



# Straylight due to intraocular lens opacification in a patient with asteroid hyalosis

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## ABSTRACT

**Purpose:** To report a rare case of intraocular lens (IOL) calcification in the presence of asteroid hyalosis with in-vivo measurements of straylight before and after treatment.

**Observations:** A patient with asteroid hyalosis presented with complaints of disability glare due to calcifications on the posterior surface of the IOL. Straylight, measured with the C-Quant, was 8.2x elevated compared to normal (log(s) 2.08). Dissolution of the posterior face IOL deposits was performed with a neodymium-doped yttrium aluminum garnet (Nd:YAG) laser, resulting in a significant decrease in straylight (log(s) 1.76), congruent with the patient's subjective improvement.

**Conclusions and importance:** To the best of our knowledge, this is the first report describing a patient with an opacified IOL due to asteroid hyalosis with in-vivo measurements of straylight before and after treatment. It illustrates that awareness of glare complaints in patients with an opacified IOL is important, documentation with C-Quant measurements may be helpful in indicating treatment, evaluating the treatment, and following up the patient, and treatment with a Nd:YAG laser may dissolve the opacifications to a clinically satisfactory level.

## 1. Introduction

Intraocular lens (IOL) calcification in the presence of asteroid hyalosis is an uncommon late complication of cataract surgery. It is due to hydroxyapatite accumulating on the posterior surface of silicone IOLs.<sup>1,2</sup> Until now, 28 cases have been reported.<sup>1–12</sup> The opacification can be treated by either removing the crystals with a neodymium-doped yttrium aluminum garnet (Nd:YAG) laser, by surgical removal of the crystals with pars plana vitrectomy (PPV), or by exchanging the IOL.<sup>4,8</sup>

The focus of the published reports has been on the cause of the opacifications and its treatment. Loss of visual acuity was usually limited in these patients. However, none of the case reports discussed glare. Nonetheless, opacifications of IOLs have been suggested to be clinically more associated with an increase in glare than with a decrease in visual acuity.<sup>11,13</sup> In fact, straylight and acuity are very different and quite independent aspects of quality of vision.<sup>14</sup> We present a patient who came to us with complaints of disability glare due to calcifications on the back surface of the IOL which we treated with a Nd:YAG laser. To objectify the complaints and the result of the treatment, we measured the amount of straylight with the C-Quant straylight meter ([www.oculus.de](http://www.oculus.de)) before and after treatment.

## 2. Case report

In August 2018, a 63-year old male patient presented with disturbed vision in his right eye, increasing when looking in the headlights of cars. Over 20 years ago he had had cataract surgery (details of the implanted IOL, such as it being hydrophilic acrylic, hydrophobic acrylic or silicone, were not available). In 2016, Nd:YAG laser capsulotomy was performed on his right eye because of posterior capsule opacification. At the current examination, the Snellen corrected distance visual acuity (CDVA) of his right eye was 20/30 (left eye: 20/16; expressed as the logarithm of the minimum angle of resolution [logMAR]: +0.17 and -0.09, respectively). Straylight measurement of his right eye (with an undilated pupil) with the C-Quant straylight meter showed a straylight value of 2.08 log(s). Compared to the pseudophakic straylight norm (log(s) = 1.2),<sup>15</sup> this is 8.2x elevated above the straylight value in a pseudophakic patient of the same age. Straylight measurement of his left eye (also with an undilated pupil) was 1.29 log(s), which is within normal pseudophakic limits. At slit lamp examination, an opacification was seen on the posterior surface of the IOL in the right eye (Fig. 1A and B). The size of the capsulorhexis was relatively large; the posterior capsulotomy was somewhat smaller (see Fig. 1). However, the edges of both the

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capsulorhexis and the posterior capsulotomy were not visible within the pupil margin when the pupil was undilated. The IOL in his left eye was clear (not shown). Also, asteroid hyalosis was visibly present in both eyes, albeit more in his right eye. On funduscopy no further abnormalities were seen. After consultation with the patient regarding possible treatments, Nd:YAG laser treatment was performed. To this end, the focus of the Nd:YAG laser was set to posterior, the single pulse mode was selected, and the energy level per shot was set to 0.5 mJ. By aiming the laser just posterior to the opacifications, the opacifications could be carefully and slowly dissolved from the back of the IOL while preventing the occurrence of laser pits on the lens. The deposits were very adherent to each other and to the IOL. Therefore, several shots had to be fired at the same spot in order to dissolve the deposits from the IOL. With a total of 817 shots and a cumulative energy of 390 mJ, the opacifications could be removed to a large extent (Fig. 1C and D). At follow-up 5 weeks later, the patient said that he felt his vision had improved by 80%. He did not desire further treatment such as IOL exchange. His CDVA now was 20/20 (logMAR 0.0) and his log(s) straylight value was 1.76.

### 3. Discussion

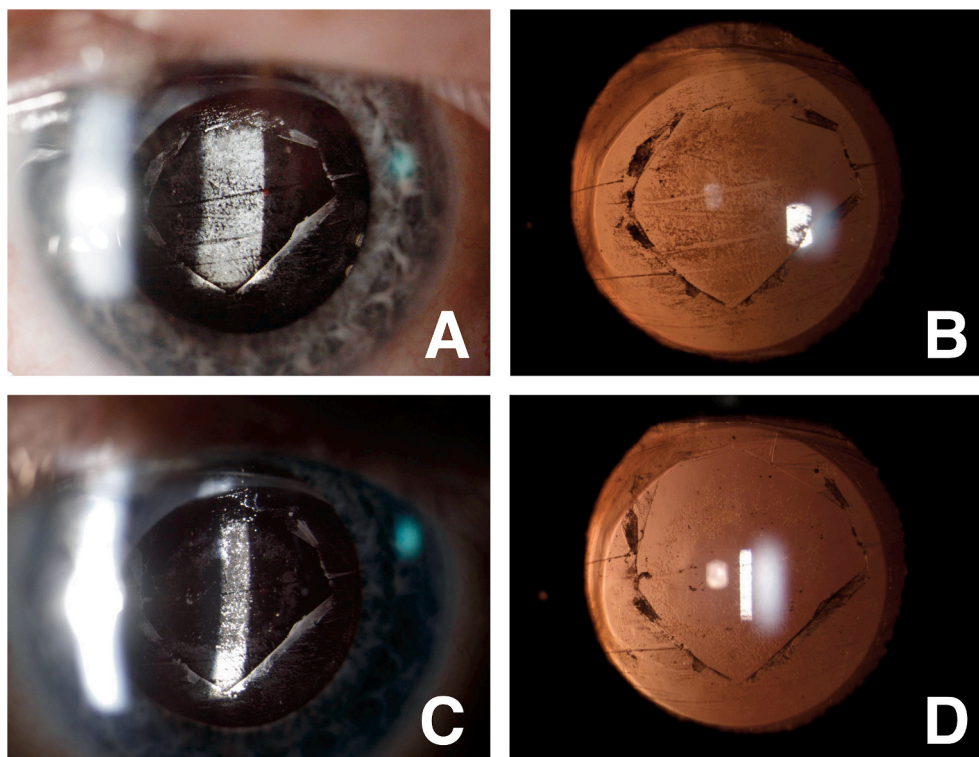
Asteroid hyalosis is a vitreous disease characterized by brilliant reflecting particles floating in an apparently normal vitreous body. These so-called asteroid bodies consist of calcium and phosphate. Its prevalence is estimated to be 1% and usually occurs unilaterally.<sup>16</sup> Typically, it does not cause any visual disturbances. The reason for this is that only a tiny fraction of the light is intercepted and thus scattered by the asteroid bodies.<sup>14,17</sup> In normal eyes, a few percent of all light entering the eye is scattered. Only if more than approximately 10% of light is intercepted and scattered, patients may start experiencing vision problems, first of all with increased straylight and glare. And, although the asteroid bodies may appear bright to the observer at the slit lamp, they will actually have little effect on quality of vision.<sup>14,17</sup>

In patients with asteroid hyalosis, and who have had cataract surgery with implantation of a silicone IOL, whitish-gray deposits with a

granular texture can accumulate as a crust-like layer on the posterior surface of the lens.<sup>6</sup> This material has been identified to be hydroxyapatite, consisting of calcium and phosphate.<sup>1,2</sup> It is believed to either be derived from the asteroid bodies or from a similar process that resulted in the vitreous condition itself.<sup>1</sup> Stringham et al.<sup>1</sup> have argued that calcium and phosphate can cross the barrier of the posterior lens capsule and thus lead to calcification of the lens with an intact capsule. Opacification, however, has been described in particular after laser capsulotomy has been performed, thereby suggesting that direct contact between the posterior IOL surface and the vitreous accelerates the process of calcium precipitation.<sup>1</sup>

The patient that we presented complained of disability glare, more specifically hazy vision at night when looking into headlights of cars. This was due to a significant increase in straylight. Straylight is an optical phenomenon where light is scattered in the eye. This forward scattered light creates a veil of light over the retina causing disability glare. The scattering of light is due to small, local inhomogeneities in the refractive index in the ocular media. The C-Quant is a commercially available instrument based on the compensation comparison method that can be used to measure visually functional straylight in a clinical setting.<sup>18</sup> It has been shown to provide accurate and precise results.<sup>19,20</sup> The measurement result is expressed as the logarithm of the straylight parameter, i.e., log(s).

In a normal eye, pupillary dilation has been found to be relatively unimportant for straylight.<sup>21</sup> This can be understood because straylight is a relative measure. It corresponds to the ratio of scattered light and total light entering the eye. Thus, if light scattering is more or less constant over the pupil plane, that ratio will be constant as well. In contrast, pupil size may affect straylight when inhomogeneities in the ocular media are not evenly distributed within the pupil margin. For example, it has been shown that when the anterior capsule is visible within the pupil margin, straylight can increase significantly.<sup>22</sup> In our patient, the edge of the capsulorhexis and of the posterior capsulotomy was not visible when the pupil was undilated. Thus, as we measured straylight in our patient with his pupil undilated, the edge of the



**Fig. 1.** Slit lamp photographs of the right eye of the patient. A, B, before neodymium-doped yttrium aluminum garnet (Nd:YAG) laser treatment. C, D, after Nd:YAG laser treatment. The decrease in particles is especially apparent when comparing the retro-illumination photographs in B and D.

capsulorhexis and of the posterior capsulotomy will not have affected our findings.

Details of the IOL were, unfortunately, not available since it had been implanted 20 years ago. More specifically, it is not known whether this lens was hydrophobic acrylic, hydrophilic acrylic or silicone. Although it might be presumed that it was a silicone lens since this material is known for adherence of hydroxyapatite particles, this cannot be stated for sure. It is also not known whether the IOL was spherical or aspheric. However, although spherical aberration does affect visual acuity (and contrast sensitivity), it does not affect straylight.<sup>14</sup> And, thus, it will not have influenced our findings. More specifically, spherical aberrations originate from light rays in the periphery of a lens that converge at a different focus than light rays in the center of the lens. Straylight, on the other hand, originates from small particles that intercept and scatter light entering the eye.

Various authors have investigated the accumulations on the back surface of the lens with scanning electron microscopy. Wackernagel et al.<sup>4</sup> have reported the size of the hydroxyapatite opacities to be approximately 7 µm in diameter. Matsumura et al.<sup>2</sup> did not report the size of the depositions; however, in their published electron microscope pictures, one can see that the deposits consist of crystals with an approximate size of 6 µm. Irregularities in the optical media that extend over 100 µm to millimeters typically influence optical aberrations and, hereby, visual acuity. On the other hand, irregularities in the order of micrometers induce light scatter and, hereby, glare. Therefore, based on their dimensions of 6 µm–7 µm, it is likely that these particles induce straylight.<sup>14,23</sup> And, as these particles covered a large proportion of the optic in our patient, it caused the disability glare.

Several treatment options to remove the calcium deposits on the posterior surface of the IOL in the presence of asteroid hyalosis have been published. Nd:YAG laser treatment, which is the least invasive and most safe treatment option, can be applied to remove the deposits to some extent. In our case, this led to a significant improvement in visual acuity and, in particular, in straylight. The C-Quant straylight value decreased from log(s) 2.08 before treatment (8.2x above the normal pseudophakic value) to log(s) 1.76 after treatment (3.9x above the normal pseudophakic value). This was congruent with the patient's subjective improvement. Nonetheless, complaints may not disappear completely as it is difficult to remove the deposits in total. In addition, the calcium-phosphate precipitates may reaccumulate.<sup>1,9,11</sup> It has to be noted that we used a considerable amount of laser energy (i.e., 390 mJ) to remove the deposits on the IOL. It is known that, when performing a posterior capsulotomy with a Nd:YAG laser, possible complications are cystoid macular edema (CME), an increase in intraocular pressure, and retinal defects/detachments. It is, however, not clear whether these complications are due to opening of the posterior capsule or due to the energy transmitted to the eye, or both.<sup>24,25</sup> In our case, the posterior capsule had already been opened. Nonetheless, frequent follow-ups over a longer period of time may be advisable after using a Nd:YAG laser to remove asteroid hyalosis deposits to identify possible short-term and long-term complications.

PPV can also be used to clean the posterior surface of the IOL, albeit with varying success.<sup>7,8,10,12</sup> PPV may, however, also be used to remove the vitreous including the asteroid bodies which might even halt the progressive dystrophic calcification of the IOL.<sup>7,12</sup> In case of persisting complaints, IOL exchange may be considered. However, if the posterior lens capsule has been compromised due to a Nd:YAG laser capsulotomy, there is an increased risk of loss of vitreous. Therefore, ophthalmologists might consider deferring laser posterior capsulotomy treatment in a suspected calcified silicone IOL to facilitate an IOL exchange procedure.<sup>6</sup>

#### 4. Conclusions

Our present case shows that calcifications on the back of the IOL associated with asteroid hyalosis can induce severe straylight complaints while visual acuity may be (relatively) preserved. In addition,

Nd:YAG laser treatment can lead to a satisfying improvement in both straylight and visual acuity. Long term follow-up will show whether recurrence of the deposits in this patient will take place, in which case IOL exchange or PPV may be considered. We would like to emphasize that awareness of glare complaints in patients with an opacified IOL is important and that documentation with C-Quant measurements may be helpful in indicating treatment, evaluating the treatment, and following up the patient.

#### Patient consent

Consent to publish the case report was not obtained. This report does not contain any personal information that could lead to the identification of the patient.

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#### Authorship

All authors attest that they meet the current ICMJE criteria for Authorship.

#### Intellectual property

We confirm that we have given due consideration to the protection of intellectual property associated with this work and that there are no impediments to publication, including the timing of publication, with respect to intellectual property. In so doing we confirm that we have followed the regulations of our institutions concerning intellectual property.

#### Research ethics

We further confirm that any aspect of the work covered in this manuscript that has involved human patients has been conducted with the ethical approval of all relevant bodies and that such approvals are acknowledged within the manuscript.

#### Declaration of competing interest

The Netherlands Academy of Arts and Sciences owns a patent on straylight measurement, with Dr. van den Berg as the inventor, and licenses that to Oculus Optikgeräte GmbH for the C-Quant instrument.

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