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Case Report

Immediate Choroidal Expansion after Bleb Needling

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Keywords
Choroidal expansion · Bleb needling · Spectral-domain optical coherence tomography

Abstract
The purpose was to report a case of immediate choroidal expansion after a needling procedure. This is a retrospective case report of an 80-year-old male with pseudoexfoliative glaucoma who underwent Xen 45 Gel stent implantation and then trabeculectomy in the right eye. During follow-up, several bleb needling procedures were required to treat bleb fibrosis. Before and after the last bleb needling, spectral-domain optical coherence tomography (SD-OCT) was performed to investigate choroidal changes. SD-OCT was also repeated 1 week later. SD-OCT showed instant choroidal expansion (both in the macular and peripapillary area) that was quite sustained throughout the 1 week-follow-up and after 5 months. Bleb needling can cause immediate choroidal expansion that can be quite sustained throughout several months of follow-up. SD-OCT is essential for detecting choroidal changes.

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Introduction

Open-angle glaucomas are chronic, progressive optic neuropathies, resulting in a loss of retinal fiber layer leading to visual field loss and visual impairment [1]. Since elevated intraocular pressure (IOP) is an important risk factor for glaucoma progression, treatments are directed to IOP reduction [2, 3]. Treatments include antiglaucoma drugs, laser procedures, and surgery [1].

The primary goal of glaucoma-filtering surgery is to bypass the conventional outflow pathways by creating a corneoscleral fistula that leads to a subconjunctival filtering bleb [4].

Wound healing is one of the main determinants of the long-term IOP control after filtering surgery [5, 6]. Excessive wound healing or repair leads to scar formation in the conjunctiva. Risk factors for conjunctival scarring are young age, Afro-Caribbean/Hispanic race, inflammatory eye disease, long-term multiple topical medical therapy, aphakia by intracapsular surgery, recent intraocular surgery (<3 months), previous conjunctival incisional surgery, previous failed glaucoma filtration surgery, neovascular glaucoma [7, 8]. Antimetabolites such as 5-fluorouracil and mitomycin-C (MMC) are frequently used in patients undergoing glaucoma filtration surgery in order to reduce postoperative conjunctival scarring and improve drainage [9].

Bleb revision was first described by Ferrer in 1941 when he performed a conjunctival dialysis consisting of an incision of scar tissue, followed by separation of the conjunctiva from the sclera using a spatula [10]. Bleb revision with needling is an established method of managing bleb fibrosis in a failed bleb. Traditionally, it was performed either with 5-fluorouracilor MMC augmentation [11–13]. Gonioscopy should be performed to exclude mechanical blockage of the internal ostium by the vitreous or iris prior to bleb needling. Locating the site and margin of the scleral flap and assessing the mobility of the conjunctiva are routine preoperative measures. Topical anesthesia with xylocaine gel and asepsis with povidone-iodine are usually used. The procedure can be done at the slit-lamp or may require an operating theater for complicated cases. The endpoints include bleb formation and low IOP in the presence of a formed anterior chamber [14].

Choroid is the posterior portion of the uveal tract and nourishes the outer portion of the retina. The choriocapillaris is the largest capillary bed with the highest rates of blood flow in the body and can accommodate throughput of multiple red blood cells at once [15]. Its vasculature derives from the ophthalmic artery and it is composed of the choriocapillaris layer, the medium vessel layer, and the outer layer of large vessels. Blood is discharged from the lobules of the choriocapillaris by collecting venules that join the afferent veins. Veins of the larger lumen form the subcapillaris plexus and flow into the vortex veins. The vortex veins join the orbital venous system after leaving the eye [16]. The wall of the choriocapillaris has large fenestrations that allow proteins to escape and bring with it passive diffusion of fluid into the suprachoroidal space. This fluid is prevented from entering the subretinal space by the zonula occludens protein found in the retinal pigment epithelium. The IOP exerts a force to prevent too much fluid from accumulating in the suprachoroidal space to counteract the hydrostatic force of fluid following the proteins exiting the large fenestrations of the choriocapillaris [15–18].

The choroid is a dynamic structure, and its thickness depends on several factors [12]. Older age, higher IOP, higher myopia, and longer axial length are associated with a thinner choroid [12]. A reduction in the average or regional peripapillary choroidal thickness has been reported in glaucoma [12].

IOP reduction due to trabeculectomy is associated with a corresponding increase in choroidal thickness [13]. In this case report, we show a choroidal expansion after a needling procedure using spectral-domain optical coherence tomography (SD-OCT).

Case Report

This study is a retrospective case report of a patient followed at the Clinica Oculistica, DiNOGMI, Ospedale Policlinico San Martino IRCCS, University of Genoa. We present a case of an 80-year-old male with pseudoexfoliation glaucoma in both eyes. His ocular history included phacoemulsification with intraocular lens implantation in both the left eye (October 2008) and the right eye (April 2016), Xen 45 Gel Stent implant for uncontrolled glaucoma in the right eye (January 2018), hypotony with choroidal effusion due to overfiltering bleb in the early postoperative course treated with systemic steroids, several needling procedures and one MMC subconjuntival injection to treat bleb fibrosis, and trabeculectomy following failed XEN-45 implantation (December 2018). During follow-up after trabeculectomy, the patient underwent many needling procedures, a focal pressure, and a flap lifting to revive the bleb and to lower IOP to the target range. At the last follow-up visit, the patient presented with a flat bleb and an IOP of 40 mm Hg in the right eye. He was under treatment with topical netilmicin/dexamethasone three times a day. His best-corrected visual acuity (BCVA) was 20/40–20/33 in the right eye and 20/22 in the left eye with a myopic correction in both eyes (–0.50 spherical D). IOP was well controlled in the left eye with dorzolamide-timolol as it was 13 mm Hg.

In order to lower IOP in the right eye, a bleb needling was carried out at the slit lamp. After that, the bleb elevated markedly, and IOP was reduced to 10 mm Hg. Before and after the needling procedure SD-OCT using Swept Source DRI OCT Triton™ (Topcon Medical Systems, Tokyo, Japan) was performed to detect any choroidal changes (Table 1). The eye was imaged using the wide field 12 × 9 mm raster scan setting with the scan centered on the posterior pole. SD-OCT revealed the following changes in choroidal thickness: from 176.4 to 236.2 μm in the macular region and from 93.75 to 124.69 μm in the peripapillary area (Fig. 1, 2).

Axial length was measured with AL-Scan Optical Biometer by NIDEK and decreased from 23.53 mm (before needling) to 23.39 mm (after 1 week) in the right eye. One week later, the bleb was rather elevated, IOP was 15 mm Hg, and SD-OCT showed a quite persistent choroidal expansion (199.1 and 104.13 μm in macular and peripapillary region, respectively) (Fig. 3, Table 1).

After 2 weeks, the patient presented an IOP of 33 mm Hg, and two needling procedures were performed 10 days apart in order to stabilize IOP to 15 mm Hg for the following 2 months. At the last follow-up visit, IOP was 25 mm Hg, and another bleb needling was carried out; however, it could not decrease IOP. After this procedure, SD-OCT was performed, and it

revealed a choroidal thickness of 187.8 μm in the macular region and 100.63 μm in the peripapillary area. Besides, it showed a cystoid macular edema and a serous detachment of the neurosensory retina in the macula (Table 1).

Discussion

The choroid is a vascularized and pigmented tissue that is extended from the ora serrata anteriorly to the optic nerve posteriorly [19]. It contains large membrane-lined lacunae, which, at least in birds, function as part of the lymphatic drainage of the eye and which can change their volume dramatically, thereby changing the thickness of the choroid as much as four-fold over a few days (much less in primates). It contains non-vascular smooth muscle cells, especially behind the fovea, the contraction of which may thin the choroid, thereby opposing the thickening caused by expansion of the lacunae. It has intrinsic choroidal neurons, also mostly behind the central retina, which may control these muscles and may modulate choroidal blood-flow as well. These neurons receive sympathetic, parasympathetic, and nitrergic innervation [19].

As one of the most highly vascularized tissues of the body, its main function has been traditionally viewed as supplying oxygen and nutrients to the outer retina. Other likely functions include light absorption, thermoregulation via heat dissipation, and modulation of IOP via vasomotor control of blood flow. The choroid also plays an important role in the drainage of the aqueous humor from the anterior chamber via the uveoscleral pathway [19].

Several hypotheses were proposed to explain choroidal thickness changes [19]. First, it is possible that the increase in thickness is due to an increased synthesis of large, osmotically active proteoglycans, which would pull water into the choroid. Second, it could be the result of an increase in the size or number of the fenestrations in the choriocapillaris, which could similarly increase the amount of osmotically active molecules in the choroidal matrix. Third, fluid could enter the choroid as part of the drainage from the anterior chamber. Fourth, the fluid could be a result of altered transport of fluid from the retina across the RPE. Finally, in addition to other processes, changes in the tonus of the nonvascular smooth muscle that spans the width of the choroid in both birds and primates might play a role. This last hypothesis is supported by the finding that drastically lowering the IOP causes choroidal expansion [19], and pseudoexfoliation glaucoma patients have a higher IOP than primary open-angle glaucoma, so the IOP changes could be more evident. For this reason, pseudoexfoliation glaucoma could be considered a risk factor for choroidal thickening after needling or surgery. Moreover, it has been reported that IOP reduction can induce several kinds of morphologic changes in eyes after trabeculectomy, including choroidal thickening [20–22]. The significance of choroidal thickening after trabeculectomy to the slowing of glaucoma progression has not been established. In subgroups of glaucoma, choroidal circulation has been suggested to be related to glaucoma pathogenesis. If so, choroidal thickening could have an inhibitory effect on glaucoma progression [23].

In our case report, we describe an instant choroidal expansion following a needling procedure detected using swept source-OCT. As trabeculectomy, bleb needling can drastically

reduce IOP, and thus can cause ocular changes such as increases in choroidal thickness. One week after the needling procedure, choroidal thickening was quite sustained, demonstrating that a procedure carried out at the slit lamp can also produce a lasting change. After several months, choroidal thickness was slightly reduced in both the macular and peripapillary area. Nonetheless, the thickness was not decreased beneath the values measured prior to the needling procedure that was performed 5 months earlier.

In conclusion, bleb needling can immediately increase choroidal thickness detectable by using swept source-OCT. Further studies are needed to elucidate the choroid's behavior and its significance.

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Statement of Ethics

No ethics committee was involved because this is a retrospective study. The treatment followed the tenets of the Declaration of Helsinki. Written informed consent was obtained at the first visit for both data and images.

Conflict of Interest Statement

None of the authors has a proprietary interest in the development and marketing of any products mentioned in the article.

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Author Contributions

M.I. surgeon; M.I. and M.M. project; M.I., M.M., A.V., and C.E.T. wrote the manuscript and approved the final version of the manuscript.

References

1 European Glaucoma Society Terminology and Guidelines for Glaucoma, 4th Edition - Chapter 2: Classification and terminology Supported by the EGS Foundation: Part 1: Foreword; Introduction; Glossary; Chapter 2 Classification and Terminology. Br J Ophthalmol. 2017;101(5):73–127.
2 The Advanced Glaucoma Intervention Study (AGIS): 7. The relationship between control of intraocular pressure and visual field deterioration. The AGIS Investigators. Am J Ophthalmol. 2000 Oct;130(4):429–40.
3 Musch DC, Gillespie BW, Lichter PR, Niziol LM, Janz NK; CIGTS Study Investigators. Visual field progression in the Collaborative Initial Glaucoma Treatment Study the impact of treatment and other baseline factors. Ophthalmology. 2009 Feb;116(2):200–7.
4 Roy FH, Benjamin L, series editors. Surgical Techniques in Ophthalmology: Glaucoma Surgery (ed 1). Saunders; 2007. ISBN-13: 978-1416030218.
5 Seibold LK, Sherwood MB, Kahook MY. Wound modulation after filtration surgery. Surv Ophthalmol. 2012 Nov;57(6):530–50.
6 Skuta GL. Antifibrotic agents in glaucoma filtering surgery. Int Ophthalmol Clin. 1993;33(4):165–82.
7 Fontana H, Nouri-Mahdavi K, Lumba J, Ralli M, Caprioli J. Trabeculectomy with mitomycin C: outcomes and risk factors for failure in phakic open-angle glaucoma. Ophthalmology. 2006 Jun;113(6):930–6.
8 Fontana H, Nouri-Mahdavi K, Caprioli J. Trabeculectomy with mitomycin C in pseudophakic patients with open-angle glaucoma: outcomes and risk factors for failure. Am J Ophthalmol. 2006 Apr;141(4):652–9.
9 Iester M, Ravinet E, Mermoud A. Postoperative subconjunctival mitomycin-C injection after non-penetrating glaucoma surgery. J Ocul Pharmacol Ther. 2002 Aug;18(4):307–12.
10 Ferrer H. Conjuntival dialysis in the treatment of glaucoma recurrent after sclerectomy. Am J Ophthalmol. 1941;24:788–90.
11 Broadway DC, Bloom PA, Bunce C, Thiagarajan M, Khaw PT. Needle revision of failing and failed trabeculectomy blebs with adjunctive 5-fluorouracil: survival analysis. Ophthalmology. 2004 Apr;111(4):665–73.
12 Goharian I, Sehi M. Is There Any Role for the Choroid in Glaucoma? J Glaucoma. 2016 May;25(5):452–8.
13 Zhang X, Cole E, Pillar A, Lane M, Waheed N, Adhi M, et al. The Effect of Change in Intraocular Pressure on Choroidal Structure in Glaucomatous Eyes. Invest Ophthalmol Vis Sci. 2017 Jun;58(7):3278–85.
14 Leung DY, Tham CC. Management of bleb complications after trabeculectomy. Semin Ophthalmol. 2013 May;28(3):144–56.
15 Agarwal A. Gass' atlas of macular diseases. Volume 1. 5th ed. Amsterdam: Elsevier Saunders; 2012. p. 4.
16 Emi K, Pederson JE, Toris CB. Hydrostatic pressure of the suprachoroidal space. Invest Ophthalmol Vis Sci. 1989 Feb;30(2):233–8.
17 Bakir B, Pasquale LR. Causes and treatment of choroidal effusion after glaucoma surgery. Semin Ophthalmol. 2014 Sep-Nov;29(5-6):409–13.
18 Schrieber C, Liu Y. Choroidal effusions after glaucoma surgery. Curr Opin Ophthalmol. 2015 Mar;26(2):134–42.
19 Nickla DL, Wallman J. The multifunctional choroid. Prog Retin Eye Res. 2010 Mar;29(2):144–68.
20 Usui S, Ikuno Y, Uematsu S, Morimoto Y, Yasuno Y, Otori Y. Changes in axial length and choroidal thickness after intraocular pressure reduction resulting from trabeculectomy. Clin Ophthalmol. 2013;7:1155–61.
21 Saeedi O, Pillar A, Jefferys J, Arora K, Friedman D, Quigley H. Change in choroidal thickness and axial length with change in intraocular pressure after trabeculectomy. Br J Ophthalmol. 2014 Jul;98(7):976–9.
22 Kara N, Baz O, Altan C, Satana B, Kurt T, Demirok A. Changes in choroidal thickness, axial length, and ocular perfusion pressure accompanying successful glaucoma filtration surgery. Eye (Lond). 2013 Aug;27(8):940–5.
23 Yoshikawa M, Akagi T, Nakanishi H, Ikeda HO, Morooka S, Yamada H, et al. Longitudinal change in choroidal thickness after trabeculectomy in primary open-angle glaucoma patients. Jpn J Ophthalmol. 2017 Jan;61(1):105–12.

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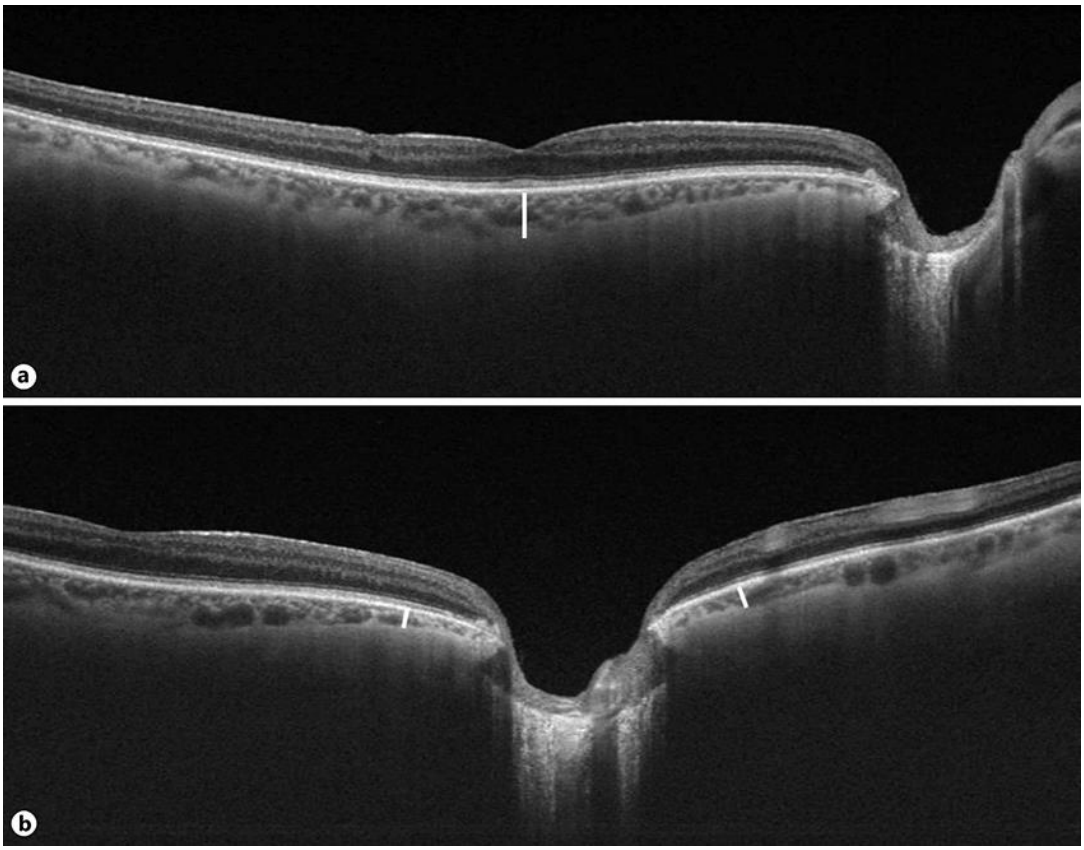

Fig. 1. SD-OCT scan showing macular (**a**) and peripapillary (**b**) choroidal thickness before bleb needling.

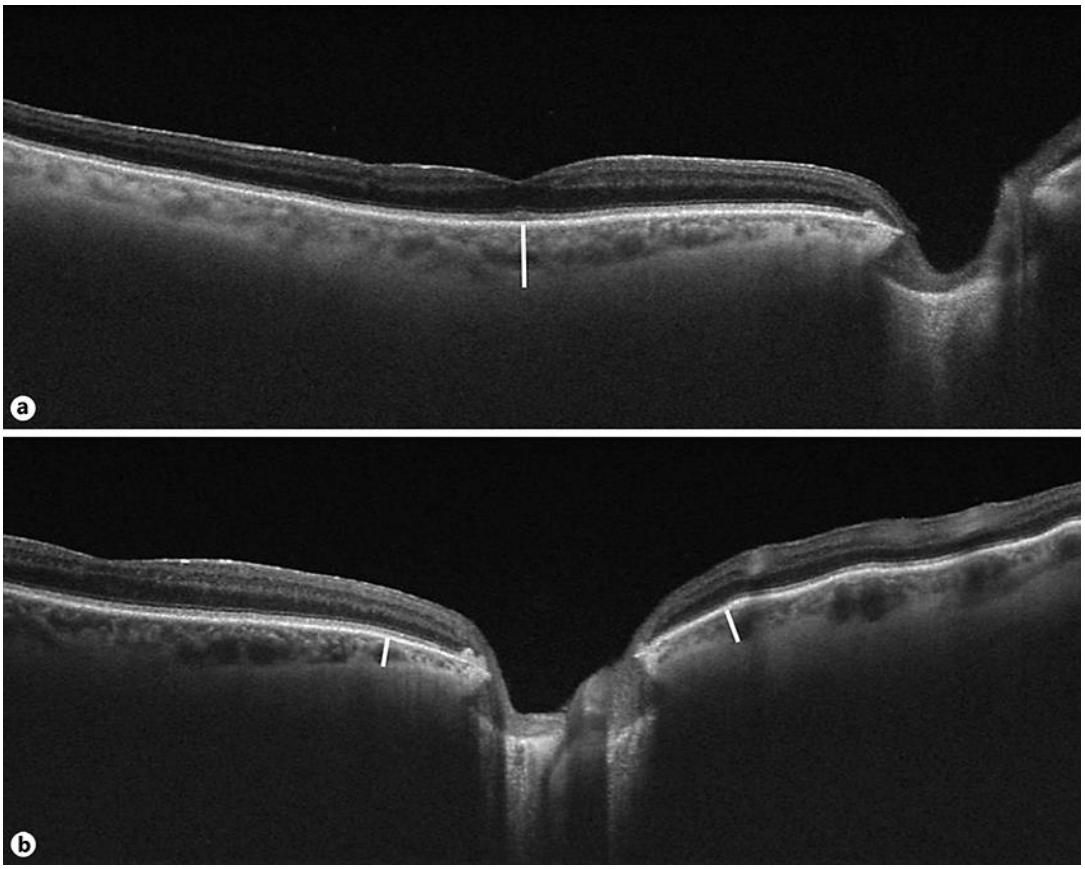

Fig. 2. SD-OCT scan demonstrating the increase in macular (**a**) and peripapillary (**b**) thickness immediately after the needling procedure.

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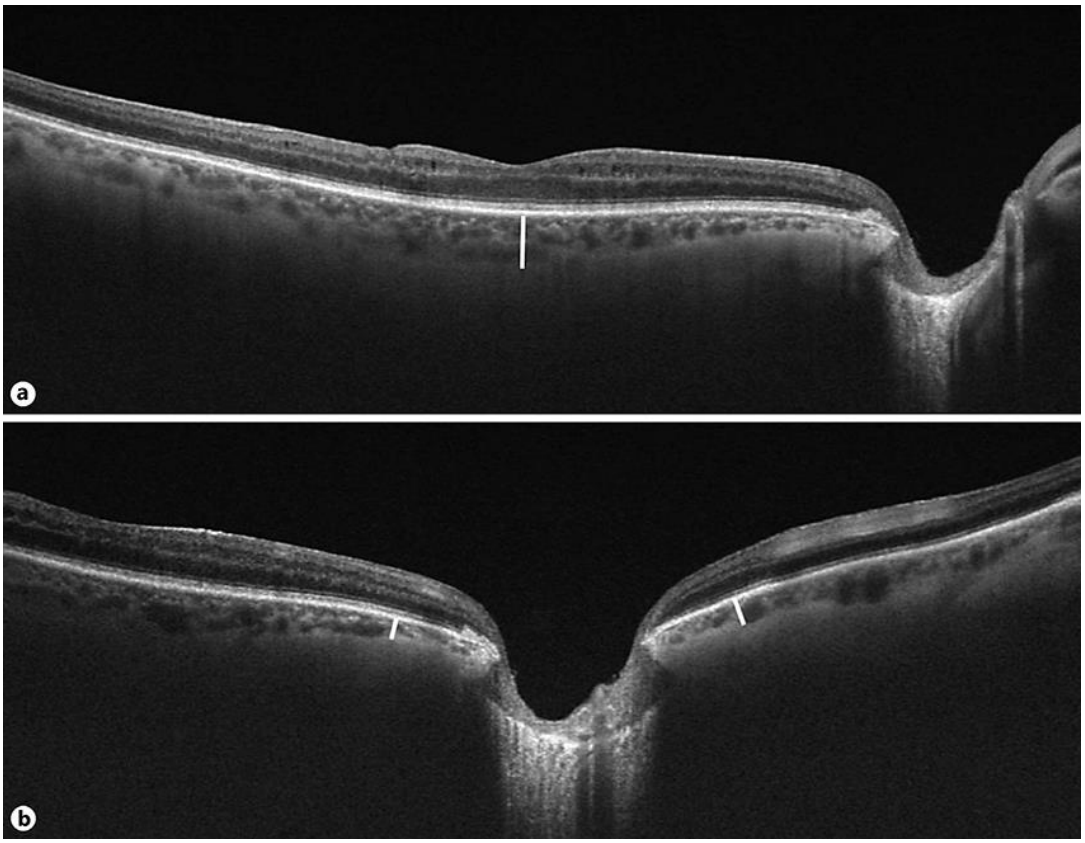

Fig. 3. SD-OCT performed 1 week later showing a quite sustained choroidal thickening, both in the macular (**a**) and peripapillary (**b**) regions.

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Table 1. Bilateral intraocular pressure and choroidal thickness values during follow-up

	Post-trabeculectomy eye (right eye)			Fellow eye (left eye)		
	IOP, mm Hg	choroidal thickness, μm		IOP, mm Hg	choroidal thickness, μm	
		macular region	peripapillary region		macular region	peripapillary region
Day 0 (before bleb needling)	40	176.4	93.75	13	221.5	101.7
Day 0 (after bleb needling)	10	236.2	124.69			
Day 7	15	199.1	104.13	14		
Day 21	33			14		
Day 31	15			12		
Day 95	15			13		
Day 166 (before bleb needling)	25			11		
Day 166 (after bleb needling)	25	187.8	100.63			