OCT of the Posterior Segment

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Indication for preoperative posterior segment OCT

While preoperative posterior segment OCT is not an essential examination before every cataract procedure, it can be useful to supplement clinical fundoscopy for several reasons. First, the exclusion or diagnosis of a macular pathology can help to gauge postoperative outcomes after cataract surgery. Second, diseases that require therapy before cataract surgery itself (e.g. neovascular AMD) can be identified, and special precautions or therapeutic strategies for the postoperative period can be recommended (e.g., to prevent cystoid macular edema in diabetic patients). Finally, the exclusion of macular pathologies on OCT is absolutely essential prior to the implantation of "premium" IOLs (multifocal, EDOF) to exclude a macular pathology as any significant macular pathology is a contraindication to such implants [1].

Author's recommendation

For many patients, preoperative screening for maculopathy using OCT is very useful, particularly when considering a multifocal IOL.

Practical aspects of posterior segment OCT

While pharmacological mydriasis is not necessary for a good macular OCT image, the quality of the image may decrease in miosis as the crystalline lens becomes cloudier. OCT devices are offered by a variety of different manufacturers, and each comes with its own proprietary software. In all devices, macular scan patterns can

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be adjusted manually. A quick and practical line scan where only a horizontal section ("B-scan") is acquired through the fovea stands opposed to a full volume scan where additional macular sections are acquired above and below the line scan (e.g., a total of 49 sections (=B-scans) at a distance of 5.3 μm each over an area of 20° × 20 centered on the fovea). Although the line scan, often printed out or exported as a PDF into electronic health records is quick and easy to export, macular pathologies can easily be overlooked if they lie extrafoveally (but are likely to spread to the fovea in the next few years). Therefore, macular volume scans are suggested over single line scans.

Author's recommendation

Volume scans with several retinal sections across the entire macula are superior to line scans (a single section through the fovea) when screening for maculopathies.

Overview of the main pathologies

Age-related macular degeneration

Since both cataract and age-related macular degeneration (AMD) increase in incidence with age, preoperative OCT screening is an important part of the surgical planning. This is especially true when a patient has a positive family history or when the fundus is abnormal. AMD can manifest itself as an early form (drusen > 63 − 125 μm), intermediate form (drusen > 125 μm or pigment epithelial changes) or late form (neovascular AMD, geographic atrophy) [2].

Diagnosis may be obvious in the presence of classic foveal "soft" drusen which can also be seen on routine fundoscopy (Fig. 1 upper picture). However, the diagnosis is more complicated in patients with reticular pseudodrusen (Fig. 1 lower picture), which present as small, sharply defined lesions located in the subretinal layers. Reticular pseudodrusen are usually extrafoveal and can therefore be overlooked on a simple line scan. They are more conspicuous in the associated infrared or autofluorescence image, or in macular volume scans with multiple B-scans (Fig. 2). Despite their often-inconspicuous clinical appearance, reticular pseudodrusen represent a serious dysfunction of the choriocapillaris and a predisposing factor for retinal angiomatous proliferation (RAP), geographic atrophy and deposition of pseudovitelliform material (Fig. 2 lower picture). When considering patients for a multifocal IOL, reticular pseudodrusen in particular (and of course soft drusen) should therefore be carefully excluded. An assessment of the partner eye should never be omitted, especially with regard to possible signs of AMD.

Patients with neovascular AMD (Fig. 3) should first receive an intravitreal therapy with anti-vascular endothelial growth factor (VEGF) inhibitors prior to cataract surgery. The aim should be to establish a "dry" interval before reliable biometry and safe surgery can be performed. Patients with geographic atrophy should be informed about their reduced visual prognosis. A large number of studies however have shown that AMD patients of all stages (including late forms) benefit significantly from cataract surgery so it should not be considered a contraindication to surgery [3].

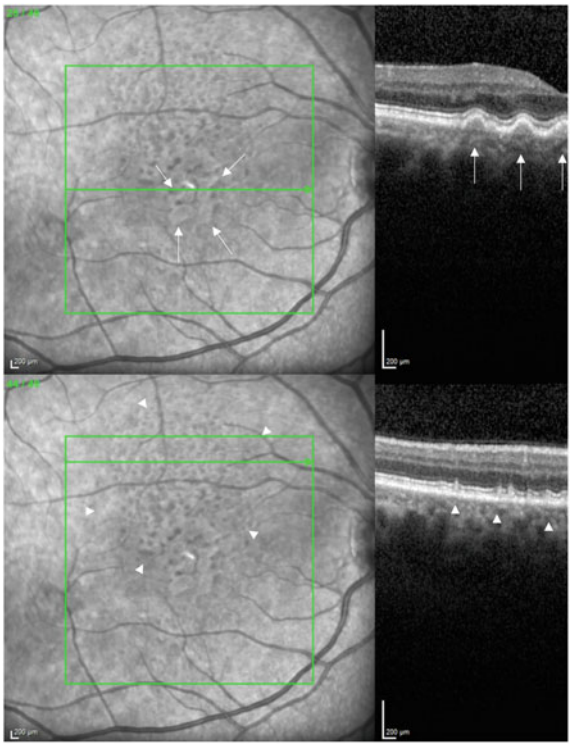

Fig. 1 Age-related macular degeneration (AMD). Drusen are the hallmark of AMD, which can present as soft drusen (upper picture, marked by arrows) or reticular pseudodrusen (lower picture, marked by arrowheads; also called: subretinal drusenoid deposits). The latter can often be overlooked on funduscopy and single-line scans of the fovea since they are often located extrafoveally. Near-infrared confocal scanning laser ophthalmoscopy will aid with detection

Author's recommendation

A normal foveal line scan does not rule out AMD - reticular pseudodrusen are often located extrafoveally and indicate a risk for more severe macular pathology in the future. a (GA, RAP).

Diabetic macular edema

Diabetic macular edema (DME) is seen as focal or diffuse thickening of the central retina, often with large intraretinal cystoid cavities (Fig. 4) and/or subretinal fluid. Hyperreflective foci (white intraretinal dots) indicate that the edema is more likely chronic. The treatment of DME with intravitreal anti-VEGF inhibitors or corticosteroids is recommended to achieve reliable biometry and perform safe surgery. In the case of anti-VEGF therapy, surgery can be performed between two injections (e.g., 2 weeks after the last injection), often augmented with an intraoperative application of steroids and postoperative prescription of NSAID eye drops, as the risk of DME relapse or Irvine-Gass syndrome is significantly increased [5]. Surgery under "steroid protection" has also proven to be a successful approach, where dexamethasone is administered as a three-month intravitreal implant and cataract

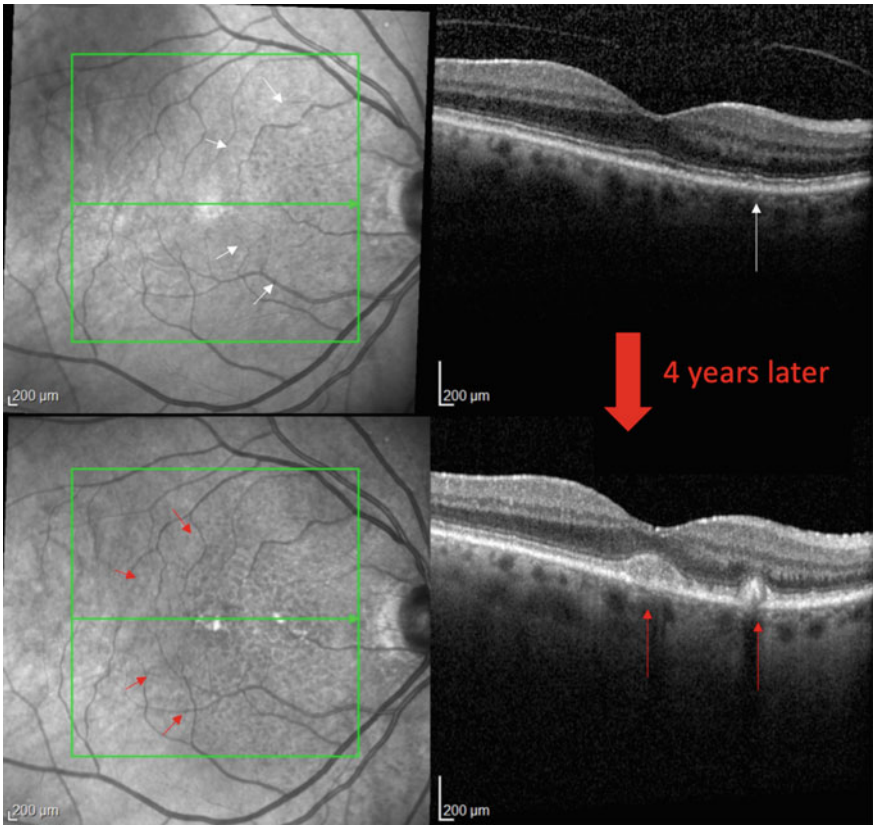

Fig. 2 Age-related macular degeneration (AMD) with reticular pseudodrusen. Reticular pseudodrusen can be easily overlooked on macular line scans (white arrow). Over time, subretinal pseudo-vitelliform material can develop (lower picture four years later). In such cases of maculopathy, the implantation of multifocal IOLs is not recommended

surgery is performed after 6 weeks, after which edema prophylaxis is provided for another 6 weeks by the steroid implant.

Retinal vein occlusion

Retinal vein occlusion can manifest as central retinal vein occlusion, hemi-central retinal vein occlusion or branch retinal vein occlusion. For the cataract surgeon they usually become problematic when associated with cystoid macular edema (Fig. 5). Intraretinal fluid may also be accompanied by subretinal exudation [6]. As with DME, anti-VEGF or steroid therapy is required intravitreally before cataract surgery can be performed. In these cases too, surgery during the interval between anti-VEGF injections or under steroid protection may be appropriate. The addition of intraoperative steroids can be beneficial in preventing a worsening of the CME postoperatively.

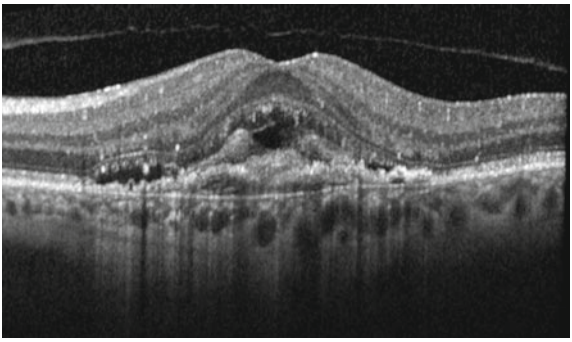

Fig. 3 Neovascular age-related macular degeneration. Pigment epithelium detachment and subretinal hyperreflective material (dense white matter subfoveally) are highly suggestive of choroidal neovascularization. Angiography (OCT or dynamic fluorescein) and subsequent timely anti-VEGF therapy is recommended before cataract surgery

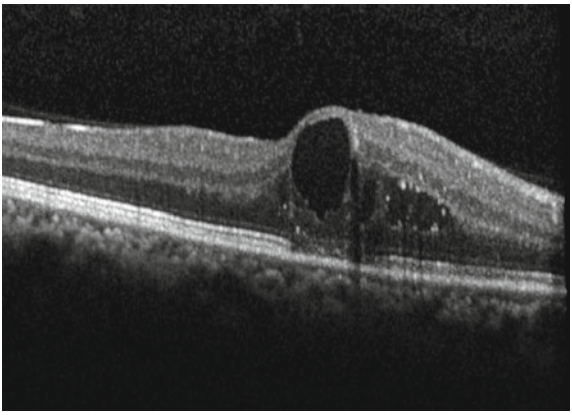

Fig. 4 Diabetic macular edema with center involvement (giant cyst) and smaller intraretinal cysts. Note the hyperreflective dots in the nasal aspect of the macula

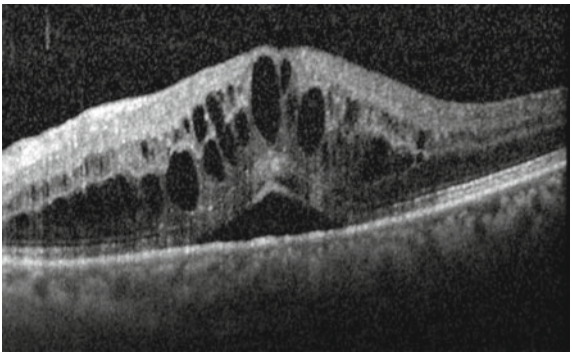

Fig. 5 Macular edema secondary to retinal vein occlusion. Note the intraretinal and subretinal fluid

Pachychoroid maculopathies (including central serous chorioretinopathy).

Pachychoroid (pachy meaning thick) maculopathies are retinochoroidal pathologies characterized by a thickened, congested choroid. Central serous chorioretinopathy (CSC) is the most widely recognized representative of the pachychoroid spectrum and is defined by the presence of subretinal fluid (stage 2; Fig. 6; thickened choroid marked with a white arrow). Pachychoroid pigment epitheliopathy (PPE) is a preliminary stage, in which only RPE defects without subretinal fluid occur (stage 1). If choroidal neovascularisation (CNV) forms secondary to CSC (approx. 25–39%), this is called pachychoroid neovasculopathy (PNV; stage 3). If aneurysms form within the CNV, pachychoroid aneurysmal type 1 CNV (PAT1; former/also polypoidal choroidal vasculopathy (PCV), stage 4) occurs. In many patients, these stages progress over time though they can also regress under therapy. A classification system has recently been suggested to describe the various pachychoroid disease entities [7].

PPE without subretinal fluid does not pose a problem for cataract surgery but progress to CSC can be seen when steroids are given. In the case of CSC, PNV or PCV, pachychoroid maculopathy should be treated with anti-VEGF if CNV is present, micropulse or argon lasers and, in many cases, photodynamic therapy before cataract surgery is performed. In these cases, steroids should be used with care.

Pachychoroid disorders of the macula

Stage	
0	Uncomplicated pachychoroid (UCP)
I	Pachychoroid pigment epitheliopathy (PPE)
II	Central serous chorioretinopathy (CSC)
III	Pachchoroid neovasculopathy (PNV)
III a	with neurosensory detachment (overlap with CSC)
III b	without neurosensory detachment
IV	Pachychoroid aneurysmal type 1 CNV (PAT1) / Polypoidal Choroidal Vasculopathy (PCV)

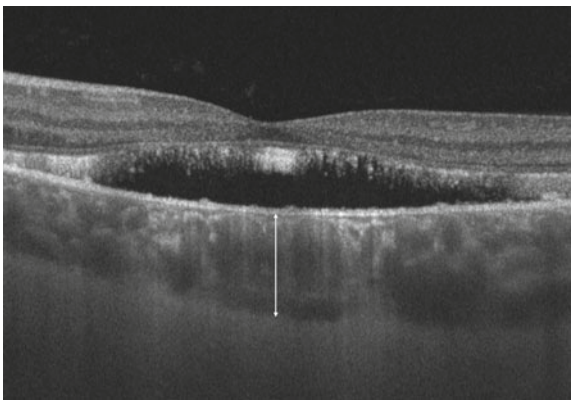

Fig. 6 Central serous chorioretinopathy with subretinal fluid. Central serous chorioretinopathy belongs to the Pachychoroid spectrum (stage II) which is defined by abnormal choroidal thickening (white arrow) and the presence of pachyvessels (thick vessels in the choroid >180 μm)

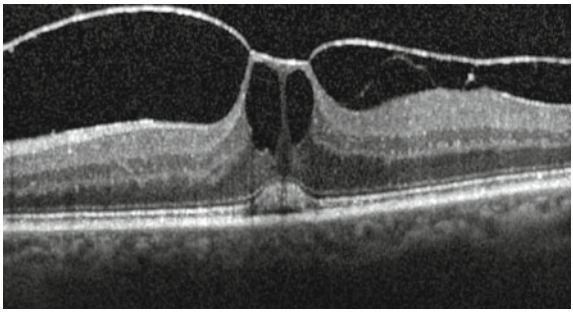

Fig. 7 Vitreomacular traction. Note the subretinal cleft ("subretinal fluid") which is indicating rather strong traction. Also note the epiretinal membrane nasally and temporally suggesting pars plana vitrectomy over intravitreal agents to release traction (ocriplasmin/gas)

Maculopathies of the vitreoretinal interface

The interaction of a pathological, detached vitreous body with the residual points of adhesion to the retina leads to maculopathies of the vitreoretinal interface [8]. These include vitreo-macular traction syndrome (VTMS), macular pucker and the macular holes. VMTS is characterized by a focal attachment of the partially detached vitreous body to the fovea, causing tractional deformation of the retina (Fig. 7). Intraretinal gaps are formed and in more pronounced pathology the photoreceptor layer may also be affected (delicate subretinal fluid accumulation in Fig. 7). In principle, marked VMTS, especially with concomitant pathologies like a macular pucker, should be treated by combined phaovitrectomy. In the case of moderate VMT, intravitreal orcriplasm or pneumatic vitreolysis (the latter with a relatively high risk of retinal detachment) can also be considered. In the case of mild VMT, primary cataract surgery can also be performed, as posterior vitreous detachment, which usually follows shortly after cataract surgery, is in many cases sufficient to resolve the VMT.

Where a macular pucker (Fig. 8) with strong traction is present with retinal thickening, marked metamorphopsia and visual impairment (Fig. 8, green reference arrow), a combined phacovitrectomy with ILM peeling should be performed. In case of a macular hole (Fig. 9), a combined phacovitrectomy is also recommended.

Rare maculopathies

In addition to the all of the common clinical entities mentioned above, a multitude of rare maculopathies can also be detected in patients scheduled for cataract surgery, e.g., myopia-related (myopic CNV), (vascular) degenerative (e.g., macular telangiectasia, angioid streaks) or hereditary (e.g., Stargardt's disease). In unclear cases, it is always advisable to consult a retina specialist.

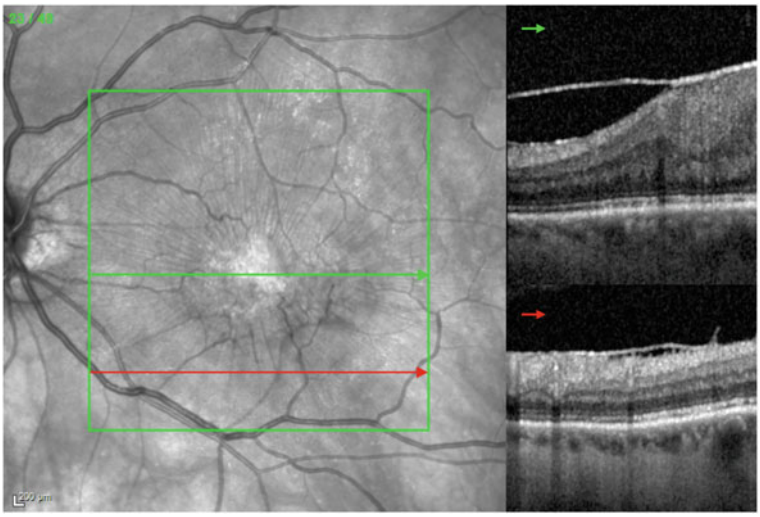

Fig. 8 Epiretinal membrane. Note that the vitreous is still attached in the foveal area (green arrow), while below the vitreous is already detached, leaving behind an epiretinal membrane

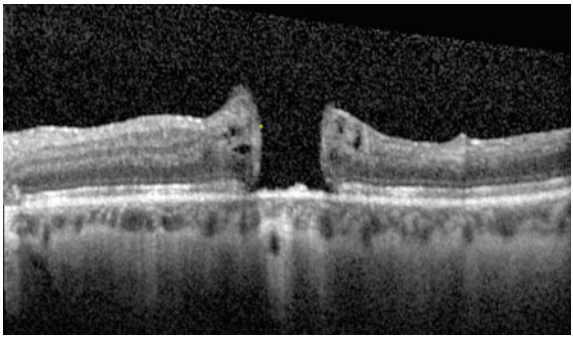

Fig. 9 Full-thickness macular hole, suggesting combined phacovitrectomy with ILM peeling

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