Research Article

Morphology of Peripheral Vitreoretinal Interface Abnormalities Imaged with Spectral Domain Optical Coherence Tomography

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The objective of this study is to describe the clinical utility and morphologic characteristics of peripheral vitreoretinal interface abnormalities with spectral domain optical coherence tomography (SD-OCT). A prospective imaging analysis of 43 patients with peripheral vitreoretinal interface abnormalities seen on binocular indirect examination with scleral indentation was done. SD-OCT was evaluated for image quality and structural findings. Laser retinopexy was performed to surround all retinal breaks containing a full-thickness component via SD-OCT. Acceptable image quality for inclusion was obtained in 39/43 (91%) patients. Mean age was 41 ± 22 years, and mean follow-up was 14 ± 1.6 months. Decision to treat was altered following SD-OCT in 5% of the patients. Two cases of previously diagnosed operculated holes were found on SD-OCT to be partial-thickness operculated breaks or focal operculated schisis. Peripheral SD-OCT is a reliable and useful technique to examine the structural features of vitreoretinal interface abnormalities in vivo. This imaging modality is useful in the clinical management of suspected retinal breaks identified with indirect ophthalmoscopy.

1. Introduction

Peripheral vitreoretinal interface abnormalities span a range of entities from incidental ophthalmoscopic findings to retinal detachment. Findings such as lattice degeneration, white without pressure, vitreoretinal traction, and posterior vitreous detachment- (PVD-) associated retinal breaks are common reasons for the need to treat with retinopexy in order to prevent retinal detachment [1, 2]. Asymptomatic retinal breaks may lead to chronic inferior retinal detachment [3] and may occasionally be difficult to distinguish from retinoschisis [4]. Most of the current approaches to clinical management are based on indirect ophthalmoscopic interpretation [1–6]. Documentation of peripheral retinal pathology is typically limited to indirect ophthalmoscopy and fundus photography. More recently, wide-field fundus photography has become available and may be useful in detecting peripheral retinal pathology [7].

Similar to how spectral domain optical coherence tomography (SD-OCT) has advanced the interpretation of posterior pole pathology, SD-OCT may be a valuable method for evaluating peripheral vitreoretinal interface abnormalities [4, 8–13]. Most of the current knowledge about these peripheral entities is based on biomicroscopy [2], histopathological examination, and electron microscopy [14]. These modalities may not fully capture the accurate structural relationship between vitreous and retina in vivo. Recently, some authors have reported SD-OCT imaging...
findings with SD-OCT of lattice degeneration [9, 10, 15],
white without pressure [11], retinoschisis [4, 16–18],
and normative data for peripheral retinal thickness [19].
The authors recently observed retinal structural features on
peripheral SD-OCT that were useful for clinical management
and revealed some unexpected cross-sectional find-
ings. The purpose of the present study was to prospectively
evaluate the feasibility and clinical utility of peripheral SD-
OCT of peripheral vitreoretinal lesions and examine their
structural morphology in vivo.

2. Materials and Methods

This prospective, consecutive, and observational case series
conformed to the tenets set forth in the Declaration of
Helsinki and was performed in accordance with the Health
Insurance Portability and Accountability Act of 1996.
Consecutive patients presenting to a single vitreoretinal
referral practice (Charles Retina Institute, Memphis, Ten-
nessee) over a three-month initial study period with
peripheral vitreoretinal pathology were included. All patients
completed informed consent for imaging and study par-
ticipation. All patients were examined with dilated slit lamp
biomicroscopy and peripheral indirect ophthalmoscopy by a
single experienced retina specialist including 360-degree
scleral indentation. Color peripheral photography and SD-
OCT (Spectrals, Heidelberg Engineering, Heidelberg,
Germany) were performed through pathology identified on
clinical examination. Patients with significant media opacity
precluding a clear view of the peripheral retina and patients
with peripheral retinal vascular disease were excluded. All
patients were followed with repeat examination at three-
month intervals if no treatment was indicated. Treated
patients were followed at one-week, at one-month, and then
at three-month intervals. No retreatment was indicated in
the present series. All patients diagnosed with full-thickness
retinal breaks were treated with focal laser retinopexy by
author Eric J. Sigler (EJS) to completely surround retinal
breaks using laser indirect ophthalmoscopy. Patients with
less than 12 months of follow-up examinations were
excluded.

2.1. Imaging. All images were obtained by a single, expe-
rienced ophthalmic photographer. Using a retinal drawing
prepared by the examining physician, the photographer
positioned the patient initially as for a standard SD-OCT
image acquisition. The patient was then instructed to direct
their gaze in the direction of the peripheral retinal lesion of
interest. The lesion of interest was identified on the preim-
gaging scanning laser ophthalmoscopy (SLO) image, and the single
line raster was positioned in a radial orientation through the
lesion of interest. The image was then acquired using 25
B-scans/A-scan and displayed as a grey-scale B-scan. At least
three parallel raster scans were obtained for each lesion. The
images were then reviewed sequentially for morphologic
features by two authors, EJS and Mohammad R. Rafieetary
(MRR). Sufficient image quality was defined as the ability to
visualize B-scan through the entire extent of the raster length
and the presence of clear detail of retinal layers in at least
three adjacent raster lines.

3. Results

Forty-three patients presented with peripheral SD-OCT
findings. Acceptable image quality was obtained in 39 pa-
tients (91%). Poor image quality was due to media opacity in
two patients and insufficient dilation in two patients. Mean
patient age was 41 ± 22 years and consisted of 26 females
and 17 males. Patient ethnicity included 26 Caucasians, nine
African Americans, and four Hispanics. Mean follow-up was
14 ± 1.6 months. Peripheral retinal findings were as follows:
white without pressure (WsP) (n = 8), lattice degeneration
(n = 16), retinal break (n = 13), horseshoe break (n = 6),
operculated break (n = 4), round atrophic break (n = 6),
cystic retinal tuft (n = 6), degenerative retinoschisis (n = 3),
and peripheral vitreoretinal traction (n = 2).

Lattice degeneration was present concurrently in six of
the patients with WsP. Lattice degeneration with atrophic
breaks was present in 9/13 patients with retinal breaks
(Figure 1). In three patients, full-thickness retinal breaks
were found present on SD-OCT that were not clinically
detectable with ophthalmoscopy and scleral depression. Two
cases diagnosed as vitreoretinal traction without retinal
breaks on ophthalmoscopy were found to have a full-
thickness component with SD-OCT. One patient di-
agnosed with having a full-thickness horseshoe break was
found to have no full-thickness component with peripheral
SD-OCT. Two out of four patients diagnosed with oper-
culated retinal breaks with ophthalmoscopy were found to
have a partial-thickness operculated break or focal oper-
culated schisis (FOS) (Figure 2). No retinal detachments
occurred within the study follow-up period. Patients treated
with laser retinopexy revealed hyperreflective spots corre-
sponding to the laser retinopexy (Figure 3) evident on both
scanning laser ophthalmoscopic image and at the level of the
outer retina by one week following therapy.

4. Discussion

The present series indicates that SD-OCT may be used to
demonstrate peripheral vitreoretinal pathology and image
some details that are not apparent with ophthalmoscopy. In
eight patients (5%), the decision to treat or observe was
changed following peripheral imaging. This is consistent
with one previous report, in which OCT proved helpful in
clinical decision-making when looking for the presence of
subretinal fluid or elevation associated with lesions,
uncovering subclinical retinal detachments and one pre-
sumed case of choroidal metastasis [9]. Additionally, SD-
OCT was used to visualize the cross-sectional anatomy of
laser retinopexy following treatment. We suggest that SD-
OCT may be used to evaluate early choriretinal adhesions
in the period when acute white laser spots have faded and
prior to the appearance of pigmentation.

A previous study of various peripheral retinal lesions
using both time domain OCT (TD-OCT) and SD-OCT
elucidated several findings [9]. The authors found that
Figure 1: Peripheral SD-OCT of lattice degeneration with vitreoretinal traction. (a) Fundus photograph of the right eye with focal lattice degeneration and bridging vessel diagnosed with probable full-thickness break with ophthalmoscopy. (b) Scanning laser ophthalmoscopic image demonstrates circumferential hypoautofluorescence and scan position (green arrow) for SD-OCT in (c) and (d), which show the boundaries of cortical vitreous lacuna (arrow) overlying an area of lattice degeneration (arrowhead) with retinal atrophy, intraretinal pigment migration, and retinal pigment epithelium (RPE) irregularity; no full-thickness component was observed.

Figure 2: Continued.
pigmented lattice degeneration tended to have thinner retinal layers and clinically unrecognizable breaks when compared to nonpigmented lattice degeneration. The present series did not demonstrate features common to idiopathic macular holes, such as circumferential subretinal fluid, focal opercula, hyaloid separation, or symmetric vitreoretinal traction surrounding atrophic holes. Another study evaluating lattice degeneration demonstrated the SD-OCT findings of previously histologically described structural elements [19]. These findings were consistent with observations in the present series, with cortical vitreous lacunae and retinal atrophy, with and without atrophic retinal breaks. WsP, which we [11] have recently termed “outer retinal whitening” due to SD-OCT findings, was frequently present surrounding and adjacent to lattice degeneration.

The present series identified the presence of partial-thickness operculated breaks, which we have termed “focal operculated schisis.” This is in apparent contrast to previous ophthalmoscopic definitions of operculated breaks [1–6]. Operculated retinal breaks have less commonly been associated with retinal detachment when viewed via
ophthalmoscopy alone; this difference has been theorized due to the absence of remaining vitreoretinal traction in operculated breaks [3]. However, retinal detachment due to operculated breaks does occasionally occur [20]. The authors hypothesize that this difference is also due to the presence of partial-thickness retinal breaks, or FOS, in some cases that do not result in retinal detachment. Therefore, SD-OCT can be used to detect the presence of a full-thickness retinal break and the need for treatment or observation in the case of operculated schisis.

The present study is limited by its single-center design, the use of only one, high-quality imaging device, and a relatively short study period.

5. Conclusions
We conclude that SD-OCT is a useful tool in evaluating peripheral retinal pathology and that it reliably provides structural details that may change clinical management. Additionally, the presence of focal operculated schisis underlies a number of presumed operculated retinal breaks.

Data Availability
The data used to support the findings of this study are included within the article.

Conflicts of Interest
The authors declare that there are no conflicts of interest regarding the publication of this paper.

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