limitations of using OCT-measured macular thickness to detect glaucomatous progression. For instance, macular thickness is known to demonstrate continual thinning with increasing age in nonglaucoma individuals. Ophthalmologists must take into account the degree of expected physiologic macular thinning when using macular thickness change to determine the presence or absence of glaucoma progression. Leung et al estimated the mean rate of change of GC-IPL thickness to be $-0.318 \, \mu m/y$.

Since the change in the proportion of progressing eyes was much less when using peripapillary RNFL measurements, Leung et al suggested that age-related changes affect macular thickness measurements much more than peripapillary RNFL measurements.

The advent of SD-OCT technology has permitted the more rapid acquisition of retinal images at a higher axial-image resolution, allowing the discrimination and measurement of individual retinal layers. SD-OCT has emerged as a fantastic diagnostic tool to assist in the detection of glaucoma and identification of glaucoma progression. Over the past number of years, the advances in OCT have mainly occurred through software upgrades, as the hardware platform is stable. However, as the software gets more elaborate, the opportunity for artifacts and misinterpretation grows. In conjunction with SD-OCT scans, ophthalmologists must take into account pretest probability based on well-validated risk factors such as age, race, central corneal thickness, refraction status, and intraocular pressure (IOP). Careful consideration of the limitations of OCT will enhance our care of patients with glaucoma.

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