

## CASE REPORT

# Buried Disc Drusen Have Hyporeflective Appearance on Spectral Domain Optical Coherence Tomography

Samantha Slotnick\* and Jerome Sherman\*

### ABSTRACT

**Purpose.** Buried disc drusen are an important differential diagnosis for papilledema. Spectral domain optical coherence tomography (SD-OCT) affords clinicians with new non-invasive opportunities to probe below the surface of the optic nerve. Clinicians may use the knowledge of this appearance to rule out buried disc drusen in patients with irregular optic nerve borders or a bulging, hyperemic appearance.

**Methods.** SD-OCTs were obtained in a patient with one surfacing disc druse, identifying the nature of the appearance of this disc druse and others in this and the contralateral eye when imaged with this technology. B-scan ultrasonography was used to confirm the presence of disc drusen. Additional scans in multiple patients with confirmed buried drusen were obtained for comparison.

**Results.** Drusen appear as rounded hyporeflectant areas on SD-OCT, similar in appearance to blood vessels. They share the appearance of cysts but show a fine hyperreflective border anteriorly. These same discrete hyporeflective areas were found at various depths within optic nerve heads with confirmed buried disc drusen.

**Conclusions.** The hyporeflective appearance may not be anticipated by clinicians, as B-scans show calcified drusen as hyperreflective on echo. It is hypothesized that the hyporeflectant appearance of drusen is due to a constancy in refractive index through the druse, as OCT detects changes in optical reflectivity. Thus, drusen are likely dense and homogenous. SD-OCT may be more useful in those patients with buried disc drusen which are not calcified as B-scan often contributes little in such cases.

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Key Words: autofluorescence, buried disc drusen, B-scan ultrasound, imaging, optical coherence tomography, SD-OCT

Buried disc drusen are an important differential diagnosis for papilledema.<sup>1,2</sup> Optical coherence tomography (OCT) has been used to assist in this differential on both qualitative and quantitative metrics.<sup>3</sup> Qualitatively, buried disc drusen confer a “lumpy-bumpy” internal contour on OCT, while optic nerves with disc edema maintain a smooth internal contour. Quantitatively, measures of the “subretinal hyporeflective space” and retinal nerve fiber layer thickness have been shown to distinguish between the two conditions.<sup>3</sup> OCT analysis has also been used to characterize the morphology of the peripapillary retinal pigment epithelium (RPE) and Bruch’s membrane in cases of papilledema where elevated intracranial pressure creates a transient inward deflection of the peripapillary RPE.<sup>4,5</sup>

Clinically, qualitative distinguishing features are of particular value. In cases of both disc drusen and papilledema, observation of the outer structures of the optic nerve may be impeded due to shadowing from dense overlying structures. Often, the RPE cannot be observed all the way to the edge of the scleral canal. For this reason, it is particularly helpful to identify the appearance of disc drusen in superficial and central depths of the optic nerve.

B-scan ultrasonography has been widely accepted as the best method for detecting buried disc drusen.<sup>1,2,6,7</sup> These structures appear as highly refractile particularly if they are calcified. However, the nature and composition of buried disc drusen is unresolved in the literature. Spectral domain optical coherence tomography (SD-OCT) affords clinicians with new non-invasive opportunities to probe below the surface of the optic nerve. The following case report utilizes a surfacing disc druse which is readily identifiable, ophthalmoscopically, to identify the appearance of disc drusen on SD-OCT. Clinicians may use the knowledge of this

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appearance to rule out buried disc drusen in patients with blurred or irregular optic nerve head (ONH) borders or a bulging, hyperemic disc appearance.

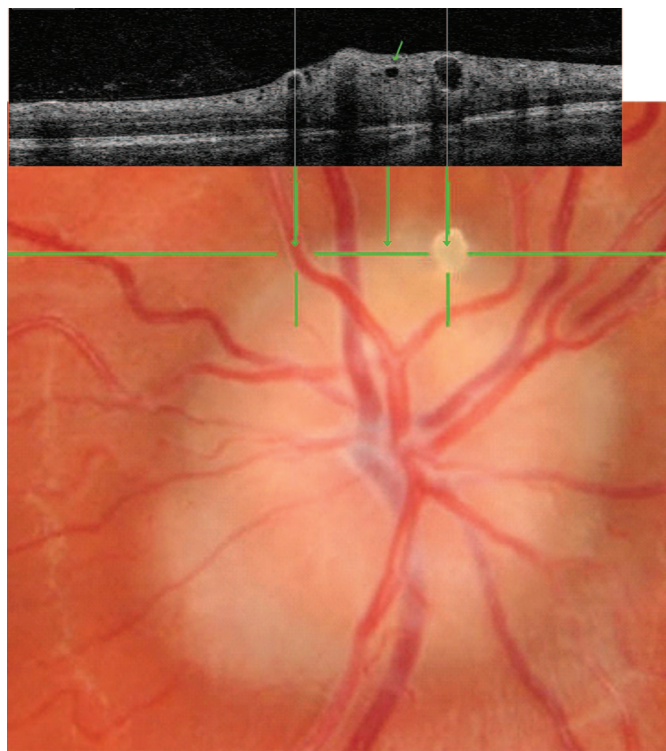
Except where indicated, all SD-OCT images in this case series have been obtained on Topcon 3D-OCT 2000 (Topcon Medical Systems, Oakland, NJ), as this instrument correlates fundus photography with OCT images. Imaging obtained with Zeiss Cirrus HD-OCT 400 (Carl Zeiss Meditec, Dublin, CA) shows identical OCT appearance on disc drusen. Both SD-OCT instruments obtain 27,000 A scans/s.

Literature review has revealed a scant number of references to the appearance of optic nerve drusen on OCT, reporting both hyporeflective and hyperreflective appearance. Patel et al.<sup>8</sup> report “lucencies”; Wester et al. report an “optically empty cavity, sometimes with a perceptible reflection from the posterior surface”<sup>9</sup>; and Yi et al. describe them as “signal-poor regions with high-signal borders.”<sup>10</sup> In contrast, Murthy et al.<sup>11</sup> report “scattered spots with high reflectivity,” and more recently Lee et al.<sup>12</sup> report “focal, hyperreflective, subretinal” masses.

## CASE REPORT

### Case 1

A 22-year-old woman presented for evaluation of presumed papilledema. She was emmetropic OU, pupils unremarkable.



**FIGURE 1.**

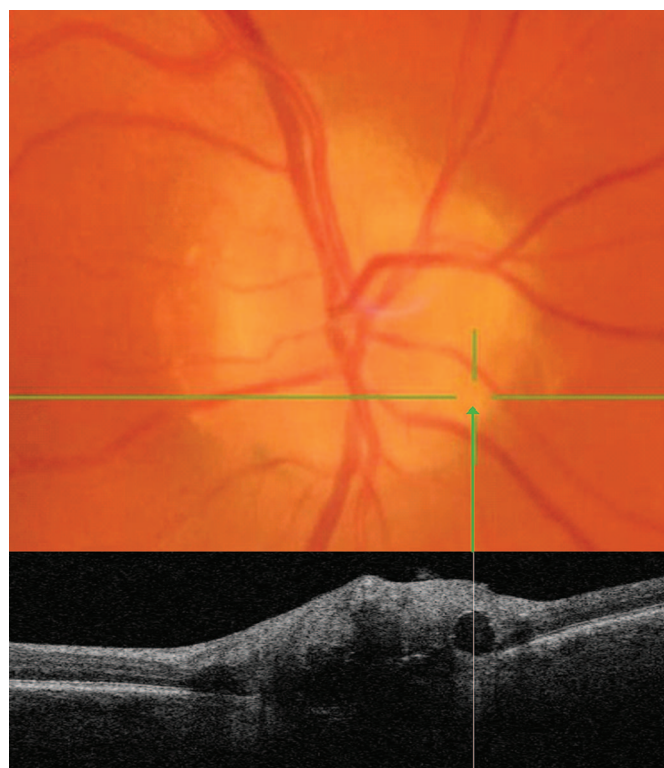
Case 1, OD. Surfacing disc druse helps identify appearance of drusen on a SD-OCT horizontal section (right marker). Image obtained with 3D Disc scan. Appearance of blood vessel marked for comparison (left marker). Buried druse, not ophthalmoscopically visible, identified within section (central arrow). This and all OCT images are shown in 1:1, rather than typical 1:2, horizontal:vertical ratio to depict actual shape of drusen. A color version of this figure is available online at [www.optvissci.com](http://www.optvissci.com).

SITA Central 30-2 visual fields revealed inferior arcuate defects extending from disc OU. Optic nerve head drusen were readily identifiable ophthalmoscopically. This provided the opportunity to learn the appearance of the druse on SD-OCT and to explore the disc for buried drusen. Fig. 1 is a retinal photo that clearly shows a druse, very close to the surface, which is ophthalmoscopically identifiable. The corresponding region on SD-OCT shows a round, hyporeflective space just below the surface (see Fig. 1, right-most marker). Another similar hyporeflective zone can be visualized deeper within the same slice of the ONH (central arrow on OCT). Accordingly, the photo shows multiple bulges and irregularities over the area of the ONH, typical of the appearance of buried disc drusen. B-scan ultrasound was performed, confirming the diagnosis of buried drusen. The leftmost marker indicates the appearance of a blood vessel on OCT for comparison. Note that the artery also has a hyporeflective lumen, but this is surrounded by diffusely hyperreflective vessel walls anteriorly and laterally with shadowing below (posterior to) the vessel.

Having identified the hyporeflective nature of the above druse, critical evaluation of this and several other patients suspected of buried disc drusen has consistently revealed multiple, small, round hyporeflective spaces at various depths.

### Case 2

A 58-year-old man presented for a routine comprehensive eye exam. He is a 2 D myope, pupils unremarkable, with pigment dispersion syndrome. Optic nerve heads appear elevated and hy-



**FIGURE 2.**

Case 2, OD. Marker indicates large buried druse, hyporeflective with hyperreflective anterior border on this horizontal SD-OCT section. Image obtained with 3D Disc scan. A color version of this figure is available online at [www.optvissci.com](http://www.optvissci.com).



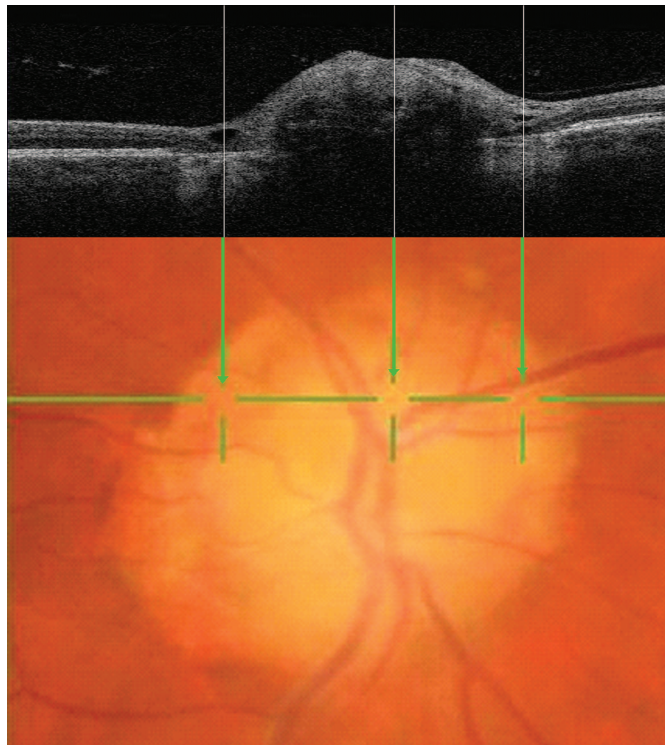
peremic with irregular borders OU, consistent with the appearance of disc drusen. SITA Standard 24-2 visual fields are normal and full. SD-OCT reveals an elevated disc with a large deep druse identified (Fig. 2).

### Case 3

A 44-year-old man presented with a complaint of monocular diplopia (OD). Evaluation revealed prominent disc drusen, OD > OS, with a reduction in the retinal nerve fiber layer affecting the papillomacular bundle. A Drance heme was identified OD. Disc drusen were confirmed with B-scan ultrasonography and fundus autofluorescence. SD-OCT imaging and fundus photos were obtained on the Topcon 3D-OCT 2000.

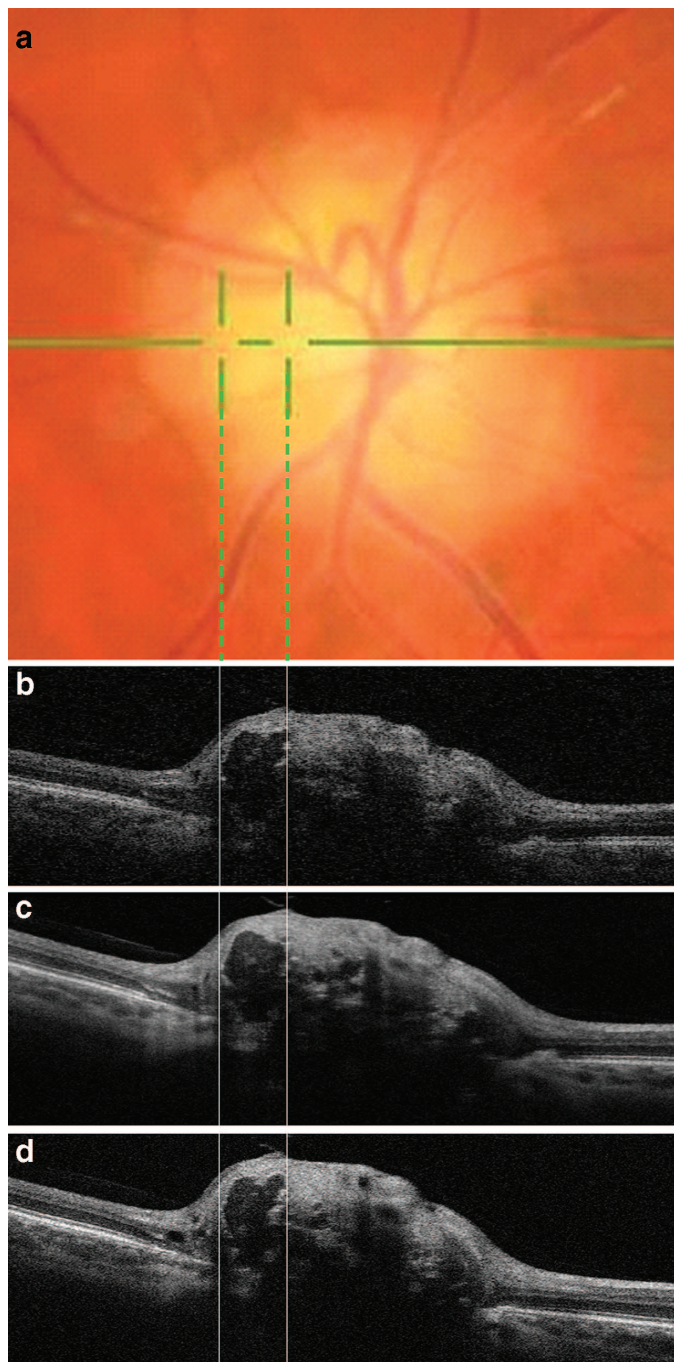
SITA Standard 30-2 visual fields revealed extensive visual field defects OU. OD shows both an inferior and superior arcuate defect along with a superior-nasal central defect. There is deep depression throughout the inferior-nasal quadrant with central sparing. OS shows an inferior arcuate defect with absolute scotomas throughout most of the inferior-nasal quadrant. There is also a superior ring defect apparent from 24 to 30°.

The disc has multiple small drusen visible in a single section OD (Fig. 3). The appearance OS reveals coalescing of drusen into a very large region (Fig. 4). A subtle area of reflectance within the demarcated region suggests adjacent drusen with minimal separation. A high-resolution scan through a nearby section better highlights the interruption in hyporeflectivity in this coalescing druse.



**FIGURE 3.**

Case 3, OD. Single horizontal SD-OCT section shows four buried drusen. Left and center vertical marker each show a moderate druse; right vertical marker passes through two small drusen at different depths. Image obtained with 3D Disc scan. A color version of this figure is available online at [www.optvissci.com](http://www.optvissci.com).



**FIGURE 4.**

Case 3, OS. A very large, coalescing druse imaged in several SD-OCT modalities. a, Fundus photo with two vertical markers placed on either side of the druse, obtained with 3D Disc scan on Topcon 3D-OCT 2000. b, Low-resolution SD-OCT image, obtained on same 3D Disc scan. c, High-resolution image, obtained with 7-Line Raster on Topcon 3D-OCT 2000. d, High-resolution (5-Line Raster) image, obtained with Zeiss Cirrus. HD-OCT. A color version of this figure is available online at [www.optvissci.com](http://www.optvissci.com).

### Case 4

A 53-year-old woman, mentally impaired, presented for a visually evoked potential to objectively assess visual acuity. On examination, optic disc drusen were identified OU. Several attempts were made to image through the drusen on OCT, but the patient's fixation was poor.



**FIGURE 5.**

Case 4, OS. Right: Fundus photo of surfacing disc druse falling external to ONH border. Left: Fundus autofluorescence shows increased intensity on disc druse but hyporeflectivity over ONH and surrounding area of peripapillary atrophy. Horizontal striations (right) are choroidal folds in this patient with congenital tortuosity. A color version of this figure is available online at [www.optvissci.com](http://www.optvissci.com).

Drusen are autofluorescent. However, they may not be readily identified on autofluorescence unless surfacing. Case 4 has a surfacing disc druse superior-nasal OS (Fig. 5, right). Note that this druse is adjacent to the ONH, but most of the body of the druse falls exterior to the border of the ONH. Interestingly, the autofluorescent image gives the appearance that the druse is completely within the area of the ONH. This is not an artifact however. There is a zone of peripapillary atrophy around the ONH. This tissue is deficient in lipofuscin and therefore does not show the typical baseline level of autofluorescence which is appreciated over the retinal area as a low level of intensity (Fig. 5, left, imaged as gray). The druse is outside the ONH but within the area of peripapillary atrophy. The horizontal striations in the fundus image are choroidal folds.

## DISCUSSION

Hyporeflective regions on OCT may result from either shadowing or from a lack of change in the index of refraction over an area. Blood vessels often cast a shadow, weakening the strength of the OCT signal posterior to it (see Fig. 1). However, the drusen identified in this case study do not obscure the details beneath them (Figs. 1–4). Therefore, the hyporeflective appearance of disc drusen when imaged on SD-OCT suggests that the composition of these drusen is highly uniform. In the same way that leaking fluid or a cyst appears hyporeflective on SD-OCT, dense, homogenous material may appear hyporeflective as well. Combining the bright appearance of these drusen on B-scan ultrasonography with their hyporeflective appearance on OCT, it is likely that these disc drusen are dense and homogenous.

The composition of buried disc drusen remains unresolved. It is possible that multiple types of disc drusen exist with variable composition between types. Until we gain a better understanding of the nature of the coalescing materials, it would be important that clinicians keep an open mind as to the nature of the appearance of buried disc drusen on SD-OCT.

Complementary technologies may be used to verify the presence of disc drusen. B-scan ultrasonography and SD-OCT appear to provide a greater level of penetration than fundus autofluorescence. Thus, these two modes of imaging are likely to be of greatest utility with buried drusen. SD-OCT may be more useful in those patients with buried disc drusen which are not calcified as B-scan often contributes little in such cases.

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