SHORT COMMUNICATIONS & CASE REPORTS

Three-dimensional imaging of an optic disk pit using high resolution optical coherence tomography

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Purpose. *To clarify the origin of the coexisting fluid in an optic disc pit case by using optical coherence tomography (OCT).*
Methods. *High resolution OCT (Cirrus™ prototype, Carl Zeiss Meditec) was used for image acquisition; three dimensional segmentation was performed using Food and Drug Administration–approved imaging software (3D-Doctor V4.0, Able software Corp., Lexington, MA) to demonstrate the structural changes of the optic nerve head and the retina.*
Results. *Using high resolution OCT, the authors demonstrated that this case of optic pit had a possible connection between the subretinal and the intraretinal space.*
Conclusions. *The authors assume that the intraretinal space is progressively filled with subarachnoidal fluid, leading to a tearing force within the outer neurosensory layers. A connection between the outer nuclear layer and the subretinal space may lead to a serous retinal detachment as a secondary event. Vision loss could consecutively be induced by a serous retinal detachment. High resolution OCT technology is able to visualize discrete changes of the microarchitecture of the optic nerve as well as the retina when combined with appropriate imaging software. (Eur J Ophthalmol 2009; 19: 321-3)*

Key Words. *High resolution, Optical coherence tomography, Optic pit*

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INTRODUCTION

Optic disk pits are congenital abnormalities of the optic nerve head first described by Wiethe (1). This condition is associated with a serous retinal detachment often extending into the macular region. Recent optical coherence tomography (OCT) studies suggest a connection between the retina and the subarachnoidal space at the site of the optic nerve head (2-4). According to these studies, fluid from the optic nerve channel may enter the sensory retina, creating a schisis-like separation of the retinal layers. Consecutively, retinal detachment is considered as a secondary change. Vitreous traction may also have an additional role in the pathogenesis of the retinal elevation (5) which has recently been documented by additional OCT evidence (6, 7).

Case report

A 71-year-old woman presented with a best-corrected visual acuity (BCVA) of 20/20 in both eyes. The patient reported neither metamorphopsia nor central scotoma. Dilated fundus examination revealed the typical appearance of an optic nerve head pit in the left eye with a shallow retinal detachment not reaching the fovea. Fundus photography (FF 450 plus, Carl Zeiss Meditec), fluorescein angiography (FA, HRA2™, Heidelberg Engineering), and OCT (StratusOCT™, Carl Zeiss Meditec) were performed to document the presumed diagnosis. A second generation frequency domain high resolution OCT (HR-OCT, Cirrus OCT™ prototype, Carl Zeiss Meditec) was used for specific analysis of alterations in the retinal microstructure. Therefore two scans (512 x 128 x 1024/3 x 1024 x

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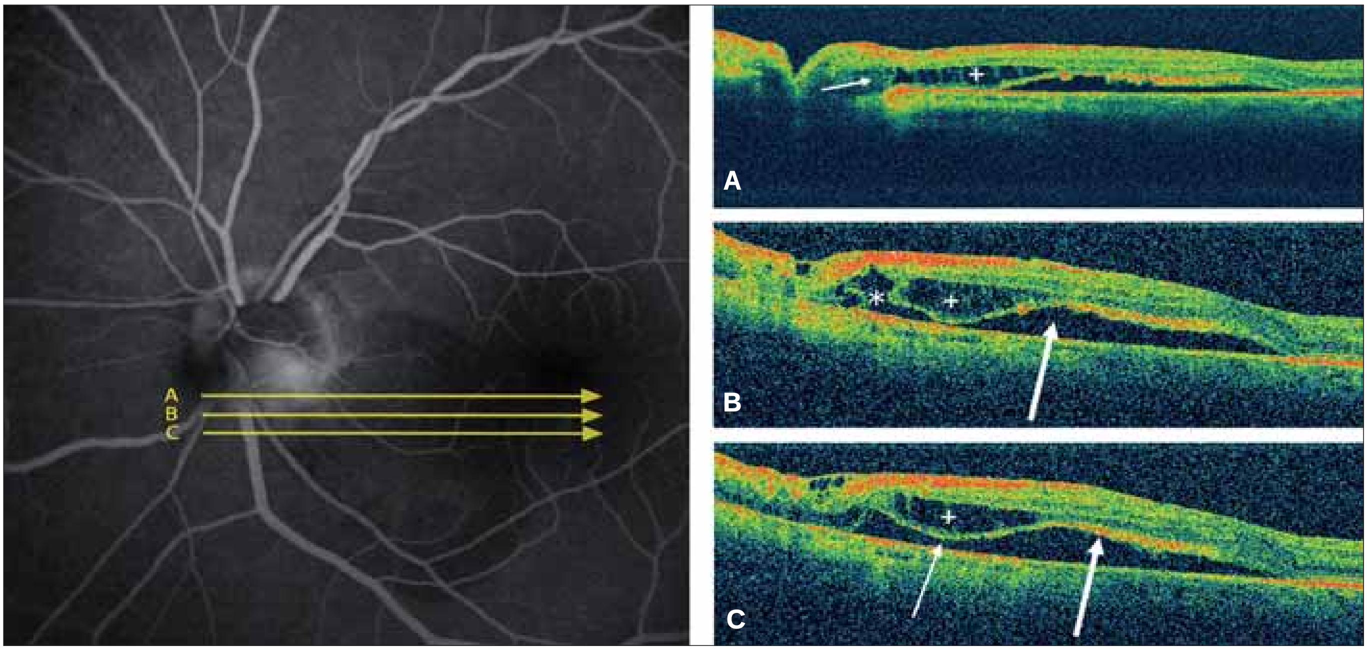

Fig. 1 - Left: *Late-phase fluorescein angiogram of the optic pit and the adjacent serous detachment. Yellow arrows indicate the scan locations from* **A, B,** *and* **C,** *respectively.* **Right:** *High resolution optical coherence tomography images indicating the possible communicating locations between the fluid spaces. The white arrow in* **A** *shows the suspected location of the fluid filtration between the perineural subarachnoid space and the retina. The white asterisk in* **B** *corresponds to the tail of the subretinal fluid space shown in* **B,** *where the two distinct fluid spaces become one. Compartments marked with plus in* **A, B,** *and* **C** *are part of the schisis space. The white arrows in* **B** *and* **C** *show where the fluid goes under the neurosensory layers (subretinal space).*

4096) with an axial resolution of 6 mm were taken following a standardized scanning protocol.

At the patient's second visit 1 month later, BCVA had dropped to 20/125.

Subretinal fluid had reached the fovea, observed with biomicroscopy. All examinations were repeated as described above to document disease progression (Fig. 1).

Two separate fluid-filled spaces could be marked in manual segmentation analysis of consecutive HR-OCT tomograms contained in one macular scan: cystoid spaces intraretinally within the outer nuclear layer and subretinal fluid underneath the outer photoreceptor elements. A three-dimensional reconstruction of the pit and the communicating locations could be created to provide precise insights into topographic relations within the relevant structures (Fig. 2).

No free communication could be detected between the perineural subarachnoid space and the intraretinal space but filtration can strongly be suspected between them (Fig. 1A: white arrow). This type of communication could also be identified in 3D reconstructions of HR-OCT scans which showed a schisis of the retinal layers and a sensory retinal detachment in the two-dimensional images. The possible location of the communicating channel could clearly be localized in Figure 1B (asterisk). This location and the mild and slow leakage can also be seen on the corresponding FA image (Fig. 1, left), which supports the above statement.

Figure 1, B and C, shows the separation of the neurosensory layers. Photoreceptor layers were absent in those locations.

DISCUSSION

Three-dimensional segmentation using Food and Drug Administration–approved imaging software (3D-Doctor V4.0, Able Software Corp., Lexington, MA) demonstrated that this case of optic pit had a possible connection between the subretinal and the intraretinal space. We assume that this space is slowly and progressively filled with subarachnoidal fluid, leading to a tearing force within the outer neurosensory layers. A connection between the outer nuclear layer and the subretinal space may lead to a serous retinal detachment as a secondary event. Vision loss could consecutively be induced by a serous retinal detachment. Notably, no signs of vitreous traction could

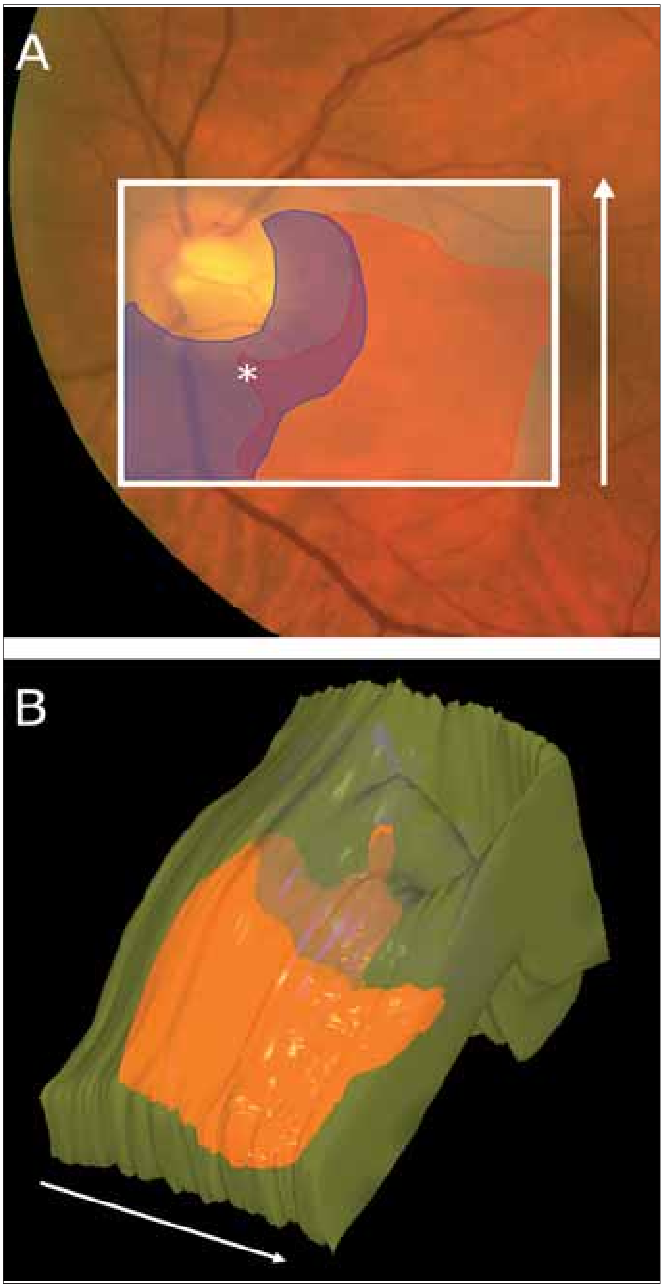

Fig. 2 - *Three-dimensional reconstruction of the region. The semitransparent white box in* **A** *corresponds to the anatomic region taken for reconstruction in* **B***. The white arrow indicates the orientation of the reconstructed block (the block was rotated clockwise to the left for better visualization). The schematic drawing in* **A** *shows top view of the reconstructed fluid spaces described below. The yellow coloring in* **B** *corresponds to the retinal surface showing the three-dimensional architecture of the optic nerve head region. Fluid spaces are shown in color: the schisis space is depicted in semitransparent blue; the subretinal space is represented in orange. The thin tail of the subretinal space extends into the schisis space, indicating a possible location where the two fluid spaces become one (exact location can be seen in* **B** *and* **A***: white asterisk).*

be identified in this case.

High resolution OCT technology is able to visualize discrete changes of the microarchitecture of the optic nerve as well as the retina when combined with appropriate imaging software. Analysis of an entire macular scan, containing 128 parallel tomograms, allows for a realistic 3D reconstruction of morphologic changes and topographic relations. Thus, combination of HR-OCT with innovative software analysis might be useful to clarify pathogenesis in some chorioretinal diseases in the future.

None of the authors has a financial or proprietary interest in any material or method mentioned in this article.

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