# CHAPTER 3

# Optical Coherence Tomography

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# Historical Perspective

Optical coherence tomography (OCT) has enhanced our understanding and management of retinal diseases, ever since the time-domain OCT was introduced in the early 2000s. The introduction of spectral-domain OCT in the mid-2000s and the later introduction of swept-source OCT provided faster scanning strategies and high-resolution images of the retina and choroid.

# Principle

OCT uses the principle of low-coherence interferometry. A low-coherence light beam is directed onto the retina and choroid, and the back-reflected light is combined with a second or reference beam, which was split off from the original light beam. The interference patterns thus produced construct an axial A-scan, and multiple A-scans from adjacent points reconstruct a cross-sectional image of the target tissue, known as a B-scan.

# Normal OCT Scans

Figure 3.1 shows the spectral-domain cross-sectional view (tomogram) of the retina and choroid, on a gray scale. Those tissues that are highly reflective (retinal pigment epithelium [RPE] or nerve fiber layer) appear brighter, and tissues with low reflectivity (vitreous or subretinal fluid) appear darker. Areas with intermediate reflectivity (retinal layers or edema) appear as shades of gray. The long wavelength of swept-source OCT (Fig. 3.2) allows a clear image of the deep ocular structures such as choroid.

In inherited retinal dystrophy, the ellipsoid zone (outer segment/inner segment junction) is an important landmark. If this zone is disrupted, discontinuous, or disorganized, it is an early indication of cell death. Progressive loss of photoreceptor cells is reflected by thinning of the outer segment, and later, of the outer nuclear layer.

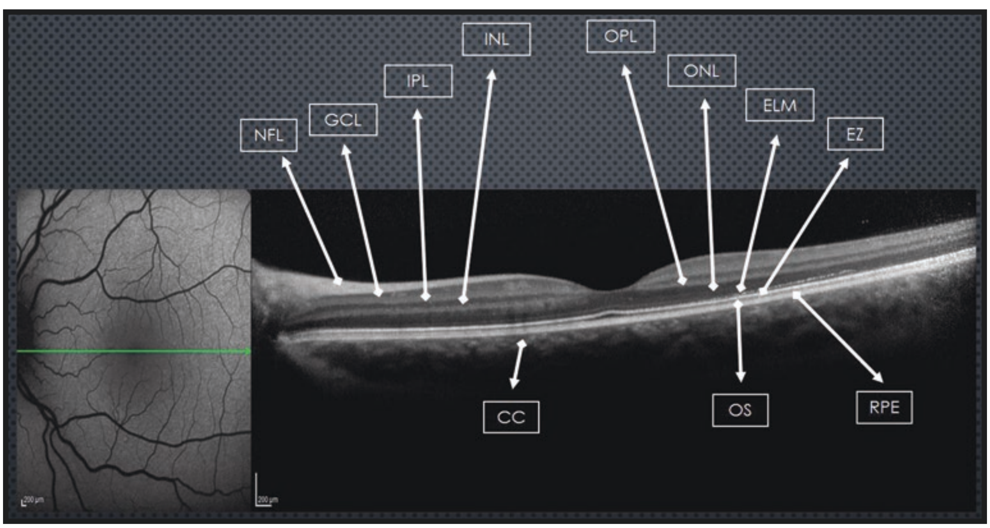


**Fig. 3.1** Spectral-domain optical coherence tomography (SD-OCT) image of retinal layers. CC—choriocapillaris; EZ—ellipsoid zone; GCL—ganglion cell layer; INL—inner nuclear layer; IPL—inner plexiform layer; NFL—nerve fiber layer; OLM—outer limiting membrane; ONL—outer nuclear layer; OPL—outer plexiform layer; OS—outer segment; RPE—retinal pigment epithelium

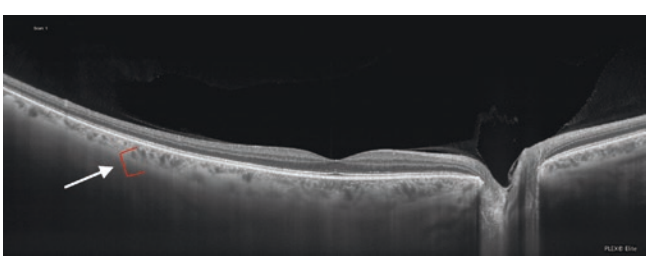

**Fig. 3.2** Swept-source OCT showing enhanced visualization of choroidal blood vessels (*arrow*)

# Suggested Reading

Drexler W, Morgner U, Ghanta RK, Kärtner FX, Schuman JS, Fujimoto JG. Ultrahigh-resolution ophthalmic optical coherence tomography. Nat Med. 2001;7:502–7. Erratum in: Nat Med 2001;7:636.

Khurana RN, Bhisitkul RB, Foster BS. Retinal optical coherence tomography. Focal points: clinical modules for ophthalmologists. Module 5. San Francisco: American Academy of Ophthalmology; 2014.

Lumbroso B, Rispoli M. Guide to interpreting spectral domain optical coherence tomography. 2nd ed. New Delhi: Jaypee Brothers Medical; 2011.