Bioptigen's High-resolution Spectral-domain Optical Coherence Tomography Imaging for Clinical and Pre-clinical Research Applications

a report by
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Bioptigen spectral-domain optical coherence tomography (SDOCT) is leading the development of OCT for applications in clinical and pre-clinical research applications. Bioptigen's exceptional image quality, fully customizable high-speed image acquisition, and versatility of scanning optics combine in the only SDOCT system suitable for use from the clinic to the operating suite, for neo-natal patients to adult, and for non-invasive imaging of animal models in the research lab.

Technology

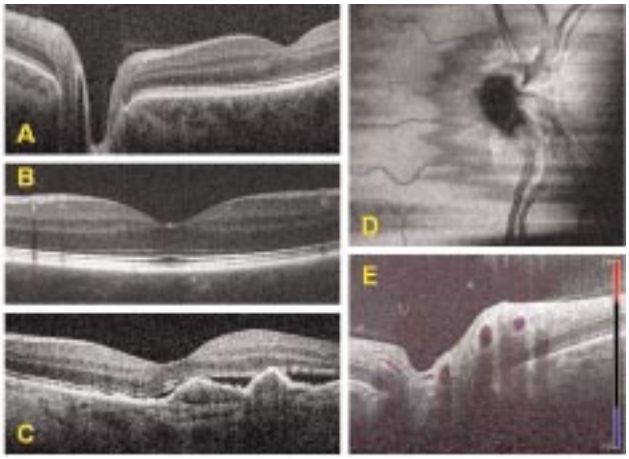
SDOCT is a second-generation imaging technology that is rapidly changing the face of ophthalmic disease management. OCT fills a niche between microscopy and ultrasound as an imaging modality that enables the depth-resolved imaging of tissue microstructure with axial and lateral resolution on the micron level. Images acquired on Bioptigen's 840nm ophthalmic SDOCT systems demonstrate an unmatched level of detail, owing to depth-independent axial resolution of 4.5 microns and lateral resolution at the retina of 20 microns. Bioptigen's system is ready for the future, with an upgrade option for ultrahigh-resolution imaging down to three microns.

Bioptigen ophthalmic SDOCT systems acquire, process, and display images at 17,000 lines. This image acquisition rate results in a reduction of the number of motion artifacts, eliminating the need to normalize distortions in cross-sectional B-scans caused by patient motion. High-density 1,000-line images are acquired at 17 frames per second, and high-density volumes of 100,000 lateral positions are acquired in just six seconds.

System Specifications

Bioptigen SDOCT is designed to provide the researcher, physician, and patient with the most advanced set of imaging tools to diagnose and treat eye disease from the very earliest stages. Resolving power is critical for assessing early symptoms of eye disease, whether it is the formation of drusen in early-stage age-related macular degeneration (AMD), the onset of choroidal neovascularization (CNV), and fractional changes in retinal edema or retinal nerve fibre layer (RNFL) thicknesses. Bioptigen systems provide 4.5-micron resolution for imaging the retina from the inner retina through to the choroid, or for high-resolution imaging of anterior structures such as the cornea, the sclera, and the angle. Superior imaging depth provides dramatic images of the optic nerve head through to the lamina cribosa. A simple change in optics allows for imaging of anterior structures such as the cornea and sclera, enabling the imaging of features such as Bowman's membrane in the cornea and Schlemm's canal at the angle. Further, the Bioptigen system is compatible with every broadband sources, providing resolution better than 3 microns; ultra high-resolution sources are available as an option. Bioptigen high-resolution systems are ideally suited for glaucoma and macular analysis, and for tracking disease change in combination with drug, laser, or surgical therapy.

Figure 1: Retinal Image Composite



Images of retina acquired on Bioptigen SDOCT systems. The figure shows a high-resolution image of optic nerve head in A and a volume intensity projection showing the optic nerve in D, an image of normal macula in B, and an image of pigment epithelial detachment in C, while E shows Doppler information overlaid on a B-scan. The images are all unaveraged, and acquired and displayed at 17,000 lines per second (except for the Doppler image, which was acquired at 4500 lines per second).

Figure 2: Image of Bioptigen Hand-held Probe System

Bioptigen's hand-held probe SDOCT systems are particularly useful in imaging subjects in the operating room, pediatric and neonatal patients, and animal models of eye disease.

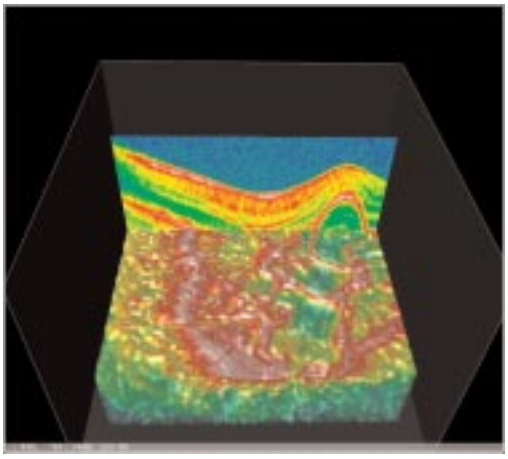
These performance advantages are brought to a broader patient and subject base through unmatched system versatility. In addition to a chin-rest

mediated clinical scanner for imaging of mobile adult patients, Bioptigen offers hand-held scanning probes for imaging disabled or immobile patients and neo-natal or pediatric patients in the exam room or the operating room. The hand-held probe provides additional utility for imaging non-clinical subjects from zebrafish to rodents, from rabbits to dogs, and to larger animals including pigs and primates. An available microscopy system is well suited to the small animal models and for *ex vivo* ocular tissue analysis. All of the optical accessories are interchangeable in the implementation of the research system, providing a very economical approach to satisfying the broad needs of the clinican-researcher.

Bioptigen hardware is supported by a robust software system with flexible workflow and advanced visualization capabilities. Pre-programmed scan modes support routine glaucoma and retinal diagnostics, while user-defined scan modes with up to 15,000 lines per B-scan and volumes to 512x512x1,024 pixels allow for more specialized investigations. The use of multi scan protocols with Bioptigen's real time review maximizes patient throughput and comfort; a complete set of images as defined by the clinician can be acquired in just a few minutes. The software is flexible enough to allow the physician or researcher to define scan protocols that result in just the information needed to make a diagnosis, a treatment plan, or advance in research.

Multiple 2D and 3D visualization and measurement modes are integrated into the system. In addition, Bioptigen offers the first OCT-based functional imaging capabilities. Doppler processing provides information on patterns of blood flow in the retinal vascular system, vital to the assessment of retinopathy. Bioptigen's programmable fixation target provides the option of retinal excitation imaging. Today, these functional imaging capabilities are of primary interest to the researcher. Over time, SDOCT functional imaging will be an important adjunct to the diagnosis and treatment of eye disease such as glaucoma and diabetic retinopathy. Today, all image data are readily available for advancing processing and analysis by the research clinician, and routine reports are available for clinical diagnosis and records.

Figure 3: 3D Image Rendered on Bioptigen Software



3D cutaway view of PED dystrophy (Figure 1 c), developed using the embedded Encircle™ visualization technology.

Bioptigen SDOCT is poised to dramatically change the nature of ophthalmic diagnostics and disease management. No other technology provides the combination of high-speed depth-resolved imaging, nor is as safe and inherently non-invasive. Bioptigen provides the highest-resolution imaging systems with the greatest versatility for the clinical and non-clinical researcher, and looks to become the leader in the development of this critical imaging technology for advanced applications in ophthalmic disease diagnosis and image-guided treatment. ■

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