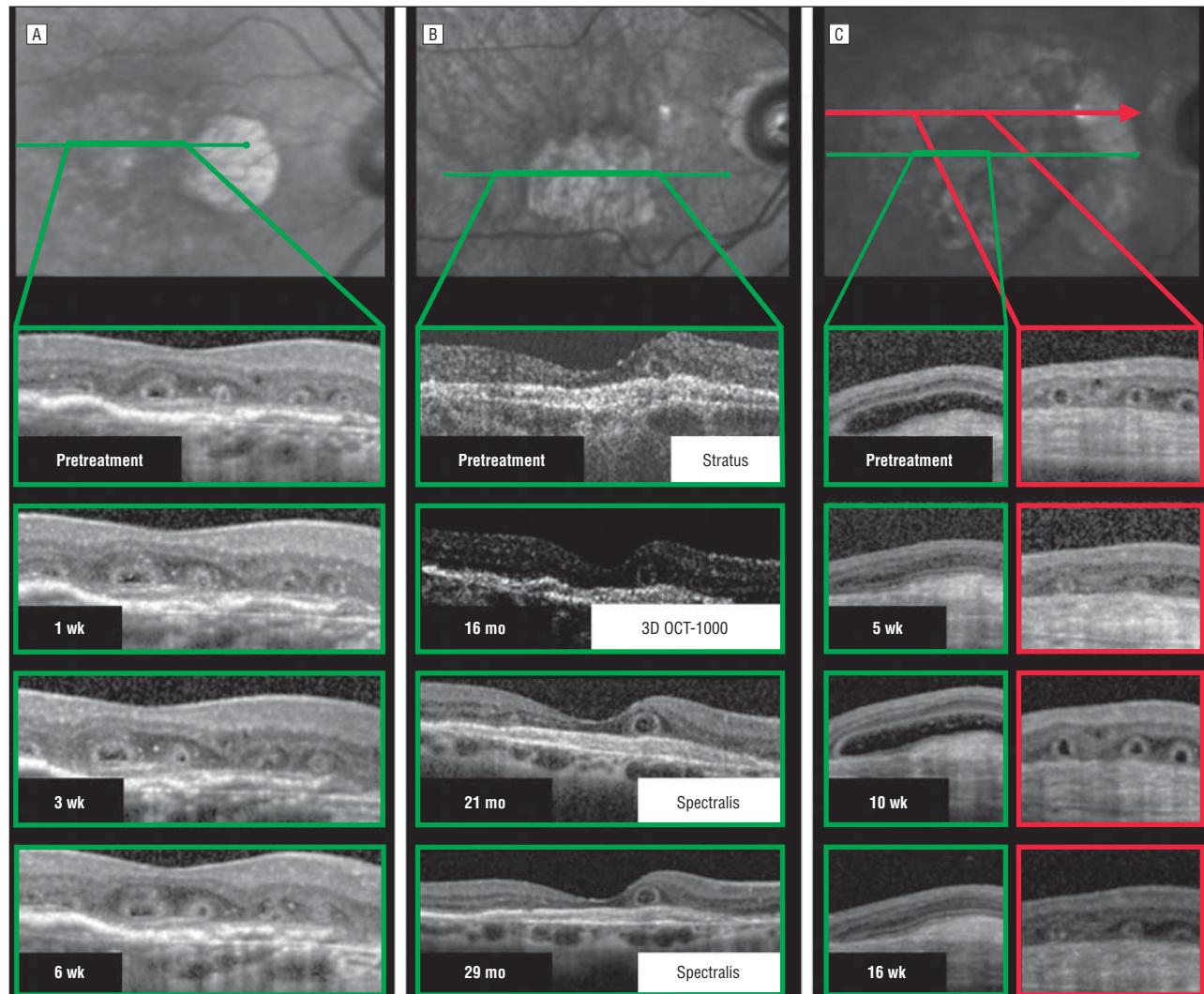


Outer Retinal Tubulation

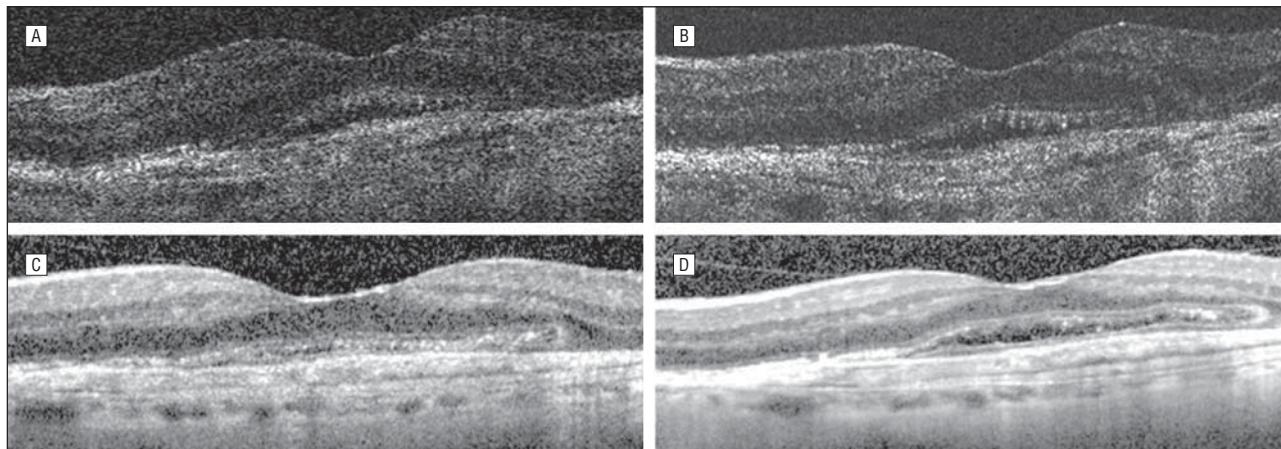
A Novel Optical Coherence Tomography Finding

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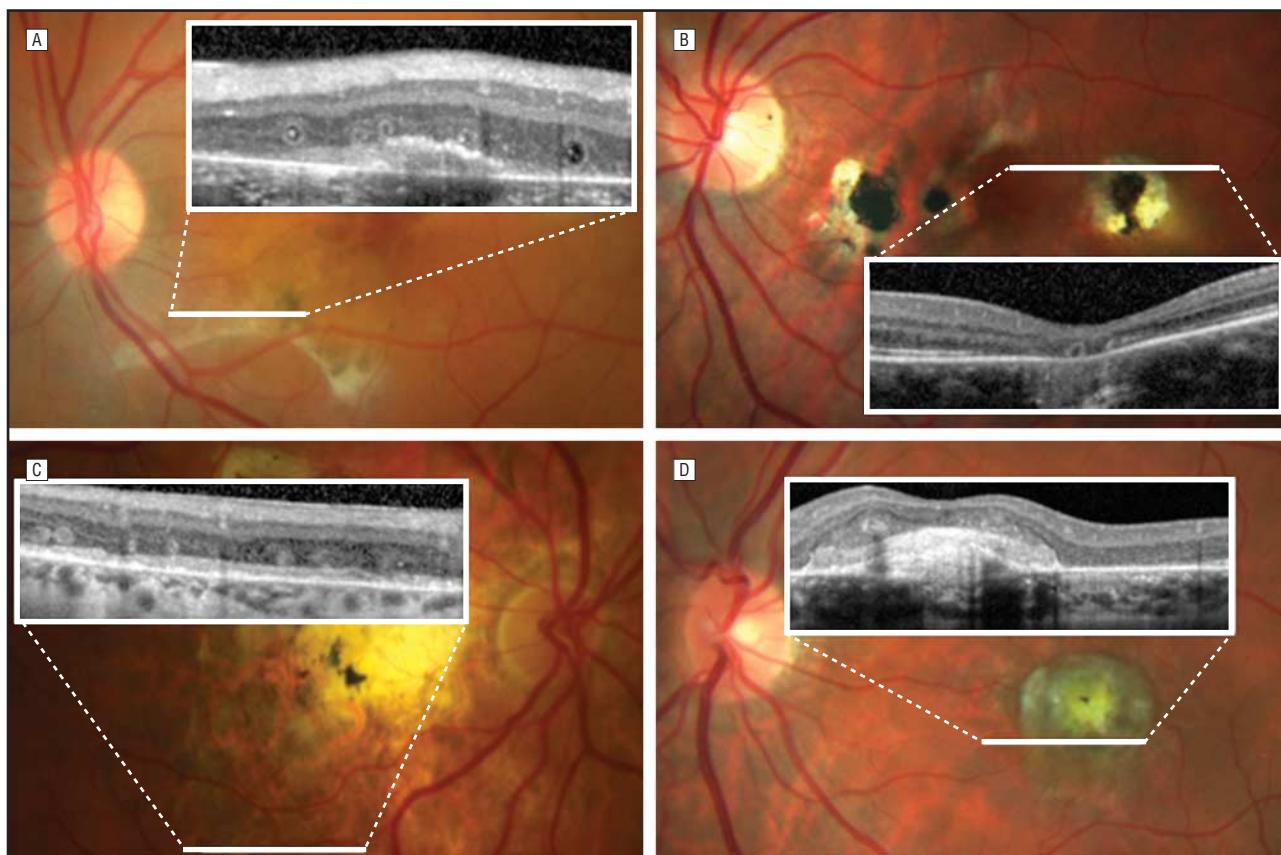
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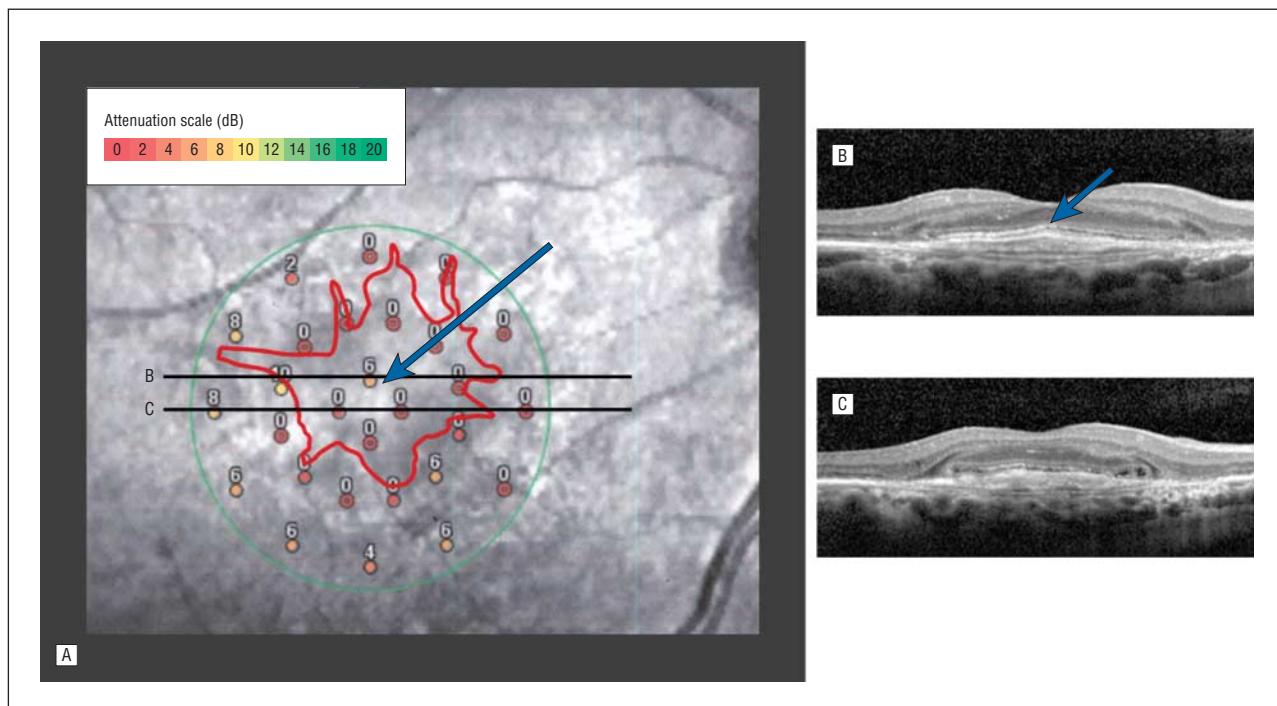
eFigure 1. Scanning laser ophthalmoscopy (SLO) and optical coherence tomography (OCT) images in 3 patients with neovascular age-related macular degeneration (AMD). A, An SLO image (top) and corresponding spectral-domain OCT (SD-OCT) B-scan sections in an 87-year-old woman with neovascular AMD. The tubular structures were overlying an elevated area of hyperreflectivity representing subretinal fibrosis related to the neovascular process. The patient underwent imaging immediately before an intravitreal injection of ranibizumab (pretreatment OCT image) and again at 1, 3, and 6 weeks after the injection. There was minimal change in the size and shape of the tubules at each point after treatment. Visual acuity was 20/60 before treatment and remained stable at each subsequent point. All OCT images were captured with Heidelberg retinal angiography with OCT (Spectralis HRA + OCT). B, Long-term follow-up (29 months) of an 87-year-old woman with neovascular AMD and outer retinal tubulation (ORT) captured with multiple OCT devices, including a time-domain OCT device (Stratus OCT) and 2 spectral-domain OCT devices (Topcon 3D OCT-1000 and Spectralis HRA + OCT). The tubular structures remained stable during the follow-up period despite multiple intravitreal injections of ranibizumab and bevacizumab. Visual acuity remained stable at 20/60 during the follow-up period. C, An SLO image (top) of an 87-year-old woman with neovascular AMD; the image was obtained using the Heidelberg retinal angiography with OCT device. The SD-OCT B-scan sections (bottom images) were captured through cavitary (green) and tubular (red) ORT structures (top OCT image). Five weeks after an intravitreal injection of ranibizumab, there was a transient collapse of the ORT structures, with a return to the pretreatment status 10 weeks after the injection. After a subsequent injection of ranibizumab at 16 weeks, the ORT structures collapsed again. The temporary collapse of the ORT structures was not associated with visual improvement.



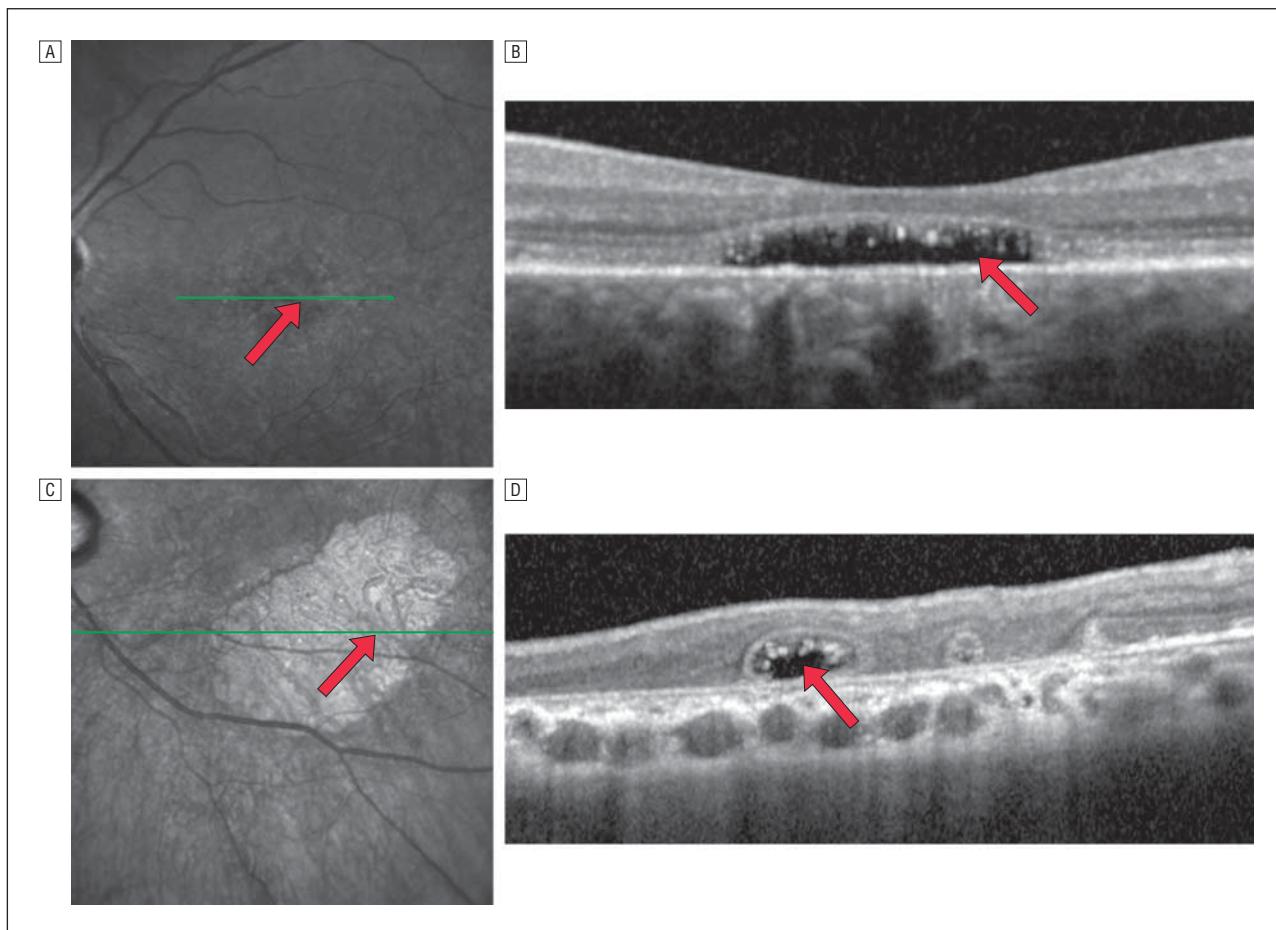
eFigure 2. High-resolution ocular coherence tomography (OCT) is used to distinguish outer retinal tubulation from subretinal fluid. Horizontal OCT B-scan images of the left eye of a 78-year-old woman with neovascular age-related macular degeneration (the same eye as described in case 3 [Figure 2 in the companion article]) at increasing resolutions shows a low-resolution image (512 A-scans) (A) and a high-resolution image (4096 A-scans) (B) on a high-definition OCT device (Cirrus HD-OCT). By using a Heidelberg retinal angiography with OCT device (Spectralis HRA + OCT), 12 B-scans were averaged, 1024 A-scans/B-scan (C), and 96 B-scans were averaged, 1024 A-scans/B-scan (D).



eFigure 3. Outer retinal tubulation (ORT) in non-age-related macular degeneration entities with choroidal neovascularization (CNV) or subretinal fibrosis. A, Color fundus photograph of the left eye of a 39-year-old woman with idiopathic thrombocytopenic purpura and central serous chorioretinopathy related to long-term corticosteroid use (case 8 in the companion article). The image shows widespread damage to the retinal pigment epithelium, including fibrous metaplasia. A spectral-domain ocular coherence tomography (SD-OCT) B-scan section (white line and inset) over an area of subretinal fibrosis reveals multiple distinct ORT structures. Visual acuity was 20/20. B, Color fundus photograph and corresponding SD-OCT B-scan section (white line and inset) of a 38-year-old woman with a history of multifocal choroiditis and panuveitis complicated by CNV (case 9 in the companion article) treated 2 years previously with verteporfin photodynamic therapy and oral corticosteroids. Visual acuity was 20/25. On a single SD-OCT B-scan section (inset), an ORT structure was detected overlying the superior edge of a chorioretinal scar. A zone of absent photoreceptors surrounds the tubular structure with overlying atrophy of the remaining retinal layers. C, Color fundus photograph and corresponding SD-OCT B-scan section (white line and inset) show the right eye of a 60-year-old woman with a history of CNV secondary to pseudoxanthoma elasticum and angiod streaks (case 10 in the companion article). She previously underwent thermal laser treatment followed by verteporfin photodynamic therapy in combination with intravitreal triamcinolone acetonide treatment. Visual acuity was 20/200. The SD-OCT B-scan section (inset) shows multiple small, isolated tubular structures overlying the inferior edge of the fibrotic lesion in areas where there are focal disruptions of the inner and outer segment junction. D, Color fundus photograph and corresponding SD-OCT B-scan image (white line and inset) of the left eye in a 35-year-old man with a tissue inhibitor of metalloproteinase-3 negative pattern dystrophy complicated by secondary CNV (case 11 in the companion article). Multiple SD-OCT B-scan sections demonstrated 2 distinct vertically orientated ORT structures overlying subretinal fibrosis (inset). Visual acuity was 20/200.



eFigure 4. Microperimetry in outer retinal tubulation (ORT). A, Microperimetry was overlaid onto a near-infrared scanning laser ophthalmoscopy image of a 78-year-old woman with neovascular age-related macular degeneration (case 12 in the companion article). The patient had received 18 intravitreal injections of ranibizumab at intervals of approximately every 7 weeks in her right eye. Visual acuity was 20/100. The border of the tubular cavity is outlined red. B and C, Two B-scan sections through the cavity (black lines in A). Microperimetry demonstrated that there was limited preservation of visual function overlying a small portion of the ORT structure in B (blue arrow).



eFigure 5. Outer retinal tubulation (ORT) originating from the photoreceptor layer. A and B, Spectral-domain optical coherence tomography in a 40-year-old man with cone dystrophy shows malformed and degenerating photoreceptor outer segments (red arrows). C and D, Hyperreflective material seen within the lumen of ORT (red arrows) of a 67-year-old woman with an unknown retinal degeneration (case 5 in the companion article). The hyperreflective material resembles the photoreceptor outer segments shown in A and B. The horizontal green lines in A and C indicate the location of the B-scan. Autofluorescence images from this patient are shown in Figure 3C and D.