Review paper

Optical coherence tomography in the diagnosis of optic disc pit maculopathy – a review of literature

Optyczna koherentna tomografia w diagnostyce dołka rozwojowego nerwu wzrokowego – przegląd piśmiennictwa

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Słowa kluczowe: optyczna koherentna tomografia, dołek rozwojowy tarczy nerwu wzrokowego, wysiękowe odwarstwienie siatkówki centralnej, angiografia fluoresceinowa.

Abstract

An optic disc pit (ODP) is a congenital anomaly of the optic disc. This disorder may cause no symptoms and be diagnosed incidentally. However, in 25–50% of cases, it is accompanied by maculopathy causing a permanent reduction in visual acuity. Optical coherence tomography is a non-invasive technique that allows detailed diagnosis and monitoring the progression of the pathology mentioned above. In ODP complicated by maculopathy, OCT visualises exudative macular detachment with the dissection of the inner retinal layers followed by detachment of the outer retinal layers. It can also reveal complications such as full-thickness macular hole and subretinal haemorrhage, which also reduce visual acuity in patients with ODP.

Streszczenie

Dołek rozwojowy jest wrodzoną anomalią tarczy nerwu wzrokowego, która może być przypadkowo wykryta w badaniu okulistycznym i przebiegać w sposób bezobjawowy. W 20–50% przypadków może być on powikłany zaburzeniami w obszarze plamki żółtej powodującymi trwałe obniżenie ostrości wzroku. Optyczna koherentna tomografia (OCT) jest nieinwazyjnym narzędziem pozwalającym na szczegółową diagnostykę oraz monitorowanie progresji choroby. W przebiegu powikłań dołka rozwojowego tarczy nerwu wzrokowego można zaobserwować wysiękowe odwarstwienie siatkówki w obszarze plamki żółtej z rozwarstwieniem wewnętrznych warstw siatkówki, po którym następuje rozwarstwienie zewnętrznych warstw. Ponadto za pomocą OCT można szczegółowo ocenić inne powikłania dołka rozwojowego istotnie obniżające ostrość wzroku, jakimi są otwór pełnościenny plamki lub krwotok podsiatkówkowy.

Introduction

An optic disc pit (ODP) was described first by Wiethe in 1882 [1]. The incidence of this pathology is 1 in 11,000 patients [2]. It occurs mainly on the temporal side of the optic disc, bilaterally in 10–15% of cases [3]. Only 20% of patients have a good prognosis for visual acuity, and this is true for those without abnormalities in the macular region [4]. In the remaining patients, visual acuity deteriorates due to accompanying central serous retinopathy, macular oedema, macular cyst, macular hole, macular haemorrhage, or progressive loss of the nerve fibre layer [4–6]. The macular abnormalities associated with ODP usually appear between the ages of 21 and 30 years [5].

Optic disc pit maculopathy

ODP has the appearance of a greyish, oval, or round depression of the optic disc of varying size

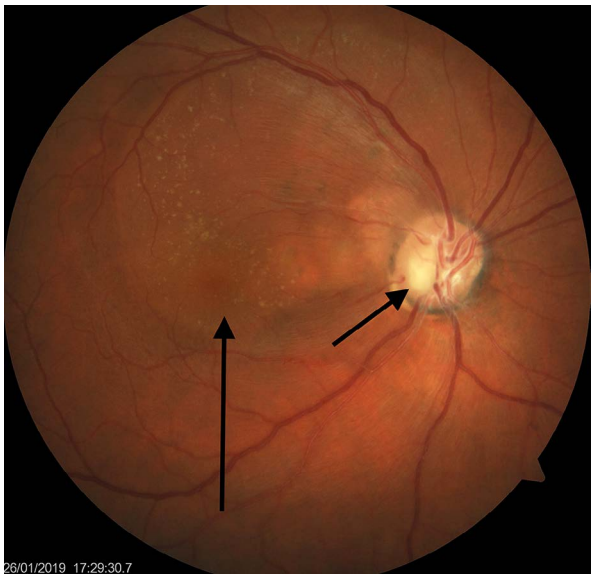

Figure 1. The fundus of the right eye with ODPM. The short, black arrow shows the optic disc pit, and the long, black arrow shows ODPM

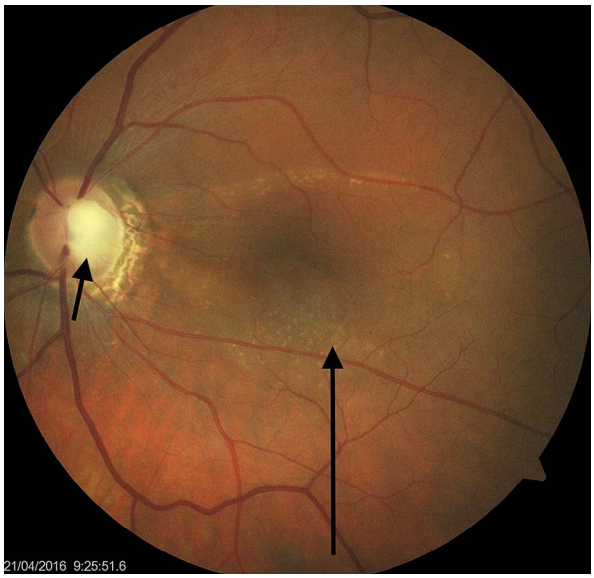

Figure 2. The fundus of the left eye with ODPM. The short, black arrow shows ODP, and the long, black arrow shows ODPM

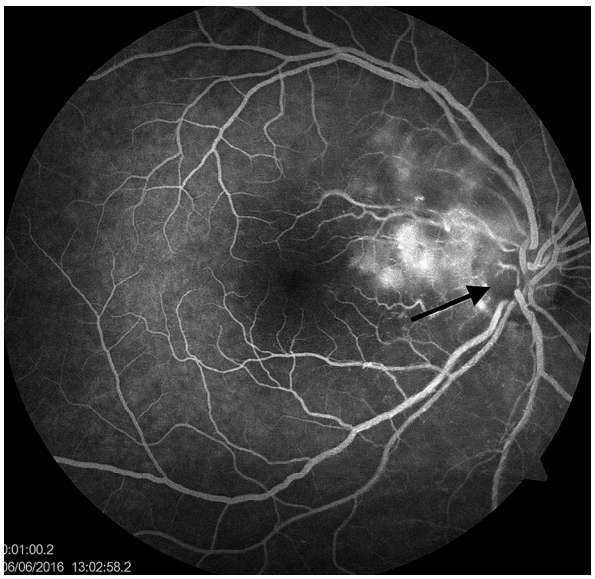

Figure 3. The FA of the right eye with ODPM. The black arrow shows the optic disc pit during the early phase of FA

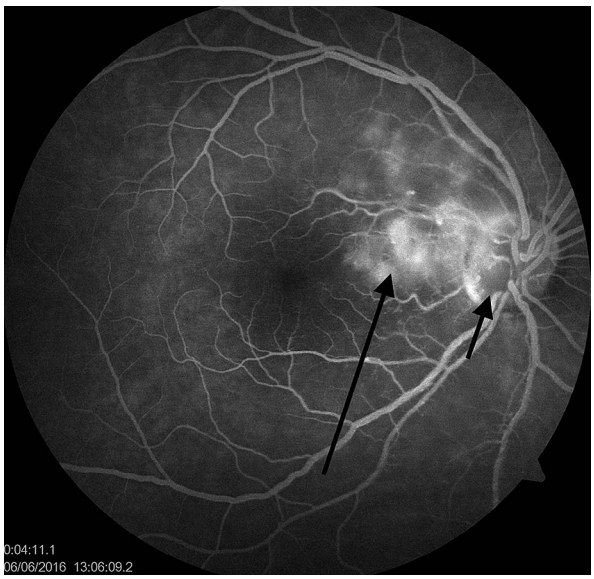

Figure 4. The FA of the right eye with ODPM. The short, black arrow shows the optic disc pit, and the long, black arrow shows ODPM during the late phase of FA

Figures 1, 2 [7–9]. It usually occurs in the temporal part of the optic disc, although sometimes it may be located centrally or nasally. ODP can be multiple and bilateral. Vitreous traction has been reported to cause the macular retinoschisis and foveal detachments following ODP. This condition is called optic disc pit maculopathy (ODPM) [7, 8, 10, 11]. Optical coherence tomography (OCT) and fluorescein angiography (FA) are useful tools in the diagnosis of ODPM. FA visualizes hyperfluorescence in the area of maculopathy increasing in time (Figures 3–6).

OCT is a non-invasive technique for obtaining cross-sections of the retina, choroid, and optic disc. The high-resolution images obtained are comparable to histological images *in vivo*. The new generation swept-source optical coherence tomography (SS-OCT) has an imaging depth of 2.6 mm allowing detailed examination of the choroid and sclera [12]. SS-OCT shows that the precortical vitreous cortex is connected to the bottom of the optic disc pit (Figure 7). Macular schisis and subretinal fluid can be detected in macular SD-OCT (Figures 8, 9). The lamina cribrosa

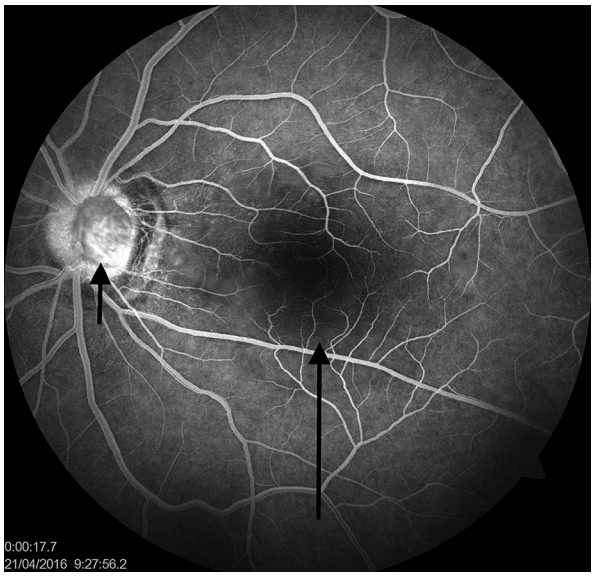

Figure 5. The FA of the left eye with ODPM. The short, black arrow shows OPP, and the long, black arrow shows ODPM during the early phase of FA

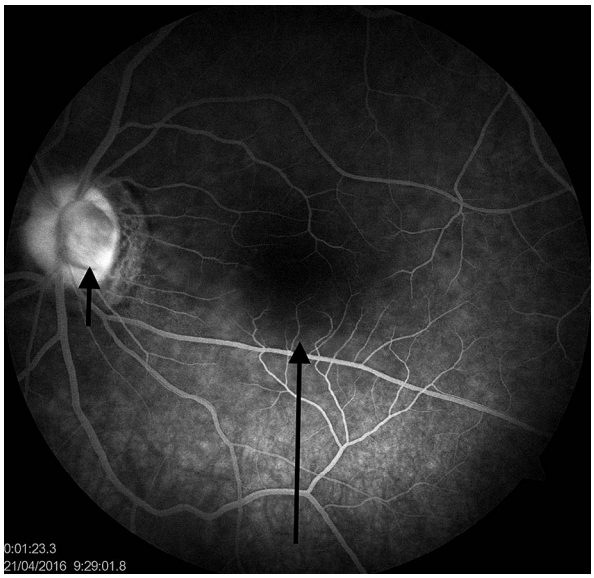

Figure 6. The FA of left eye with ODPM. The short, black arrow shows ODP, and the long, black arrow shows ODPM during the late phase of FA

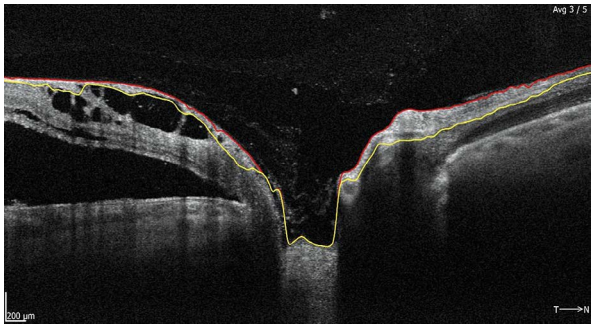

Figure 7. The SS-OCT image of the optic disc with ODPM

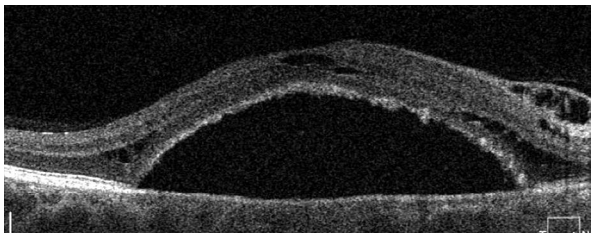

Figure 8. The SS-OCT image of the right eye with ODPM

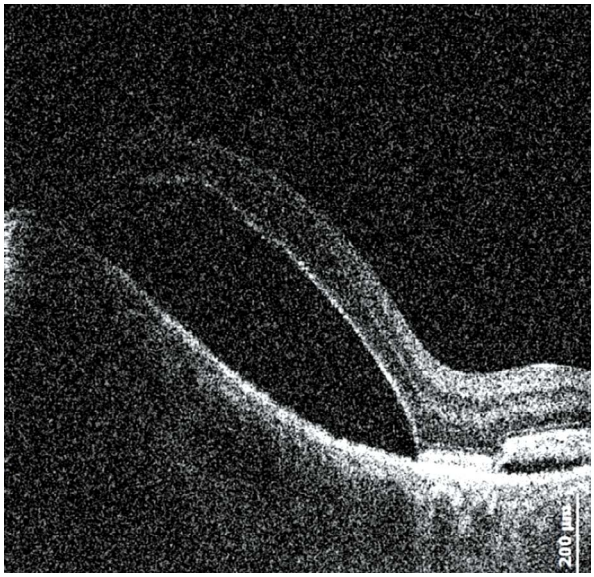

Figure 9. The SD-OCT image of the eye with ODPM

and retrolaminar optic nerve fibres are shifted toward the opposite side of the pit, and the retinal nerve tissue is herniated into the pit. Vitreous fibres continue into the pit along the pit wall. SS-OCT can also visualize the subarachnoid space immediately posterior to the tissue lining the bottom of the excavation in the eyes with ODP [13]. Katome *et al*. described the case of an optic disc pit with a connection between the vitreous cavity and the retrobulbar subarachnoid space in SS-OCT images [14].

Michalewski *et al*. observed a membrane in the bottom of an ODP in spectral-domain OCT (SD-OCT). In histopathologic studies, the "inner limiting membrane of Elschnig" (a continuation of internal limiting membrane over the optic disc) was found on top of the optic disc in ODPM. This membrane consists of residual retinal tissue, abnormal nerve fibres, and retinal pigment epithelium-like tissue [15]. Doyle *et al*. described the membrane traversing the optic disc cup consisting of neuroectodermal and astroglial tissue, which can cre-

ate a barrier to the passage of fluid into or under the retina [16]. Michalewski *et al*. observed hyperreflective tissue in a few patients in the excavation of the optic disc in SD-OCT images. It could be either condensed vitreous or glial tissue [15]. Akiba *et al*. observed a condensed vitreous strand (Cloquet's canal) extending from the surface of the pit into the vitreous gel. Cloquet's canal pulsates with eye movements, forming multiple microforamina in the membrane covering the optic pit. The liquefied vitreous probably enters the subretinal space through the optic pit [17]. Some authors consider that the glial tissue may contribute to fovea detachment [18, 19]. Michalewski *et al*. revealed hyporeflective areas at the bottom of the optic disc in SD-OCT. They suspected that these spaces represent an additional allocation of the perineural fluid, which did not pass to the intraretinal or subretinal space. It is possible that this is fluid located below Elschnig's membrane [15].

Many authors confirmed the role of cerebrospinal fluid that enters the subretinal and intraretinal space [3, 20, 21]. Chang found that the contrast dye can pass from the subarachnoid space into the subretinal fluid in patients with morning glory syndrome, which is another manifestation of ODP [21]. Kuhn *et al*. described a patient with silicon oil migration in the eye with ODP in MRI images [22]. Michalewski *et al*. confirmed also with SD-OCT the role of cerebrospinal fluid and vitreous in the origin of ODPM. They considered a 3-fold connection between the vitreous, perineural space, and subretinal and intraretinal space. These authors observed the presence of fluid only in outer retinal layers, both in the outer and inner retinal layers, in the form of an outer lamellar macular hole, or only subretinal, based on the OCT [15].

Some authors believe that ODPM is a primary process, while others believe that it is associated with posterior haloid detachment. Some researchers consider that the posterior haloid remains attached in the majority of eyes, and macular detachment is the primary process coexisting with ODP [17, 23], while other authors believe that detachment of the outer retinal layers from the retinal pigment epithelium exists without communication with the optic disc [24, 25].

Pars plana vitrectomy is recommended in the treatment of ODPM with the creation of posterior vitreous detachment and gas tamponade with or without laser photocoagulation [26–29].

Conclusions

OCT has improved the diagnosis of the anterior segment, retina, choroid, and the optic nerve in a non-invasive manner for the last 2 decades. The high-resolution images are comparable to the *in vivo* histological cross-sectional images observed *in vivo*. OCT can visualise various types of multiple layer schisis and outer layer detachment accompanying optic disc pit. Further analysis by SS-OCT for congenital optic disc anomalies can help in the proper qualification of these pathologies for surgical treatment.

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Conflict of interest

The authors declare no conflict of interest.

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