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Case report

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# Subthreshold micropulse yellow laser for the management of refractory cystoid macular edema consequent to complicated cataract surgery

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**Abstract**

**Purpose:** To report the safety and efficacy of subthreshold micropulse yellow laser of 577 nm for a complex case of refractory pseudophakic cystoid macular edema.

**Methods:** A retrospective chart review of an interventional case report of three subthreshold micropulse yellow laser interventions for refractory pseudophakic cystoid macular edema.

**Patient:** A 77-year-old healthy female underwent pseudoexfoliative cataract surgery complicated by posterior capsule rupture and sulcus intraocular lens implantation. After 3 months, she required a scleral fixation of the same lens, due to a lack of capsular support and decentration of the intraocular lens. One month later, she experienced a severe pseudophakic cystoid macular edema (foveal thickness of 399 µm and best-corrected visual acuity of 20/80 Snellen). The condition was refractory to conventional treatments prior to subthreshold micropulse yellow laser interventions, including non-steroidal anti-inflammatory eye drops, topical steroids, oral indomethacin and three sub-Tenon's triamcinolone injections, attempted over a 14-month period.

**Results:** Subthreshold micropulse yellow laser treatment was performed and immediate resolution was achieved and maintained for 2 months. Two cases of edema relapse were observed at 3 months from initial laser treatment and again at 4 months from the second laser treatment. Final patient's follow-up at 6 months from the third laser treatment evidenced the absence of edema, improved visual acuity (foveal thickness of 265 µm/best-corrected visual acuity of 20/30 Snellen) and the absence of complications.

**Conclusions:** Subthreshold micropulse yellow laser seems to be a safe and effective treatment for short-term resolution of refractory pseudophakic cystoid macular edema after complicated cataract surgery and represents a useful alternative to expensive and invasive therapies. A trend towards a longer duration of edema resolution with every subthreshold micropulse yellow laser repetition was observed.

**Keywords**

Pseudophakic cystoid macular edema, micropulse yellow laser, cataract surgery, refractory macular edema

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## Introduction

Pseudophakic cystoid macular edema (PCME) is one of the most common causes of visual loss after cataract surgery as described by Flach[1] and Yonekawa and Kim.[2] It is also referred to as Irvine–Gass syndrome as it was first described as a new disease entity by Irvine[3] in 1953 and

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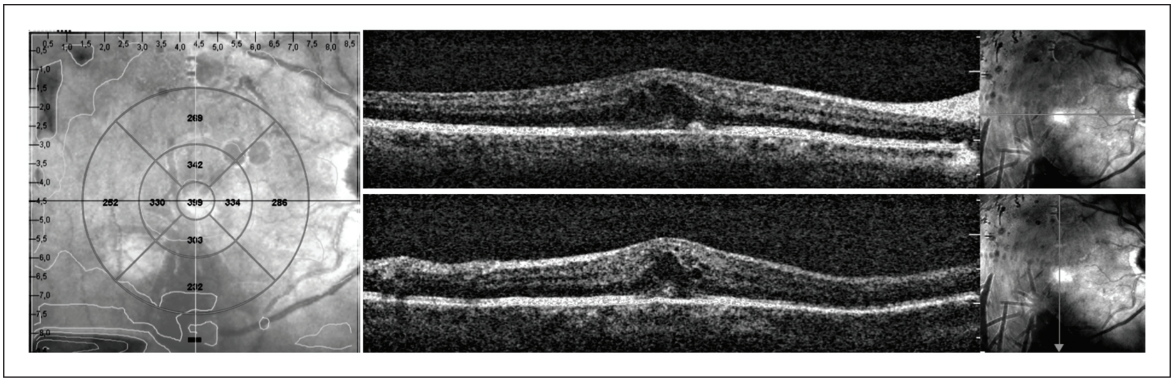

**Figure 1.** OCT images of the macular edema at 1-month post-subluxated IOL-intervention (PO1).

then studied with fluorescein angiography by Gass and Norton.[4]

The incidence of clinically significant PCME in phacoemulsification has been reported by Grzybowski et al.[5] to be between 0.1% and 2.35%, but estimates increase between 3% and 41% significantly if measured with optical coherence tomography (OCT).

It is well established that surgical manipulation along with post-operative (PO) inflammation are one of the major causes of PCME.[6] In most cases, PCME resolves without the need for therapy, but chronic PCME requires steroidal or non-steroidal anti-inflammatory therapies or anti-vascular endothelial growth factors (anti-VEGFs) injections.[5,7] Some cases refractory to therapy are encountered and resolution can be difficult, leading to visual deterioration.[8]

Subthreshold micropulse yellow laser (SMYL) can be applied to the treatment of different macular disorders, such as diabetic macular edema (DME), retinal vein occlusion (RVO) and central serous chorioretinopathy (CSC), as well reviewed by Gawecki.[9] SMYL is a revolutionary alternative to conventional continuous wave laser, it preserves retinal tissue stimulating it rather than destroying it, due to repetitive short pulses at low temperatures.[10] The efficacy of the SMYL for macular disorders has been well established in literature;[9] however, there are no cases reporting on its use in PCME treatment following complicated cataract surgeries.

We report a case of a refractory PCME due to a complicated cataract surgery with posterior capsule rupture that was resolved with SMYL treatment.

## Case description

A 77-year-old woman with systemic hypertension and no other co-pathologies underwent pseudoexfoliative (PEX) cataract surgery of the right eye with a subsequent complication of a posterior capsule rupture and sulcus implantation of an Incise® MJ14 intraocular lens (IOL) + 21.50D (Bausch & Lomb, Rochester, NY, USA) in March 2017. After 3 months, she experienced a subluxation of the IOL, which was repositioned by mean of a scleral fixation with 10.0 prolene suture through the IOL haptics. PO medication consisted in association of Betamethasone/Chloramphenicol drops four times/day for 20 days.

At 1-month post-operative (PO1) follow-up, the best-corrected visual acuity (BCVA) of her right eye was 20/80, presenting severe and extensive PCME. The patient, examined with a spectral domain OCT (OCT SLO; Optos, Inc., Scotland, UK), presented foveal thickness (FT) of 399 µm (Figure 1), obtained from the automated retinal mapping OCT software, and was subsequently treated with Nepafenac 0.3% one drop/day.

After 20 days, the PCME worsened (FT of 488 µm, Figure 2) and therapy was extended to include a dietary antioxidant supplement based on extracts of turmeric and Bromelain, Artemisia, pineapple and black pepper (Intravit®; OFFItalia Oftalmica, Firenze, Italy) and 50 mg of Indomethacin to be assumed twice/day.

At PO4, PCME was reduced (FT of 245 µm, Figure 2) and therapy was interrupted, with the exception of the dietary antioxidant supplement (reduced assumption to one tablet/day).

The patient returned at PO6 and an increased macular thickness was observed (FT of 570 µm). The assumption of Nepafenac (one drop/day) was integrated into the on-going assumption of the dietary supplement. During this consultation, we performed a ultrabiomicroscopy (Compact Touch STS UBM; Quantel Medical, France) of the posterior segment of the eye to better visualize the IOL position and the ciliary body. Interestingly, we noticed a tilting of the IOL with a displacement of the ciliary body in the inferior-temporal quadrant (Figure 3). The patient was not keen to have further major surgeries; therefore, we decided to treat her medically.

At PO8, BCVA was 20/50 and a sub-Tenon's triamcinolone injection was performed with subsequent edema reduction (from 462 to 395 µm, Figure 2).

At PO12, the edema reappeared (VA of 20/100, FT of 605 µm) with another two sub-Tenon's triamcinolone injections (PO12 and PO14). Despite medical therapy and

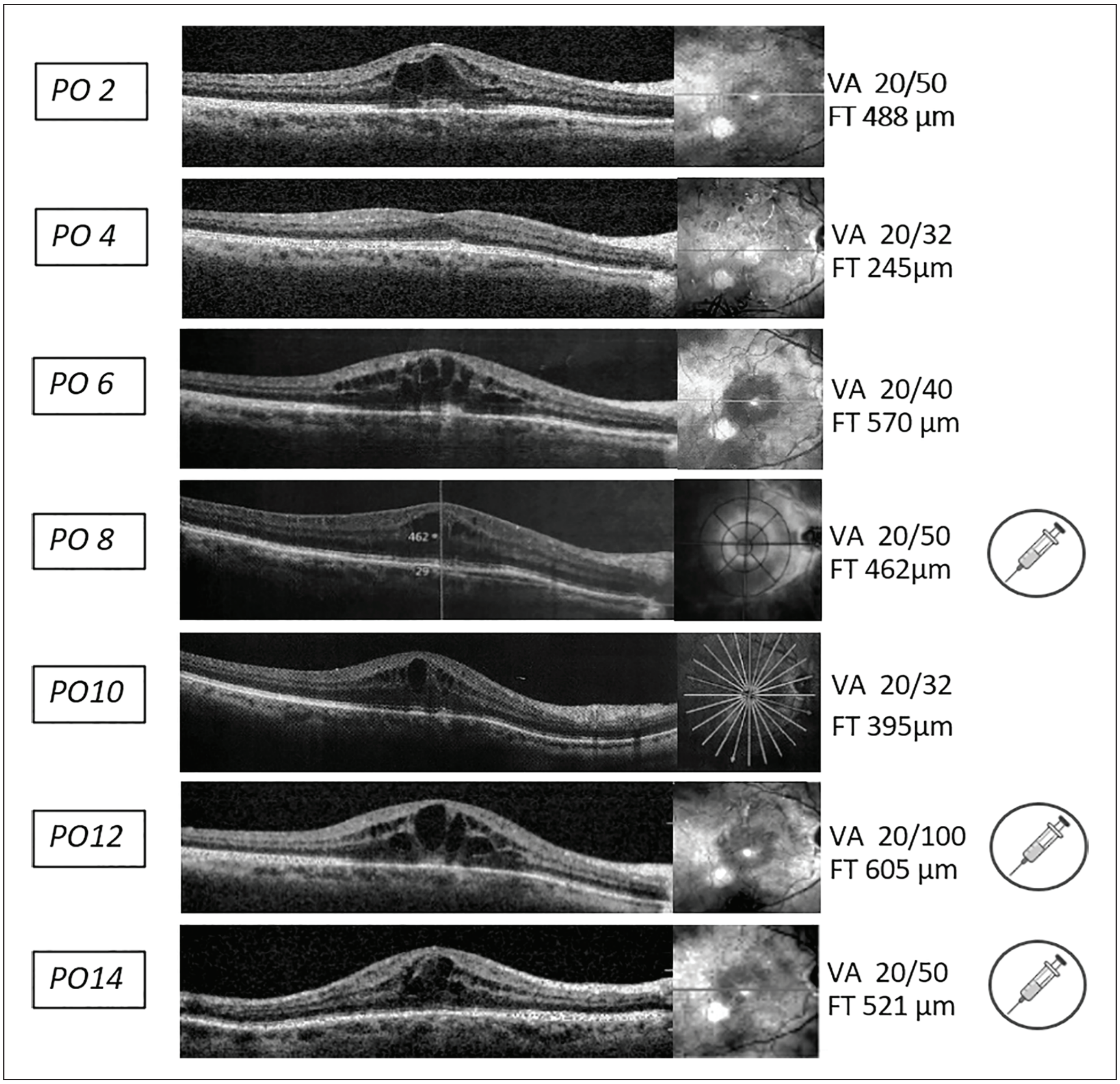


**Figure 2.** OCT images of unresolved macular edema with medical therapy and sub-Tenon's injection at 8-, 12- and 14-month PO intervention for subluxated IOL complication.

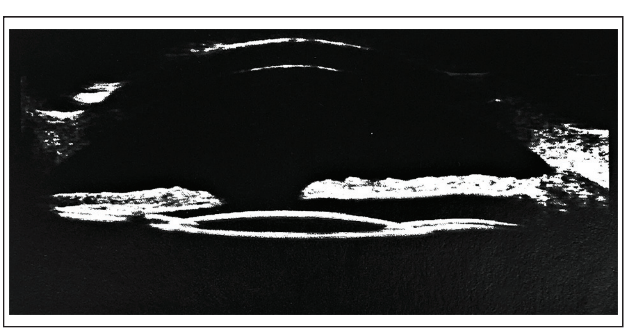

**Figure 3.** Ultrabiomicroscopy of the scleral-fixated sutured IOL.

sub-Tenon's triamcinolone injections, the edema persisted and at PO16, the VA was 20/63 and FT was 532 µm (see Figure 2).

The surgeon did not attempt Dexamethasone intravitreal implant injection due to the absence of posterior capsule and the risk of penetrating the device into the anterior chamber. Consequently, the surgeon decided to use SYML treatment as alternative solution.

## *Laser treatment*

The refractory macular edema was treated with a 577 nm SMYL photo-stimulation (IRIDEX IQ 577™; IRIDEX, Mountain View, CA, USA) using a 1.06× laser magnification lens (Goldmann three-mirror fundus lens; Volk Optical Inc., Mentor, OH, USA). Initially, a continuous wave test was performed in a non-oedematous area in the vascular arcades at more than three discs diameters from the foveal centre in order to determine the correct minimum threshold

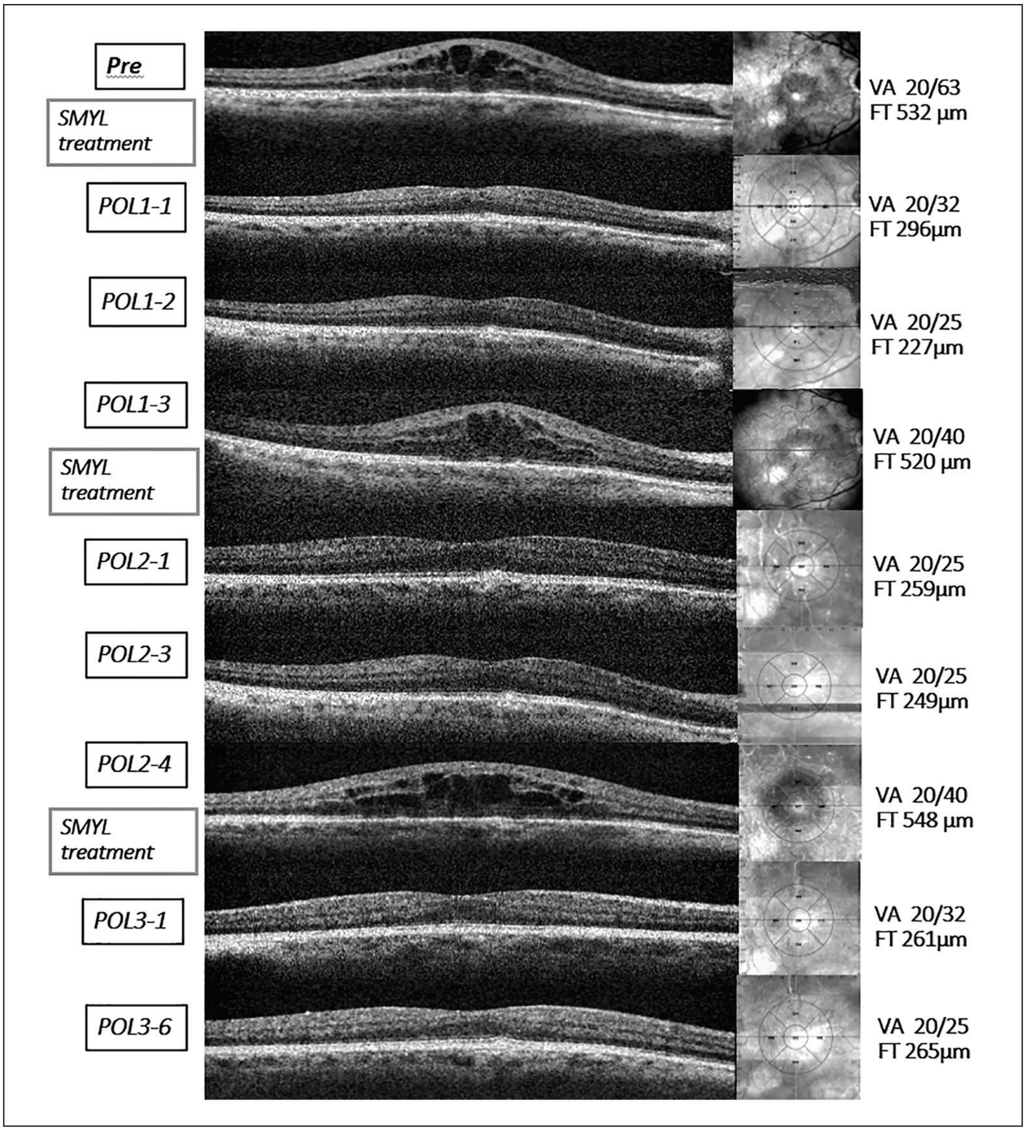


**Figure 4.** OCT images showing macular edema resolution after first laser intervention and after two subsequent re-treatments for edema relapse.
POL1-1: post-operative laser no. 1 at 1 month.

power. A 200-µm diameter spot with 200 ms pulse duration and 50 mW power was tested. The power was then augmented with 10-mW increments (while advancing the laser to non-oedematous areas immediately beside the previous test site) until a barely visible tissue reaction was observed (90 mW).

The micropulse laser therapy was then performed on the edema site, switching to 5% duty cycle and adjusting the power to four times the test spot threshold (360 mW) with 200 ms exposure, using four grids (7 × 7) with confluent spots of 200 $\mu$m (0.00 spacing) covering the whole oedematous area including the foveal centre, as previously described.[11] The setting including spot size, lens and duration remained the same as in the test spot. Bromfenac 0.09% eye drops twice/daily were prescribed post-intervention.

At 1-month post-operative laser (POL1-1), the intraretinal fluid had reduced (FT of 296 µm) and BCVA increased to 20/32. At 2-month follow-up (POL1-2), the intraretinal fluid was completely reabsorbed (FT of 227 µm) and BCVA was 20/25 (see Figure 4). Therapy with Bromfenac 0.09% eye drops twice/daily was interrupted, while dietary antioxidant supplement once/day was continued.

## Edema relapse

Two cases of edema relapse were observed at 3 months from the initial laser intervention (POL1-3) and 4 months from the second laser intervention (POL2-4) (Figure 4). For the second and third laser treatments, all parameters of the initial laser treatment were maintained with the exception of an increased power from 360 to 380 mW to try to have a better response. In both cases, the edema was successfully treated (FT of 520–249 μm with BCVA of 20/40–20/25 and FT of 548–265 μm with BCVA of 20/40–20/25, respectively). Therapy with Bromfenac 0.09% eye drops twice/day was reintroduced and dietary antioxidant supplement twice/day was continued. Final patient's follow-up was performed at 6 months from the third laser treatment (POL3-6), and no edema was evident (Figure 4).

## Discussion/conclusion

SMYL has been applied and reported in literature for the treatment of CSC, DME and macular edema secondary to RVO.[9] However, to our knowledge, this is the first report of its application for refractory PCME resolution.

Over the years, many therapeutic options have been proposed for unresponsive PCME such as corticosteroids and anti-VEGF injections.[5,7] However, those are invasive therapies and have been associated with local complications such as rhegmatogenous retinal detachment, endophthalmitis, ocular haemorrhage, intraocular pressure elevation and systemic complications including thromboembolic events.[12] Pars plana vitrectomy has been associated with complications ranging from iatrogenic tears to choroidal haemorrhage.[13]

The SMYL has been successfully used for treating CSC, DME and RVO and its safety has been proven.[6,9] Differently from conventional laser therapy, SMYL is a tissue-sparing technique stimulating retinal pigment epithelium (RPE) rather than destroying it, and producing beneficial therapeutical effects through a controlled thermal elevation of the retinal tissue.[10] The SMYL induces the overexpression of pigment epithelium derived factor (PEDF) and VEGF inhibitor (restorative and anti-angiogenic factors) within the RPE cells and the subregulation of VEGF inducers and permeability factors, thus regulating angiogenesis and vascular permeability.[14,15] Moreover, subthreshold photostimulation reduces chronic inflammation inducing the expression of heat shock protein and releasing growth factors and cytokines without any tissue damage.[16]

As the major aetiology of PCME appears to be the up-regulation of inflammatory mediators after surgical manipulation associated to the disruption of the blood–retinal barrier,[1,2] we supposed that SMYL could be a valuable solution for PCME unresponsive to standard therapies.

Of notice, our case is not a simple case of refractory PCME, as the aetiology of PCME is likely due to inflammation from the sutured IOL which results to be displaced and rubbing into the ciliary body. The UBM demonstrated the tilting of the IOL (Figure 3) and this finding suggests that the recurrence was due to this anatomical alteration which could increase the level of inflammation in comparison with uneventful cataract surgery.

In this case, a complete edema resolution was found already 1 month after laser treatment even if FT at baseline was 532 μm. The efficacy period lasted 3 months from the first treatment.

In our experience, the repetition of SMYL seemed to increase the efficacy period, with the patient free from edema and with a complete restoration of retinal profile after 6 months post-operatively to the third SMYL. We suppose that this could be related to the higher laser power used for the re-treatments or to an additive effect that could have increased the efficacy period in terms of structural and functional recovery. However, a longer follow-up period should be needed to confirm its efficacy over time.

In conclusion, our case shows that SMYL treatment seems to be a safe and effective treatment for short-term resolution of refractory PCME and represents a useful alternative to invasive and expensive therapies, such as surgery or repeated sub-Tenon's triamcinolone or intravitreal injections, without any complications.

Further studies, especially with a longer follow-up, are required to confirm the safety and efficacy of SMYL for refractory PCME in complex cases.

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### Author contributions

All authors contributed to data analysis, drafting and revising the article; gave final approval of the version to be published and agreed to be accountable for all aspects of the work.

### Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

### Ethical approval

The research complies with the guidelines for human studies and was conducted ethically in accordance with the World Medical Association Declaration of Helsinki.

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### Informed consent

The patient has given her written informed consent to publish the case.

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