Clinical and Spectral-Domain Optical Coherence Tomography Findings in Patients with Focal Choroidal Excavation

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Objective: To describe the clinical and spectral-domain optical coherence tomography (SD-OCT) findings in patients with focal choroidal excavation (FCE).

Design: Retrospective case series.

Participants: Forty-one eyes of 38 patients with FCE identified in 2 tertiary medical centers in Korea.

Methods: Clinical features, SD-OCT findings, and associated macular disorders of FCE were analyzed and detailed.

Main Outcome Measures: Statistical associations among clinical features, including lesion type, size, and choroidal thickness, and frequency of association with central serous chorioretinopathy (CSC), choroidal neovascularization (CNV), and polypoidal choroidal vasculopathy (PCV).

Results: Mean patient age was 50.1 years (range, 25–76 years). The mean spherical equivalent of refractive error was −3.7 diopters (range, −10.0 to +1.5 diopters). Three patients (8%) had bilateral lesions, and 1 patient (3%) had 2 distinct lesions in the same eye. The mean FCE width and depth were 757 μm and 107 μm, respectively, with a positive correlation between width and depth (P = 0.003). The mean subfoveal choroidal thickness of FCE eyes was 284 μm, which was not statistically different from that of age-, sex-, and refractive error–matched normal subjects. Choroidal thickness in FCE was less in eyes with hyperreflective choroidal tissue under the excavation that was present in 22 eyes (54%) versus eyes without excavation (128 vs. 190 μm, respectively; P = 0.009). Twelve FCEs (29%) were the nonconforming type, revealing separation between the photoreceptor tips and the retinal pigment epithelium (RPE) on SD-OCT. Nonconforming FCE was associated with visual symptoms (P < 0.001) and the presence of concurrent CSC (P = 0.001). Ten eyes (24%) were associated with CSC, and 9 eyes (22%) were associated with CNV, including 1 eye with PCV features. One eye with FCE and type 1 CNV developed a new excavation, and the excavated area in 1 eye with PCV enlarged slightly during follow-up.

Conclusions: Focal choroidal excavation is a relatively common entity and frequently associated with choroidal diseases, including CSC, CNV, and PCV. Although FCE is classically thought to be a congenital malformation, acquired FCE forms possibly exist. Ophthalmology 2014;121:1029–1035 © 2014 by the American Academy of Ophthalmology.

In 2006, Jampol et al1 reported a peculiar optical coherence tomography (OCT) finding in the macula, in which the choroid was excavated in an asymptomatic elderly woman. Wakabayashi et al2 identified 3 more patients with similar findings and called the lesions “unilateral choroidal excavation,” because lesions were confined to only 1 eye. They found that there are 2 types of such lesion, one with separation between the photoreceptor tips and the retinal pigment epithelium (RPE) and one without this separation. Margolis et al2 found a bilateral case in their series of 12 patients and proposed the term “focal choroidal excavation” (FCE). Obata et al4 found that FCEs are relatively stationary lesions, showing no significant changes in appearance over a mean follow-up of 37 months in 21 eyes of 17 patients.

The cause of FCE is currently unknown. Occasional bilaterality and a relatively stable clinical course in the absence of any systemic or ocular conditions that may have disturbed the choroidal layer in the macula prompt investigators to suspect that FCE is a congenital abnormality. The clinical implications of FCE are largely unknown. Most patients appear to retain good visual acuity, but a few cases have been diagnosed with concurrent choroidal vascular disorders, including central serous choriotenopathy (CSC), choroidal neovascularization (CNV), and polypoidal choroidal vasculopathy (PCV).3–5 We have studied clinical, angiographic, and spectral-domain (SD-) OCT findings of 41 eyes of 38 patients with FCE. Association with CSC, CNV, and PCV in FCE has been studied with particular interest.

Methods

This study was approved by the institutional review board of the Yonsei University College of Medicine and Seoul National University Bundang Hospital and conform to the tenets of the Declaration of Helsinki.
We performed a retrospective review of Korean patients with FCE who visited Shinchon Severance Hospital, Seoul, Korea (28 eyes of 25 patients), and Seoul National University Bundang Hospital, Seongnam, Korea (13 eyes of 13 patients), between September 2009 and May 2013. Focal choroidal excavation was defined as a macular lesion with choroidal excavation detected on SD-OCT (Spectralis; Heidelberg Engineering, Heidelberg, Germany) without evidence of scleral ectasia or posterior staphyloma. Patients with a history of trauma to the affected eye were excluded. All patients underwent comprehensive ophthalmic examinations, including best-corrected visual acuity, intraocular pressure, refractive error, slit-lamp biomicroscopy, fundus photography, and SD-OCT including enhanced-depth imaging OCT. Ancillary testing was performed with fundus autofluorescence imaging, fluorescein angiography (FA), and indocyanine green angiography (ICGA).

Greatest width and depth of FCE were measured using the caliper feature on SD-OCT. Subfoveal choroidal thickness measurements were made from the outer border of the RPE to the inner scleral border using enhanced-depth imaging OCT. For eyes with subfoveal FCE where the subfoveal RPE layer was involved in excavation, subfoveal choroidal thickness was measured from the outer border of imaginary subfoveal RPE layer extrapolated from the uninvolved adjacent RPE layers on both sides of the lesion. Choroidal thickness measurements in areas not affected by excavation also were made. Choroidal thickness under the FCE was measured from the outer border of the lowest tip of the excavated RPE layer to the inner scleral surface. Lesions were classified as the “nonconforming type” if there was separation between the photoreceptor tips and the RPE and the “conforming type” if there was no separation on SD-OCT. For statistical analyses, nonconforming FCE with associated serous retinal detachment due to concurrent CSC or CNV/PCV was defined as conforming type if it converted to conforming type FCE after retinal detachment resolution. The FCE was classified as foveal or extrafoveal depending on whether the foveal center was located within the excavated area.

Decimal visual acuities were converted to logarithm of the minimum angle of resolution for statistical analysis. Data were analyzed by simple linear regression analysis to study the correlation among clinical features. Kruskal–Wallis test was used to study the differences in clinical features among eyes with CSC, with CNV/PCV, and without CSC and CNV/PCV. Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS 20.0; SPSS Inc, Chicago, IL). Correlations and differences were considered statistically significant when P values were less than 0.05.

Central serous chorioretinopathy was diagnosed on the basis of medical history, serous retinal detachment by fundus examination and SD-OCT, and leakage at the RPE level by FA. Eyes with 1 or a few angiographic RPE leakage points were classified as classic CSC. Eyes with a broad area of granular hyperfluorescence and indistinct leakage points in FA, were classified as chronic CSC.

The CNV diagnosis was made on the basis of clinical, angiography, and OCT findings. The PCV diagnosis was made if the lesion showed early subretinal focal ICGA hyperfluorescence with at least 1 of the following clinical or angiographic criteria: branching vascular network, pulsatile polyp, hypofluorescent halo, orange subretinal nodule in color fundus photographs, and association with massive submacular hemorrhage.

Results

Demography and Clinical Features

Patient demographic and clinical features are summarized in Table 1 (available at www.aaojournal.org). The mean patient age was 50.1 years (range, 25–76 years). Twenty-five patients (66%) were men. The mean refractive error was −3.7 diopters (D) (range −10.0 to +1.5 D), excluding 4 pseudophakic eyes and 3 eyes with a history of previous refractive surgeries whose pre-surgical refractive errors were unknown. The mean decimal visual acuity was 0.5 (range, counting fingers to 1.0). Three patients (8%) had bilateral lesions, and 1 patient (3%) had 2 distinct lesions in the same eye, 1 in the foveal area and 1 in the extrafoveal region. Overall, 31 FCEs (74%) were located in the foveal area, and 11 FCEs (26%) were located in the extrafoveal area. Excavation was located in various macular quadrants, but there appeared to be a predilection for the temporal versus nasal side of the fovea (Fig 1). Systemic conditions were generally unremarkable except for 1 patient (patient 24) with asymptomatic tuberous sclerosis and 1 patient (patient 3) with systemic lupus erythematosus, the latter who had concurrent bilateral CSC associated with systemic corticosteroid therapy (Fig 2, available at www.aaojournal.org). Five patients were taking antihypertensive medications, and 1 patient was diabetic.

Focal choroidal excavations usually appeared as yellowish spots or pigmented mottling in color fundus photographs. Focal choroidal excavation appeared as yellowish spots in 13 eyes (33%) and pigmented mottling in 20 eyes (50%). No FCE was discernable in fundus photographs in 4 eyes (10%). These lesions tend to be smaller in size compared with lesions discernable in fundus photographs, especially in lesion depth on SD-OCT (62 vs. 130 μm, respectively; P = 0.039). In 3 eyes (7%), the FCE fundus appearance could not be adequately evaluated because it was obscured by type 2 CNV lesions. Fundus photographs were not available in 1 eye.

The mean greatest width of FCE was 757 μm (range, 54–2615 μm) and depth of FCE was 107 μm (range, 38–341 μm). There was a positive correlation between horizontal and vertical FCE dimensions (P = 0.003), with wider lesions having greater depth.
The subfoveal choroidal thickness varied markedly, ranging from 70 to 571 μm. The mean subfoveal choroidal thickness of 284 μm in FCE eyes was not statistically different from the mean subfoveal choroidal thickness of 41 age-, sex-, and refractive error–matched eyes from normal subjects assessed in our database (the mean subfoveal choroidal thickness, age, and refractive error of normal subjects were 265 μm, 48.7 years, and −3.3 D, respectively). The mean choroidal thickness in areas not affected by excavation was 288 μm (range, 96–558 μm). The mean choroidal thickness under the excavation was 172 μm (range, 23–531 μm). The previously described hyperreflective choroidal tissue under the excavation was identified in 22 eyes (54%). Of 22 eyes, what appeared to be a suprachoroidal space below this hyperreflective choroidal tissue was observed in 3 eyes (14%) (Fig 3). The mean choroidal thickness under the excavation in eyes with hyperreflective choroidal tissue was reduced versus those without hyperreflective choroidal tissue (128 vs. 190 μm, respectively; P = 0.009).

Visual symptoms were absent in 18 eyes (44%), none of which showed separation between the photoreceptor tips and the RPE (conforming type FCE). Visual symptoms in 19 of 23 symptomatic eyes were ascribed to the presence of concurrent macular pathology, including CSC, CNV, and PCV. The remaining 4 symptomatic eyes (patients 21, 30, 33, and 35) had excavation in the foveal area, 3 of which showed separation between the photoreceptor tips and the RPE (nonconforming type). The mean decimal visual acuity of 23 symptomatic patients improved from 0.36 to 0.48 during follow-up, but statistical significance was not observed (P = 0.068). Treatments include half-fluence photodynamic therapy for 2 CSC eyes and intravitreal anti-vascular endothelial growth factor injections for 3 CSC eyes, 9 CNV/PCV eyes, and 1 FCE only eye. Of 42 FCE lesions present in 41 eyes, 12 (29%) were the nonconforming type that was statistically associated with the presence of visual symptoms (P < 0.001) and the association of CSC (P = 0.001).

Association with Central Serous Chorioretinopathy, Choroidal Neovascularization, and Polypoidal Choroidal Vasculopathy

Ten FCE eyes (24%) had concurrent CSC. Of 10 eyes, 5 (50%) showed classic CSC and 5 (50%) showed chronic CSC on FA. Of these 10 eyes, 9 (90%) demonstrated active CSC with angiographic leakage and serous retinal detachment, whereas 1 (10%) showed resolved CSC. In 8 of the FCE/CSC eyes (80%), leakage points or granular hyperfluorescence on FA, or pigment epithelial detachments or RPE protrusions on SD-OCT were located within the choroidal excavated area. Indocyanine green angiography was performed in 6 of the FCE/CSC eyes. Choroidal hyperpermeability was seen in all 6 eyes, and all FCEs were located within this hyperpermeable region.

Nine FCE eyes (22%) had concurrent CNV. Of 9 eyes, 4 (44%) showed type 1 CNV (located in the sub-RPE space) and 5 (56%) showed type 2 CNV (located between the neurosensory retina and the RPE). In all 9 eyes, CNV was located within the area of choroidal excavation. In eyes with active CNV, especially type 2 CNV, the excavated area was not easily discernable on SD-OCT because of obscuration by CNV lesions and exudation. Excavation became evident after CNV resolution. Patients with type 2 CNV were relatively younger and more myopic compared with patients with type 1 CNV (mean age, 41.4 vs. 65.8 years; mean spherical equivalence, −3.2 vs. −0.1 D, respectively).

In comparing the FCE groups of eyes with different associated choroidal diseases, eyes with CSC had thicker choroids, whereas eyes with CNV presented with reduced visual acuity (Table 2).

Clinical Course

During the mean OCT follow-up of 9.3 months (range, 0–52 months), a conversion between conforming type and nonconforming type FCE was seen in 4 eyes (10%). Of these 4 eyes, 2 had concurrent CSC and 2 had concurrent CNV. Development or resolution of serous retinal detachment associated with CSC or CNV was responsible for this FCE-type conversion in all 4 eyes. There were 2 eyes with nonconforming FCE and CSC that received half-fluence photodynamic therapy. In these eyes, the serous retinal detachment completely resolved after treatment, but the photoreceptor tips remained separated from the RPE at the excavated area (patients 8 and 9).

After excluding all eyes associated with CSC, CNV, or PCV, there were 2 visually symptomatic eyes with nonconforming type FCE. Of these 2 eyes, a single administration of intravitreal bevacizumab in 1 eye had no apparent effect on resolving separation

Figure 3. A 35-year-old woman with type 2 choroidal neovascularization (CNV) and focal choroidal excavation (FCE) in the right eye (patient 11). A, Fundus photograph reveals a whitish-yellow lesion with hemorrhage at the fovea. B, Spectral-domain optical coherence tomography (OCT) scan through the fovea reveals disruption of the outer retina and retinal pigment epithelium (RPE), with exudation within the excavated area. C, Spectral-domain OCT scan 2 months after intravitreal bevacizumab injection reveals the resolution of CNV. Focal pigment epithelial detachment associated with CNV is located within the excavated area (arrowhead). D, Hyperreflective choroidal tissue (thick arrow) and the suprachoroidal space (arrowheads) are seen in an enhanced-depth image OCT scan. The thin white arrow indicates OCT scan direction.
between the photoreceptor tips and the RPE (Fig 4, available at www.aaojournal.org).

In 1 case, a small FCE appeared to newly develop in an eye with CNV during follow-up (Fig 5). In 1 eye with PCV, the excavated area appeared to slightly enlarge over 52 months (Fig 6). In all other eyes, no remarkable changes in the excavation size or shape of excavation were detected during follow-up.

### Discussion

Focal choroidal excavation was identified in 41 eyes of 38 patients in SD-OCT images, with bilateral FCE present in 3 patients (8%). Careful examination of the fundus identified FCE as indistinct yellowish spots or pigmentary blotting in most cases, but in 4 eyes (10%) the lesion could not be identified by fundus examination. These lesions were smaller in size and especially in lesion depth. Identification of FCE in these cases was confirmed only by OCT examination.

Patient demographics in this study were comparable to those in previous studies. Patient age varied from 25 to 76 years, with a mean age of 50.1 years. Most were moderately myopic with the mean refractive error of −3.7 D, as previously described.\(^1\)\(^\text{10}^-\)\(^\text{13}\) Men were affected slightly more frequently (66%) in this study, but a sex predilection for FCE remains unclear. Margolis et al\(^1\) previously reported that 8 of 12 patients (67%) were female in their series. Racial predilection is unknown, but the majority of patients who have been reported are Asians. We found a total of 56 eyes of 49 patients with FCE in a PubMed search (search years, 2006—2013; search words, focal choroidal excavation, choroidal excavation[s]), among whom 40 patients (82%) were identified as Asian, with the majority of these being Japanese.\(^1\)\(^\text{5}^-\)\(^\text{10}\)\(^\text{13}\) By including the 38 Korean patients in our study, which is the largest case series published to date, the ratio of assessed patients with FCE becomes 90% Asians. Whether there is a racial/ethnic predisposition to FCE requires validation in further studies.

There was speculation that FCE is associated with a thicker choroid.\(^3\)\(^\text{14}^-\)\(^\text{16}\) Ellabban et al\(^1\) also found a thicker subfoveal choroid in eyes with FCE and CSC compared with FCE eyes without CSC. This is expected because choroidal thickening in CSC eyes has long been known.\(^14\)\(^\text{16}\) Ellabban et al found that the choroid in eyes with FCE and CSC was thinner versus typical CSC eyes without excavations, presumably because of a myopic trend in FCE eyes. It is not clear whether a thickened choroid is a characteristic finding in FCE-only eyes, whereas choroid thickening is characteristic of FCE eyes that are associated with CSC.

Two OCT excavation patterns have been described, conforming FCE and nonconforming FCE, based on whether or not there is a separation between the photoreceptor tips and the RPE.\(^1\)\(^\text{13}\) The nonconforming type of FCE is clinically more relevant, because this excavation type is closely associated with the presence of visual symptoms, usually in the form of metamorphic or blurred vision. Whether these 2 excavation patterns represent different stages of disease or can convert to each other during the clinical course of FCE is not well studied. Margolis et al\(^1\) hypothesized that conforming FCE lesions could progress to nonconforming lesions because gradual stress on the outer retina can result in separation of the photoreceptor tips from the RPE. We found a case with conforming FCE that spontaneously converted to nonconforming FCE.

### Table 2. Demographics and Clinical Features of Eyes with Focal Choroidal Excavation Based on Association with Central Serous Chorioretinopathy and Choroidal Neovascularization/Polypoidal Choroidal Vasculopathy

<table>
<thead>
<tr>
<th>Demographics (No. of eyes)</th>
<th>Total</th>
<th>Concurrent CSC</th>
<th>Concurrent CNV/PCV</th>
<th>Absence of CSC, CNV/PCV</th>
<th>P Value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men/women</td>
<td>25/16</td>
<td>7/3</td>
<td>5/4</td>
<td>13/9</td>
<td>-</td>
</tr>
<tr>
<td>Right/left</td>
<td>24/17</td>
<td>8/2</td>
<td>5/4</td>
<td>11/11</td>
<td>-</td>
</tr>
<tr>
<td>Age (yrs)</td>
<td>50.1±11.3</td>
<td>48.3±11.3</td>
<td>52.2±14.8</td>
<td>48.7±14.5</td>
<td>0.728</td>
</tr>
<tr>
<td>Spherical equivalent (D)</td>
<td>−3.7±3.6</td>
<td>−3.0±3.7</td>
<td>−1.5±2.8</td>
<td>−5.0±3.6</td>
<td>0.138</td>
</tr>
<tr>
<td>Visual acuity (logMAR)</td>
<td>0.32±0.42</td>
<td>0.27±0.46</td>
<td>0.69±0.46</td>
<td>0.20±0.28</td>
<td>0.015</td>
</tr>
<tr>
<td>Subfoveal CT (µm)</td>
<td>284±112</td>
<td>355±99</td>
<td>278±80</td>
<td>254±117</td>
<td>0.031</td>
</tr>
<tr>
<td>Unaffected CT (µm)</td>
<td>288±108</td>
<td>357±79</td>
<td>268±78</td>
<td>266±120</td>
<td>0.025</td>
</tr>
<tr>
<td>FCE (No. of lesions)</td>
<td>42</td>
<td>10</td>
<td>9</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Width (µm)</td>
<td>757±494</td>
<td>1056±713</td>
<td>685±502</td>
<td>655±319</td>
<td>0.278</td>
</tr>
<tr>
<td>Depth (µm)</td>
<td>107±65</td>
<td>122±73</td>
<td>128±88</td>
<td>93±48</td>
<td>0.258</td>
</tr>
<tr>
<td>CT under excavation (µm)</td>
<td>172±116</td>
<td>199±86</td>
<td>165±98</td>
<td>163±134</td>
<td>0.212</td>
</tr>
<tr>
<td>Conforming/nonconforming</td>
<td>30/12</td>
<td>3/7</td>
<td>7/2</td>
<td>20/3</td>
<td>-</td>
</tr>
<tr>
<td>Foveal/extrafoveal</td>
<td>31/11</td>
<td>6/4</td>
<td>6/3</td>
<td>19/4</td>
<td>-</td>
</tr>
</tbody>
</table>

CSC = central serous chorioretinopathy; CNV = choroidal neovascularization; CT = choroidal thickness; FCE = focal choroidal excavation; logMAR = logarithm of minimum angle of resolution; PCV = polypoidal choroidal vasculopathy.

*Kruskal–Wallis test comparing the 3 subgroups.

\(^1\)Includes an eye with 2 distinct focal choroidal excavations.
Focal Choroidal Excavation

In this patient’s eye, however, serous retinal elevation resulted from CSC development rather than progression of the excavation itself. On resolution of serous retinal detachment, nonconforming type FCE reverted back to conforming type FCE. Likewise, 2 eyes with FCE that initially presented with nonconforming type FCE and active CNV reverted to conforming type FCE after CNV resolution. However, in 2 eyes with nonconforming type FCE and active CSC, the photoreceptor tips remained detached from the RPE at the excavated area after complete resolution of serous retinal detachment. These eyes may have originally presented as nonconforming type FCE before CSC progression.

Margolis et al\textsuperscript{3} identified CSC case in an FCE eye and suggested a possible relationship between these 2 conditions. Obata et al\textsuperscript{2} also reported a case of recurrent CSC in an FCE eye. Ellabban et al\textsuperscript{7} recently reported that FCE was identified in 7.8% of CSC eyes using swept-source OCT. We found that CSC was present in 24.4% of FCE eyes. Both FCE and CSC appear to share characteristic clinical features. Choroidal vascular hyperpermeability and punctate hyperfluorescent spots in ICGA have been described in FCE\textsuperscript{1} and are typical findings in CSC.\textsuperscript{16–19} Some investigators\textsuperscript{2,3} have noted increased choroidal thickness in FCE, similar to CSC. The reported mean or median age of patients with FCE, including the present study, ranges from 45 to 55 years,\textsuperscript{3,4,7} which is also the typical age range for patients with CSC. In eyes with both FCE and CSC, excavations are usually located within areas of fluorescein leakage and choroidal hyperpermeability,\textsuperscript{7} which was also the case in our study. It is unclear whether the presence of CSC is purely coincidental or associated with the altered choroid structure in FCE. Other than having a thicker choroid, FCE/CSC eyes did not show significant differences in patient demographics and clinical features versus FCE eyes without CSC (Table 2).

Ellabban et al\textsuperscript{7} found unusual hyperreflective choroidal tissue on OCT beneath the excavation in 56% of eyes with FCE and CSC. They suspected that it represents focal scarring in the choroidal connective tissue, whereby subsequent scar contraction results in RPE retraction, especially when the choroid is thickened during the active CSC stage. This hyperreflective layer was identified in 22 FCE eyes (54%) in the present study, although 20 of these 22 eyes were not associated with CSC. Ellabban et al\textsuperscript{7} described the suprachoroidal space in 3 of 5 eyes (60%) with a hyperreflective layer, appearing as if the outer choroidal boundary was pulled in by the contraction of the choroidal tissue. In support of this observation, we found that the presence of a hyperreflective layer was significantly associated with decreased choroidal thickness under the excavation. This may have resulted from inward contraction of the outer choroidal boundary by the hyperreflective choroidal tissue. These findings may be involved in the pathogenesis of FCE.

Choroidal neovascularization and PCV have been described in FCE eyes.\textsuperscript{3–5} Margolis et al\textsuperscript{3} reported 1 FCE eye with type 2 CNV (8% of FCE eyes studied). Obata et al\textsuperscript{2} identified 1 FCE eye (5% of FCE eyes studied) that developed CNV during follow-up and 5 eyes (14%) with cicatrizated subretinal neovascularization adjacent to the excavation.\textsuperscript{2} We found that 9 FCE eyes (22%) were associated with type 2 or 1 CNV, including 1 eye with PCV features. Eyes that showed type 2 CNV shared the features of idiopathic subfoveal CNV, that is, affected patients were younger and myopic, and showed good and prompt response to intravitreal bevacizumab treatments.\textsuperscript{20–22} Choroidal neovascularization can develop in various inherited and acquired conditions, including age-related macular degeneration, myopia, and choroiditis. It often accompanies the anatomic disruption, such as Bruch’s membrane ruptures and chronic chorioretinal disorders, and can be triggered by ischemia and hypoxia.\textsuperscript{23,25} There was a close topographic association between FCE and CNV/PCV; in all 9 FCE eyes with CNV and PCV, the latter condition was located within the excavation area in our study. If preexisting FCE is a malformation that can act as a platform for developing CNV and PCV, then anatomic alterations and relative...
choroidal ischemia at the excavation due to focal choroid
thinning may predispose the FCE eye to develop CNV/PCV at
the excavated area. However, it remains uncertain whether
FCE is a congenital malformation or an acquired condition.
Investigators previously suspected congenital or develop-
mental abnormalities as the cause of FCE, because the lesion
was stationary during follow-up and appeared unrelated to any
systemic or ocular condition.5,4,10 In the present study, the
FCE size and shape generally remained stable during follow-
up. However, in 1 case a small choroidal excavation de-
veloped during CNV scarring changes in age-related macular
degeneration during a 45-month long-term follow-up. In
another FCE case with PCV, the excavated area slightly
enlarged over 52 months of follow-up. Thus, a condition that
can lead to choroidal scarring of the macula may result in an
“acquired form” of FCE. Choroidal scarring from traumatic
choroidal rupture can result in the pulling of the outer retina
into a shape that resembles FCE on OCT.26 Obata et al17
described a published case report that seemed to show a
time-domain OCT image of choroidal excavation in an eye
with recent acute retinal pigment epitheliitis, although the
authors of the case study did not mention excavation in the
choroid.27 It may be the case that FCE can develop as a
congenital lesion or an acquired lesion. These 2 FCE types
would not necessarily represent the same disease entity or
share the same pathogenesis. However, we suspect that
choroidal scarring may have a possible role in FCE
pathogenesis, at least in some of the acquired cases. The
reported mean or median age of patients with FCE in the
literature ranges from 45 to 55 years, and the youngest
patient with FCE reported so far is a 25-year-old man in the
present study.1,5,7,10 This suggests that FCE may be a
secondary ocular change in some cases. If FCE solely repre-
sents a congenital malformation, we would expect to identify
additional younger patients in future studies.

Study Limitations
The current study is limited by the retrospective study
design, moderate follow-up period, and small number of
studied eyes that may limit the statistical comparisons of our
findings. The frequency of FCE associated with CSC, CNV,
or PCV may be overestimated because FCE eyes with these
conditions are usually symptomatic and often referred to
tertiary referral centers, such as our institutions, for the
management of these pathologies. Conversely, uncomplic-
cated FCEs are usually identified as incidental findings on
OCT examinations.

In conclusion, focal choroidal excavation seems to be a
relatively common entity and may be more prevalent in
Asian populations versus other races/ethnicities. The lesion
itself can affect vision, especially if it is nonconforming in

Figure 6. A 60-year-old man with polypoidal choroidal vasculopathy (PCV) and focal choroidal excavation (FCE) in the right eye (patient 14). A, Fundus
photograph reveals subretinal hemorrhage and hemorrhagic pigment epithelial detachment with a reddish-orange subretinal nodule (white thick arrow). B, Early-phase indocyanine green angiographic (ICGA) imaging reveals a polypoidal lesion corresponding to the reddish-orange nodule in fundus photograph
(thick arrow) and 2 smaller polyps (black thick arrow and white arrowhead). C, After 4 sessions of monthly intravitreal bevacizumab, early-phase ICGA reveals
a round hypofluorescent region (dotted circle) corresponding to the excavated area that was obscured by subretinal hemorrhage in A and B. A polypoidal
lesion (black thick arrow) is located within the excavated area. The 2 other polyps identified in B had regressed. D, Fundus photograph taken 52 months after
A reveals a small orange nodule (black arrow) within the excavated area. E, Early-phase ICGA reveals an enlarged area of hypofluorescence indicating the
enlarged excavated area (dotted circle). F, Time-domain OCT taken through the excavated area at the time of C reveals FCE (between arrowheads). G,
Spectral-domain OCT at the time of E reveals widened and deepened FCE. The thin white arrows indicate OCT scan direction. Fundus images on OCT scans
show the exact location of OCT scans.
nature and involves the fovea. The coexistence of FCE with macular choroidal diseases, including CSC, CNV, and PCV, occurred frequently, and in most cases there was a topographic association between excavation and choroidal diseases. The FCE pathogenesis may involve scarring changes in the choroidal layer; in this regard, acquired FCE may be possible. However, the origin, natural progression, and clinical implications of FCE remain to be elucidated.

References


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