Abstract

**Purpose:** To determine whether Spectralis Enhanced Depth Imaging (EDI) Spectral Domain OCT images provide enough resolution of the choroid to visualize and measure lesions traditionally followed by ultrasound.

**Design:** Observational Case Series

**Methods:** EDI OCT scans were correlated with patients who are traditionally followed with Ultrasound. EDI OCT scans were obtained by positioning the Heidelberg Spectralis SD-OCT closer to the eye than usual in order to obtain an inverted image, which concentrates the signal on the choroid. At the time of this article, we had not received the update from Spectralis, which employs an EDI button to replace the need to move the camera closer to invert the image. Seven line scans were obtained over the thickest portion of the lesion, and measurements using the Spectralis software were made, measuring from the end of the Retinal Pigment Epithelium to the end of the Choroid.

**Conclusions:** For this observational case series, it seems that EDI OCT could be useful for obtaining measurements of choroidal lesions that are too small to accurately measure or visualize with ultrasound. In addition, ease of use of the OCT machine for patient and operator is a benefit, while ophthalmic ultrasound is extremely operator dependent and requires direct contact with the eye. However, currently EDI OCT cannot image very peripheral lesions or lesions too large to fit within the active scan screen, and media opacification limits the signal strength of OCT.

**Keywords**

Enhanced Depth Imaging (EDI), Choroidal Lesions, Ultrasound, Standardized Echography, Spectral Domain Optical Coherence Tomography (SD-OCT), Heidelberg Spectralis

Ultrasound is the gold standard for measuring intraocular tumors; however, a lesion must be elevated by 0.75mm before it can be distinguished. Even if a lesion can be detected, accurate measurement may require even more elevation. Since most adult intraocular tumors begin in the choroid, Optical Coherence Tomography (OCT) has been limited in viewing these tumors. The technique of Enhanced Depth Imaging (EDI) using the Heidelberg Spectralis SD-OCT (Heidelberg Engineering, Heidelberg, Germany) first appeared in the literature in 2008. It provides enhanced resolution of the choroid, and thus, the ability to visualize and follow choroidal lesions.

There are a few tips for obtaining high quality EDI scans of the choroid using the Spectralis. If the lesion is small enough, try to get all margins in the frame and capture a raster of lines over the lesion in order to scroll through the image so that the operator can follow the lesion carefully.

**Figure 1:** (a) Standard OCT scan of the retina, scan signal concentration is on the anterior retina. (b) EDI image of the same retina; we can now delineate the borders of the choroidal lesion.
Correlation of Ocular Ultrasound and Spectralis Enhanced Depth Imaging (EDI) of Ocular Lesions

through to find maximum height and width. Maximum height and width are important; if the ocular oncologist decides intervention in the form of plaque therapy is needed, the largest measurement is used to determine the size of the plaque needed.¹

In addition, use the Automatic Real Time (ART) mode with the maximum frames possible, since the preset volume scan, which averages nine frames, usually does not reveal enough detail to delineate borders of the lesion. If you do not have the Spectralis update with the EDI button, choosing “XL” as the size of the eye usually results in higher resolution scans instead of only moving the camera closer (Figure 1).

To measure a lesion found on OCT using the Spectralis software, drag the caliper icon in the lower right hand corner of the screen and resize it to measure the lesion, (Figure 2a). To measure these choroidal lesions, the measuring tool was placed at the edge of the hyper-reflective line indicative of the retinal pigment epithelium and stretched to the outer edge of the choroid, where it meets the inner sclera, (Figure 2b). In the normal population, choroidal thickness measured by OCT is thickest under the fovea and begins to thin further out from the fovea nasally. Mean choroidal thickness is 287µ under the fovea and 145µ when measuring 3 mm nasal to the fovea.³

For the purpose of this article, the inverted images have been rotated 180 degrees in Photoshop to appear the way we traditionally view OCT scans, with the anterior retina facing up.

Case one is a patient who presented with an atypical, amelanotic choroidal nevus (Figure 3). For a nevus, malignancy cannot be ruled out without continued monitoring for change over a period of years. With ultrasound, the lesion measured approximately 0.7 mm; however on OCT the lesion measures approximately 0.4 mm, (Figure 4). Because this lesion is so small, the limited resolution of ultrasound makes it difficult to differentiate layers and thus caliper placement is more difficult.³ (Figure 5) As there is a measurement variation, it is important to serially follow a lesion on the same equipment; however the improved resolution of the OCT may provide more ease of comparison in the case of such a small lesion.

Figure 3: Atypical, amelanotic choroidal nevus.

Figure 4: (a) With ultrasound, the lesion measured approximately 0.7 mm. (b) With OCT, the lesion measures approximately 0.4 mm.

Figure 5: Caliper placement is more difficult with ultrasound.
Case two is a twenty year old male with a suspicious choroidal nevus in the left eye. Indications that this is a suspicious nevus to be followed carefully are orange pigmentation, subretinal fluid and proximity to the optic nerve, (Figure 6). Even though this lesion is only mildly elevated, the appearance of these three risk factors means this lesion has a 50% chance of growing, which is indicative of melanoma. The other two risk factors to be considered when observing choroidal lesions are if the lesion is greater than 2.0 mm in height or if the patient presents with visual symptoms. This lesion is under the 2.0 mm mark, measuring 1.36 mm on ultrasound and 1.04 mm on OCT, (Figure 7). This variance in measurement could be deemed acceptable, when taking into account the acceptable range in measurements for ultrasound from A-scan to B-scan is considered 0.2 to 0.3 mm in height. The patient was asked to come back in 4-6 months in order to observe for growth.

Case three provides evidence that EDI OCT can resolve choroidal infiltrate where ultrasound may not be sensitive enough. A 52 year old male recently diagnosed with leukemia presented with complaints of a “yellow-green dirty screen” in the center of vision of both eyes, general blurry vision in both eyes and occasional flashes in both eyes. Fundus photos show a few small dot and blot hemorrhages on the right eye and subretinal fluid in the area of the macula in both eyes, (Figure 8). Ultrasound identified thickening in the macula with no echographic evidence of choroidal thickening, (Figure 9). However, EDI OCT reveals choroidal thickening of 513µ in the right eye and 503µ in the left eye, which is markedly thicker than the normal average of 287µ (Figure 10). The choroidal thickening along with the subretinal fluid in conjunction with the diagnosis of Leukemia is indicative of Leukemic Choroidopathy. Four weeks after the start of chemotherapy, the patient’s visual symptoms completely resolved and the choroid measured 337µ on the right eye and 310µ on the left eye, which is much closer to the normal range (Figure 11).
Conclusion

While OCT cannot replace ultrasound, the newer OCT technique of Enhanced Depth Imaging can be useful for measuring very small lesions or thickening of the choroid\textsuperscript{2,3,6}. SD-OCT has the ability to register scans to a reference image, which helps for future correlation, while ultrasound is extremely operator dependent and there are fewer individuals well versed in its use. By continuing to scan small lesions or other choroidal pathology using both ultrasound and EDI OCT, more information may be able to be gleaned than using ultrasound alone.

References


