Introduction

OCT is an investigative tool that provides high resolution cross-sectional images of the retina; analogous to B Scan ultrasound which utilizes sound waves. OCT uses light from a super luminescent Diode, resolution of 10 micrometers. [70]

OCT was first demonstrated in 1991 with images of in vitro human retina and coronary artery, [89] which is a useful noninvasive imaging technique to diagnose & manage a variety of retinal diseases. [73]

OCT gained significant importance throughout the last decade because it allows evaluating retinal morphologic features in detail similar to an in vivo histological examination. However, conventional OCT imaging is based on 6 radial, cross-sectional scans, and the information therefore is limited to a few randomly selected locations and an overall low resolution of structural details. The 3D OCT uses a fast spectral-domain technique and performs scans in a faster pattern throughout the entire macular area, at a superior resolution of 5μm in axial and 20 μm in transverse directions. As a result, the retinal morphologic features can be imaged at all locations transversally and can be located to all retinal layers axially. These advances in OCT technology offer novel insight in retinal examination per se, but also may be used to complement findings from conventional angiographic evaluation. [16]

The first demonstration of 3D OCT for in vivo retinal imaging in 2002 . The superior sensitivity of 3D-OCT has opened up the possibility of much faster scanning without loss of image quality. The technology has been particularly promising for ophthalmology. [50]

A 3D OCT scanner capable of acquiring volumetric data of the retina is becoming an increasingly important modality in ophthalmology for the diagnosis and management of a variety of retinal diseases such as glaucoma, diabetic retinopathy and

age related macular degeneration (AMD) which are major causes of a loss of vision (fig 1-1). [138]

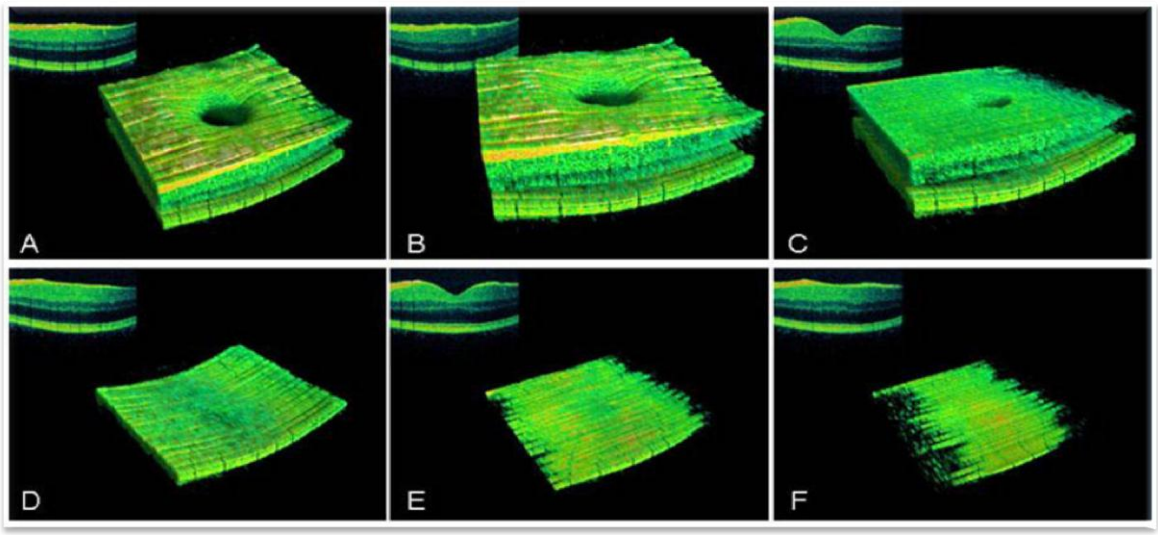

Fig 1.1. Three dimensional OCT of a normal human retina at different views (A,B) with simultaneous fly through B-scans of the whole volume (upper left corner). Virutal C-scans system (C-F) enables arbitrary horizontal removal of different retinal layers revealing morphologic information inside the scanned volume. [138]

For example, the thickness variation of a retinal nerve fiber layer (RNFL) is an important indicator to represent glaucomatous changes [50], also the ratio of the optic disc cup and rim surfaces (cup-to-disc ratio) in the 3D OCT scan can also be used to determine the progression of glaucoma. [1]

Optical coherence tomography is a new method of high-resolution, cross-sectional visualization of tissue that requires appropriate knowledge of the normal anatomy of the eye fundus. Optical coherence tomography enables carrying out an "optic biopsy" because it delineates the layers of the retina (Fig. 1.2). Foveal thickness has been calculated to be147 ± 17 μm in normal eyes with OCT. [87]

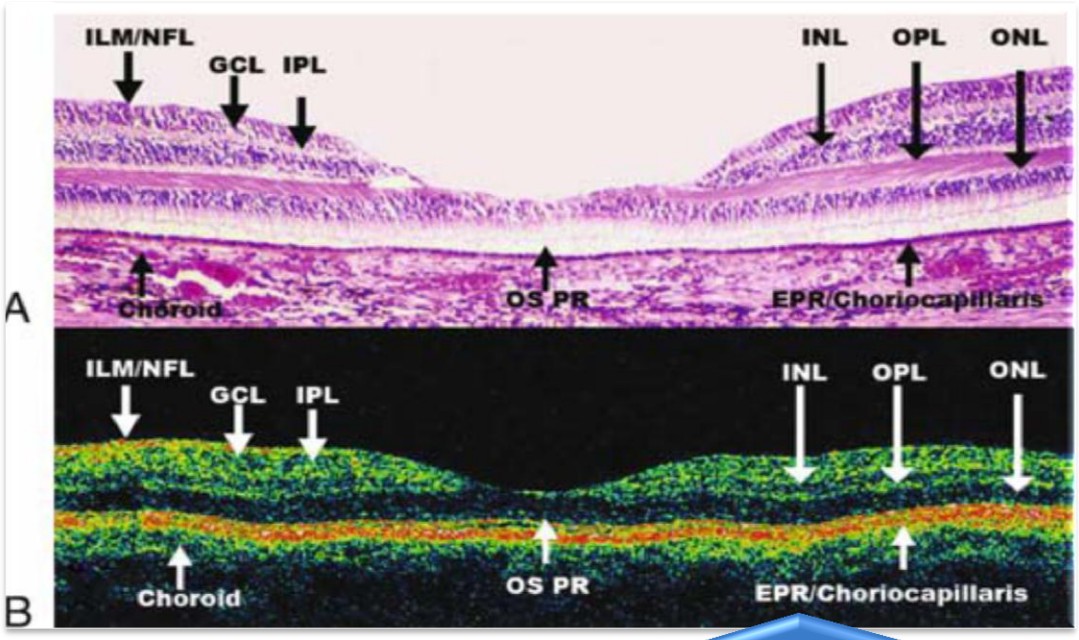

Fig. 1.2. Optical coherence tomography (OCT) of a normal eye. It has been found that OCT enables carrying out an "optic biopsy" because it delineates the layers of the retina. (A) Pathologic anatomy of the fovea. ILM/NFL, internal limiting membrane/nerve fiber layer; GCL, ganglion cell layer; IPL, inner plexiform layer; INL, inner nuclear layer; OPL, outer plexiform layer of Henle; ONL, outer nuclear layer; OS PR, photoreceptor's outer segments; RPE/Choriocapillaris, retinal pigment epithelium and choriocapillaris complex. (B) Optical coherence tomography of normal macula with different layers of the retina labeled. [87]

A highly scattering layer (70 μm in thickness), which is visible as red, delineates the posterior boundary of the retina in the tomogram and corresponds to the retinal pigment epithelium (RPE) and choriocapillaris complex. [84]

The nerve fiber layer appears as a highly backscattering red layer at the vitreoretinal interface .The RPE and nerve fiber layer define the posterior and anterior boundaries of the sensory retina, respectively; these boundaries are important in quantifying neurosensorial retinal thickness on OCT. [12]

Retinal areas of relative low reflection correspond to the location of the nuclear layers, and the photoreceptor inner and outer segments. The vitreoretinal interface can

be seen in OCT images as a high-contrast boundary between the vitreous and retina. The normal vitreous gel is optically transparent and therefore not visible in OCT imaging .The choroid and RPE together match to a wide band of retinal high reflection that decreases at greater choroidal depth and sclera. [12]

Optical coherence tomography images demonstrate reproducible patterns of retinal morphology that correspond to the location of retinal layers seen on light microscope. [153]

Layers of relative high reflectivity corresponded to horizontally aligned retinal components such as the nerve fiber layer and plexiform layers as well as to RPE and choroid. In contrast, the nuclear layers, and the photoreceptors inner and outer segments demonstrate relative low reflectivity(Fig. 1.2A, B). [153]