

The Next Generation of Retinal Imaging Arrives in Santa Rosa

We have just added the next generation of optical coherence tomography (OCT)/fluorescein angiography (FA) technology at our offices in Santa Rosa. In fact, our two Heidelberg Spectralis HRA+OCT machines are the first in Northern California! (UCSF and Stanford have this equipment on order.)

The benefits of this new technology are numerous:

- Faster imaging with simultaneous FA and OCT
- Anatomic correlation across modalities, and
- Markedly enhanced image resolution with 3-dimensional reconstruction.

The Spectralis also provides auto fluorescence imaging and indocyanine green (ICG) angiography. We anticipate that this new technology will benefit our (and your) patients by decreasing imaging time, allowing multiple types of images without moving to another machine and, most importantly, providing better information to the doctors. The result will be improved patient care.

How Does It Work?

Earlier generation OCT machines work by comparing signals between the light reflecting from the subject and a control pathway. The speed is limited by the time required to move a mechanical mirror. The difference in time between the two signal pathways allows calculations to produce an image. This is the so-called time-domain OCT found in machines such as the Zeiss Stratus.

The new generation of OCT uses the Fourier transformation to create an image from the spectra of the reflected light. This new equipment does not use a mechanical mirror and thus is approximately 50 times faster than older devices. Information is gathered regarding the shift in frequency of the reflected light that is used to produce an image. This newer design is called spectral domain or Fourier domain OCT.

Why Is It Better?

Higher speed has several advantages. As we all know, patients blink and move during ophthalmoscopy and imaging procedures. A faster imaging device allows more samples to be taken in a shorter time period. With more data comes greater resolution and reduced artifact, resulting in better quality images.

The image resolution with the Heidelberg Spectralis has been truly astounding. We are able to see retinal layers as on a histologic cross-section. Using the new equipment, we can commonly identify pathology as subtle as the loss of photoreceptor outer segments.

The greater speed results not only in improved resolution along a given cross-section or scan line, but also increased density of scan lines. This prevents missing an abnormality

or having a sub-optimal view of the area of interest, as is common with time-domain OCT. The greater density of scans also permits three-dimensional reconstruction to precisely correlate the ophthalmoscopic appearance with the underlying retinal structures.

The final benefit of greater speed – and one that is unique to the Heidelberg machine – is eye tracking and precise image registration. One could imagine that a single line scan of high resolution would be helpful, but many would be better. It would be even better if the images could be precisely aligned with each other rather than overlapping or at slightly different angles. With even slight patient movement, alignment becomes a problem when attempting to register up to 64 line scans in an area as small as the macula.

The eye tracking system overcomes this problem by recognizing retinal landmarks and moving the scanning laser image with the patient's eye movements. This tracking allows all single line scans to remain in the appropriate relationship. In turn, it permits 3-D reconstruction because the relative location of each line scan is known and has a preset relationship with the other line scans. Scan line locations for a given patient can also be permanently registered so that at future visits the same precise retinal area can be scanned to more accurately follow a particular lesion. Images are also registered across modalities so that an area of leakage seen on angiography, for example, can be compared exactly to the OCT images of that location.

What is Autofluorescence?

Autofluorescence is a new way of imaging the retina and is thought of as providing a metabolic or physiologic picture. In this technique lipofuscin, a byproduct of dying or dysfunctional cells is better visualized. It is valuable in the evaluation of choroidal melanoma and macular dystrophies, and is becoming the standard of care for following atrophic or dry age-related macular degeneration.

How Does It Improve Care?

Our patients report that the new machines are easier for them and faster than previous exams with Stratus OCT and digital angiography. The uncomfortable bright flash of digital photography is replaced by a steady light of lower intensity, reducing the photostress of previous technologies. If needed, simultaneous OCT, FA, and ICG angiography can be performed, greatly facilitating evaluation and further lessening the burden on the patient. With automatic eye-tracking, we are able to image children or those with fixation difficulties with improved accuracy and image quality.

It is probably impossible to determine the advantages in outcomes with any degree of accuracy. Some centers report that they are able to detect 10% more active choroidal neovascular membranes with spectral OCT. This improved detection is certainly important in this era of effective therapy. Relying on the older time domain images for the evaluation of AMD is somewhat analogous to performing focal laser treatment for diabetic macular edema without the guidance of fluorescein angiography. It can be done, but it is not as accurate and would be considered below the standard of care. The vast

improvement in imaging will allow greater sophistication in our ability to detect and understand macular disease, which will undoubtedly enhance the quality of care for retinal patients. We felt it was important to bring this state-of-the-art technology to Santa Rosa and keep regional retinal care at the leading edge.