Changes in Straylight after Cataract Surgery

Reus, Nicolaas J; van den Berg, Thomas J T P

published in
Journal of Cataract and Refractive Surgery
2024

DOI (link to publisher)
10.1097/j.jcrs.0000000000001349

document version
Publisher's PDF, also known as Version of record

Open

ARTICLE

Changes in straylight after cataract surgery

Nicolaas J. Reus, MD, PhD, Thomas J.T.P. van den Berg, PhD

Purpose: To investigate straylight in the immediate postoperative period after cataract surgery.

Setting: Amphia Hospital, Breda, the Netherlands.

Design: Prospective, comparative, single-arm, single-center, single-surgeon study.

Methods: Patients underwent cataract surgery on both eyes. 1 eye was randomly selected for implantation with a Clareon CNA0T0 intraocular lens (IOL); the fellow eye received a Vivinex XY1 IOL. Straylight was measured with the C-Quant straylight meter.

Results: 25 patients were included. Preoperatively, 1 day, 1 week, 1 month, and 3 months postoperatively, eyes with a CNA0T0 IOL had straylight levels (mean ± SD) of 1.48 ± 0.23, 1.26 ± 0.20, 1.06 ± 0.19, 1.11 ± 0.25, and 1.09 ± 0.20 log(s), respectively. For eyes with an XY1 IOL, these values were 1.48 ± 0.21, 1.41 ± 0.41, 1.10 ± 0.20, 1.13 ± 0.20, and 1.16 ± 0.20 log(s), respectively. From 1 week postoperatively, straylight values did not change (1 week vs 3 months: $P = .40$ and $P = .14$ and 1 month vs 3 months: $P = .74$ and $P = .50$ for CNA0T0 and XY1, respectively). The Pearson correlation coefficient for straylight values between the 2 eyes of individual subjects was 0.80 at 3 months.

Conclusions: Straylight levels can be considered stable 1 week after cataract surgery. We believe it is safe to use straylight measurements 1 month postoperatively for clinical trials. Straylight is highly correlated between the 2 eyes of an individual postoperatively.

J Cataract Refract Surg 2024; 50:244–249 Copyright © 2023 The Author(s). Published by Wolters Kluwer Health, Inc. on behalf of ASCRS and ESCRS

Straylight is the visual effect of an optical phenomenon in which light is scattered in the eye. It is typically perceived as the radiation of light emanating from a bright light source against a dark background.[1] Straylight creates a veil of light over the retina, which reduces the contrast of the image projected onto the retina.[2–5] Typical complaints include glare while driving at night and hazy vision and perception of halos.[5,6] It can also cause spatial disorientation.[7] In cataracts, straylight is greatly increased due to an increase in the number of small particles in the lens.[7] It can be the leading complaint when cataract develops. With cataract surgery, the cloudy lens is removed and replaced with a clear artificial intraocular lens (IOL). This leads to a reduction in straylight postoperatively and a subsequent improvement in visual impairment.[8,9]

Previous studies on straylight after cataract surgery have typically measured straylight at either 1 or 3 months postoperatively.[10–13] These studies have shown that the amount of straylight decreases significantly with cataract surgery. However, it is not known when straylight can be considered stable after cataract surgery. The aim of this study was to investigate how straylight changes in the immediate postoperative period and when it can be considered stable.

METHODS

This prospective, comparative, single-arm, single-center study was conducted at the Department of Ophthalmology of the Amphia hospital, Breda, the Netherlands. Institutional Review Board/Ethics Committee (MEC-U; www.mec-u.nl) approval was obtained. The study was preregistered with the International Clinical Trials Registry Platform (https://trialsearch.who.int/; ID: NL8119). Written informed consent was obtained from all subjects after explanation of the nature and possible consequences of the study. The study adhered to the tenets of the Declaration of Helsinki.

This study is part of a larger study investigating factors that may affect residual straylight after cataract surgery. One such factor may be the adhesion of the IOL to the lens capsule or the adhesion of lens epithelial cells to the IOL, which remain (to some extent) in the lens bag after cataract surgery. To investigate a possible effect of different IOLs, we implanted a Clareon CNA0T0 IOL with AutonoMe (www.alcon.com) in 1 eye and a Vivinex XY1 IOL with iSert (www.hoyasurgical.com) in the fellow eye and assessed straylight postoperatively. Both IOLs are single-piece hydrophobic

Submitted: April 6, 2023 | Final revision submitted: October 17, 2023 | Accepted: October 18, 2023

From the Department of Ophthalmology, Amphia Hospital, Breda, the Netherlands (Reus); Netherlands Institute for Neuroscience, Royal Netherlands Academy of Arts and Sciences, Amsterdam, the Netherlands (van den Berg).

Supported by an investigator-initiated grant from Alcon Laboratories, Inc. (IIT 41855129)

Presented (in part) at the 39th Congress of the ESCRS, Amsterdam, the Netherlands, October 2021.

Corresponding author: Nicolaas J. Reus, MD, PhD, Department of Ophthalmology, Amphia, Molengracht 21, 4818 CK Breda, the Netherlands. Email: nreus@amphia.nl.

0886-3350/$ - see frontmatter
https://doi.org/10.1097/j.jcrs.0000000000001349

monofocal IOLs with a blue light filter and have comparable light transmission characteristics.[14,15]

Twenty-five patients with cataract in both eyes who were scheduled for cataract surgery were included. Inclusion criteria were a diagnosis of cataract in both eyes, having consented to and planned to undergo cataract surgery in both eyes, planned implantation of a nontoric monofocal IOL, targeted refractive error of emmetropia, and age of at least 18 years. Exclusion criteria were any comorbidity (other than cataract) that could significantly affect visual function and/or increase straylight and/or prolong visual recovery postoperatively (eg, significant macular degeneration, glaucoma, and diabetic eye disease), a history of ocular surgery (eg, corneal refractive surgery), an increased risk for complicated cataract surgery, corneal astigmatism of ≥3 diopters (D), and a calculated IOL power for emmetropia in any eye that was outside the available range.

Visual acuity (VA) and straylight were measured preoperatively and at 1 day, 1 week, 1 month, and 3 months postoperatively. Straylight was measured using the C-Quant straylight meter (www.oculus.de). This instrument measures ocular straylight using the compensation comparison method and has been shown to provide accurate and precise measures of straylight in routine clinical practice.[16–20] An estimated SD less than 0.10 log was used as the limit value for reliability. Values were expressed as the logarithm of the straylight parameter, that is, log(s). Every measurement was performed twice. The average of the 2 measurements was taken for calculations. VA was measured at 4 m using the Early Treatment Diabetic Retinopathy Study chart and was recorded as the logMAR. Manifest refractive errors were converted to standard 6-m values.[21]

Cataract surgery was performed by one of the authors (N.J.R.) at the ophthalmological day care surgical center of the Amphia hospital. All surgeries were performed under topical anesthesia. A temporal clear corneal incision of 2.2 mm and 2 side-port incisions of ± 1 mm were used in all eyes. Phacoemulsification was performed with a peristaltic phacoemulsification device (Centurion Vision System; www.alcon.com). As per standard care in the hospital, no eye shield was given postoperatively. All patients used dexamethasone 0.1% eyedrops 3 times a day for 3 weeks in tapering fashion and nepafenac eyedrops once daily starting the night preoperatively for 3 weeks. One eye was randomly selected to be implanted with the CNA0T0 IOL; the fellow eye received the XY1 IOL. The power of the implanted IOLs was calculated with the Barrett Universal II formula on the optical biometer (IOLMaster 700; www.zeiss.com) using an A constant of 119.1 (corresponding to a lens factor of 1.94) for CNA0T0 IOLs and an A constant of 119.2 (corresponding to an lens factor of 1.99) for XY1 IOLs (as suggested by the manufacturers).[22] Randomization was performed with the randomization module of the certified Castor data management platform (www.castoredc.com). There was a 2-week interval between the operations on both eyes.

Data were analyzed using custom modules in the python programming language. Normality was tested with the Shapiro-Wilk test. Differences within eyes and between fellow eyes were tested with a paired samples t test. The significance level for all tests was 0.05. Bonferroni correction was used in case of multiple testing.

RESULTS

The mean (SD; range) age of patients was 72.8 (6.5; 53 to 84) years. Seventeen patients (68%) were female. A CNA0T0 IOL was implanted in the right eye in 13 (52%) patients. Further patient characteristics are presented in Table 1. One eye of 1 patient (who was randomized to implantation of a CNA0T0 IOL) had a very high estimated SD of 0.46 at the preoperative visit. This measurement was excluded from analysis. One eye (with an XY1 IOL) of 1 patient developed cystoid macular edema at the 3-month visit. This measurement was excluded from analysis. All other measurements were used for analysis. One patient developed a moderate punctate keratopathy at 1 month postoperatively in both eyes for which lubricating eyedrops were prescribed; the punctate keratopathy had disappeared at the 3-month visit. Three eyes (6%) of 3 patients had a temporary increase in intraocular pressure (IOP) (28 mm Hg to 32 mm Hg) 1 day postoperatively, for which IOP-lowering medication was given either once or for a couple of days. One eye of 1 patient developed a posterior vitreous detachment 1 month after cataract surgery without any further sequelae.

Figure 1 shows the repeatability of the straylight measurements. The mean difference between the first and the second measurement at each time point was 0.003 log(s). The upper 97.5 percentile of the distribution of the differences was 0.212 log(s); the lower 2.5 percentile was −0.219 log(s).

As can be seen in Figure 2 and Table 2, straylight values at 1 day after cataract surgery were generally already lower than preoperatively. The difference between preoperative and 1-day postoperative straylight values was statistically significant for eyes with a CNA0T0 IOL ($P < .01$) but not statistically significant for eyes with an XY1 IOL ($P = .46$). Two eyes (with an XY1 IOL) showed a significant increase in straylight (log[s] values of 2.13 and 3.01). These 2 eyes had a significant amount of corneal edema. They had poorer VAs with corrected distance VAs (CDVAs) of 0.32 logMAR and 0.46 logMAR, respectively. Overall, CDVA improved from preoperatively 0.2 ± 0.1 and 0.3 ± 0.1 logMAR in eyes with a CNA0T0 and with an XY1, respectively, to 0.05 ± 0.11 and 0.08 ± 0.13 1 day postoperatively (Table 1). Although both straylight and VA improved at 1 day, the correlation between straylight and CDVA was weak (Pearson correlation coefficient, 0.32) (after exclusion of the 2 cases with significant corneal edema).

One week postoperatively, straylight values had decreased further and remained stable afterward. There was no statistically significant difference in straylight between 1 week and 3 months ($P = .40$ and .14 for CNA0T0 and XY1, respectively) and between 1 month and 3 months ($P = .74$ and .50 for CNA0T0 and XY1, respectively). Straylight values were statistically significantly lower at 3 months than preoperatively and to 1 day postoperatively both for eyes with a CNA0T0 ($P < .001$ and $P < .001$, respectively) and an XY1 IOL ($P < .001$ and $P < .01$, respectively).

The straylight values between the 2 eyes of individual subjects were generally highly correlated: the Pearson correlation coefficient was 0.62 preoperatively, 0.30 at 1 day, 0.77 at 1 week, 0.67 at 1 month, and 0.80 at 3 months (Figure 3). In other words: after cataract surgery, subjects with lower amounts of straylight in 1 eye were likely to have lower amounts of straylight in the fellow eye. Similarly, subjects with more straylight in 1 eye were likely to have more straylight in the fellow eye.

Parameter	CNA0T0 Mean ± SD (range)	XY1 Mean ± SD (range)
CDVA preop (logMAR)	0.22 ± 0.13 (−0.04, 0.56)	0.25 ± 0.10 (0.06, 0.50)
LOCS NO	4.0 ± 0.5 (3.0, 4.8)	4.0 ± 0.5 (3.0, 5.0)
LOCS NC	4.0 ± 0.5 (3.0, 5.0)	4.0 ± 0.4 (3.0, 5.0)
LOCS C	1.9 ± 1.4 (0.1, 5.5)	1.9 ± 1.4 (0.1, 5.5)
LOCS P	1.1 ± 1.5 (0.1, 4.5)	0.8 ± 1.3 (0.1, 5.0)
CDE	5.3 ± 2.9 (0.1, 16.6)	5.3 ± 2.0 (1.5, 10.6)
IOL power (D)	22.1 ± 2.5 (14.0, 26.5)	21.7 ± 2.9 (11.0, 25.0)
SEQ at 3 mo postop (D)	0.23 ± 0.33 (−0.21, 0.79)	−0.19 ± 0.37 (−1.21, 0.42)
Cylinder at 3 mo postop (D)	0.84 ± 0.44 (0.00, 2.00)	1.02 ± 0.65 (0.00, 2.50)
PE at 3 mo postop (D)	0.17 ± 0.31 (−0.42, 0.63)	−0.26 ± 0.34 (−1.18, 0.30)
UDVA at 1 d postop (logMAR)	0.20 ± 0.11 (−0.02, 0.44)	0.24 ± 0.16 (0.00, 0.54)
CDVA at 1 d postop (logMAR)	0.05 ± 0.11 (−0.08, 0.30)	0.08 ± 0.13 (−0.08, 0.46)
UDVA at 3 mo postop (logMAR)	0.10 ± 0.11 (−0.08, 0.30)	0.12 ± 0.09 (−0.04, 0.32)
CDVA at 3 mo postop (logMAR)	−0.03 ± 0.07 (−0.14, 0.12)	0.00 ± 0.08 (−0.14, 0.20)

Table 1. Patient characteristics

C = cortical; CDE = cumulative dissipated energy; NC = nuclear color; NO = nuclear opacity; P = posterior; PE = prediction error; SEQ = spherical equivalent

Figure 4 shows the straylight values vs age at various time points with superposition of the phakic and pseudophakic norms.[9,23] From 1 week postoperatively onward, the straylight values fell within, or were even slightly below, the pseudophakic norm. Note, however, the large variability in straylight values of individual eyes. The average (unlogged) straylight values were 1.10x, 0.90x, 0.92x, and 0.93x the average pseudophakic norm at 1 day, 1 week, 1 month, and 3 months, respectively.

DISCUSSION

We have found that straylight values in eyes with implantation of a hydrophobic IOL can be considered stable as early as 1 week after cataract surgery. This is important both clinically and for research. Previous scientific studies on straylight have measured straylight at either 1 month or 3 months postoperatively. Our results show that stable straylight values can be reliably obtained at 1 month postoperatively. The ability to accurately measure straylight at 1 month postoperatively significantly reduces the time needed to follow-up subjects.

One day postoperatively, straylight levels were already lower in most eyes than preoperatively. This can be important for patients, as it means that they may already be experiencing an improvement in their visual function. Nonetheless, straylight levels had generally not yet reached the low levels seen at 1 week and later. At the slitlamp, this seemed to be due to the presence of corneal edema. Corneal edema after cataract surgery may be due to several factors, such as the amount of balanced salt solution used during surgery, the irrigation flow rate used, the amount of phacoemulsification energy used, the

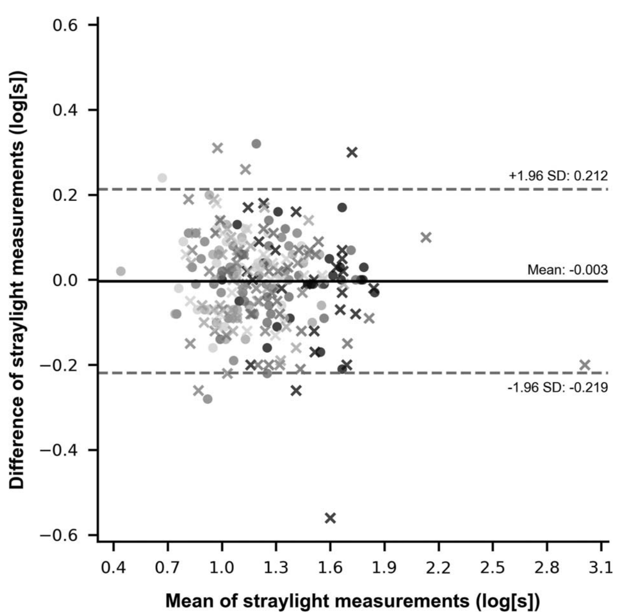

Figure 1. Bland-Altman plot showing the difference between the first and second straylight measurement at each visit for each eye vs the mean of the two. *Circular markers* represent eyes implanted with a CNA0T0 IOL. *Cross markers* those with an XY1 IOL. The *solid line* represents the mean difference. The *upper* and *lower dotted lines* represent the 97.5 percentile and 2.5 percentile of the distribution of the differences, respectively.

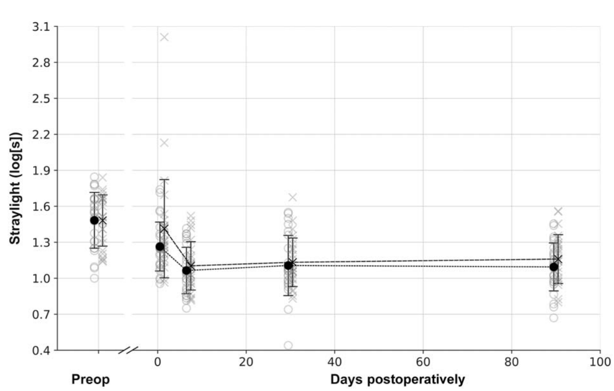

Figure 2. Straylight values before and 1 day, 1 week, 1 month, and 3 months after cataract surgery. Individual straylight values are shown in *gray* with *open markers*. Mean ± SD straylight values are shown in black with *closed markers*. *Circular markers* represent eyes implanted with a CNA0T0 IOL; *cross markers* those with an XY1 IOL. Some horizontal displacement has been added to the datapoints at each time point for readability.

Table 2. Mean ± SD straylight values, expressed as log(s), of eyes implanted with a CNA0T0 IOL and their fellow eyes implanted with an XY1 IOL before and 1 day, 1 week, 1 month, and 3 months after cataract surgery

Parameter	CNA0T0 IOL eyes	XY1 IOL eyes	*P* value
Preop	1.48 ± 0.23	1.48 ± 0.21	.98
1 d postop	1.26 ± 0.20	1.41 ± 0.41	.10
1 wk postop	1.06 ± 0.19	1.10 ± 0.20	.17
1 mo postop	1.11 ± 0.25	1.13 ± 0.20	.49
3 mo postop	1.09 ± 0.20	1.16 ± 0.20	.02

Differences were not statistically significantly different after Bonferroni correction

amount of corneal distortion due to instrument maneuvering, and patient-related factors.[24] It is important to note that an experienced cataract surgeon performed all phacoemulsification surgeries through a temporal approach. Whether our results would have been similar if we had used a superior incision remains to be investigated. A superior approach may induce more corneal edema due to suboptimal access to the eye, for example, in deep-set eyes. In addition, a less experienced surgeon, for example, a resident, might have induced more corneal edema, resulting in slower recovery of visual function. Whether other factors, such as anterior chamber flare or transient fibrosis of the posterior capsule, may have contributed to the increased straylight levels 1 day postoperatively remains to be investigated. Two eyes (in the XY1 IOL group) had a significantly higher amount of straylight than preoperatively. This was due to severe corneal edema. One week postoperatively, the corneal edema had resolved spontaneously and the straylight values normalized. Of note, the amount of energy used for emulsification in these eyes was very similar to that used in the other eyes. It is not known what other factors may have been involved.

Similar to straylight, VA (both UDVA and CDVA) was better 1 day after cataract surgery than before. The 2 eyes that showed significant corneal edema had a poorer VA. When eliminating these 2 outliers, there was a poor correlation between straylight and UDVA (Pearson correlation coefficient, 0.17) and a weak one between straylight and CDVA (Pearson correlation coefficient, 0.32). This illustrates that VA and straylight are 2 different aspects of visual function.[7] Of note, similar to the straylight measurements, our patients' UDVA and CDVA were also stable 1 week after cataract surgery.

After cataract surgery, straylight values returned to levels that are similar to published data for pseudophakic eyes.[23] The range of normal values for straylight is twice as wide in pseudophakic eyes (0.84 log[s]) than in phakic ones (0.40 log [s]).[9,23] The reason for this is not known. The amount of straylight normally varies from eye to eye and increases with age. In the young normal eye, one-third of the straylight is due to light scattered in the cornea, one-third to light scattered in the crystalline lens, and the remaining third to light transmitted through the iris and sclera and light scattered at the retina.[2,6] In cataract, the amount of scattering increases. By contrast, IOLs generally have very little light scatter. In fact,

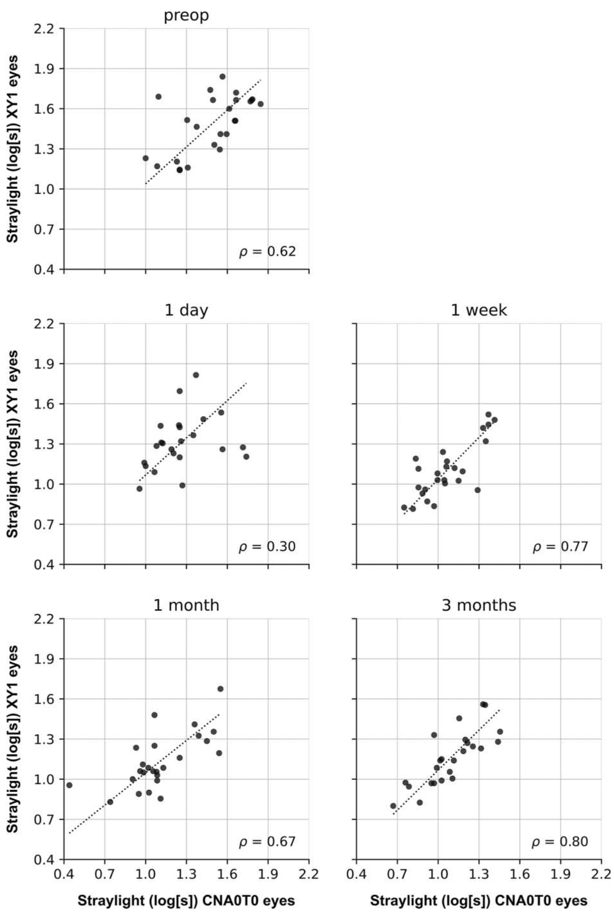

Figure 3. Comparison between straylight values of both eyes of the same patient at different time points (ie, before and at 1 day, 1 week, 1 month, and 3 months after cataract surgery). At 1 day postoperatively, measurements from the 2 patients with significant corneal edema were excluded from this analysis. The *dotted straight line* represents the reduced major axis regression line. The Pearson correlation coefficient is shown in the lower right corner of each subfigure.

they induce less straylight than the phakic lens of a 20-year-old subject.[25,26] Thus, one would expect straylight in pseudophakic eyes to be even lower than the phakic norm. By contrast, straylight levels in young pseudophakic eyes are higher than in young phakic ones.[9,23] Slitlamp examination of our subjects did not reveal any obvious sources of increased straylight. The cornea was very clear at the slitlamp in all patients. As were the IOLs themselves, there were no glistenings, subsurface nanoglistenings (SSNGs), or surface haze in any of the IOLs at any visit. In addition, the posterior capsule was very clear at all visits.

Straylight values after cataract surgery in the 2 eyes of individual patients were highly correlated: Subjects with more straylight in 1 eye were likely to have more straylight in the fellow eye. We do not know the reason for this. Whether it is due to similar scattering characteristics of the cornea, posterior capsule, vitreous, or other parameters in an individual remains to be investigated.

We found no statistically significant differences (after Bonferroni correction) in straylight between eyes implanted with the CNA0T0 or the XY1 IOL.[14,15] Including

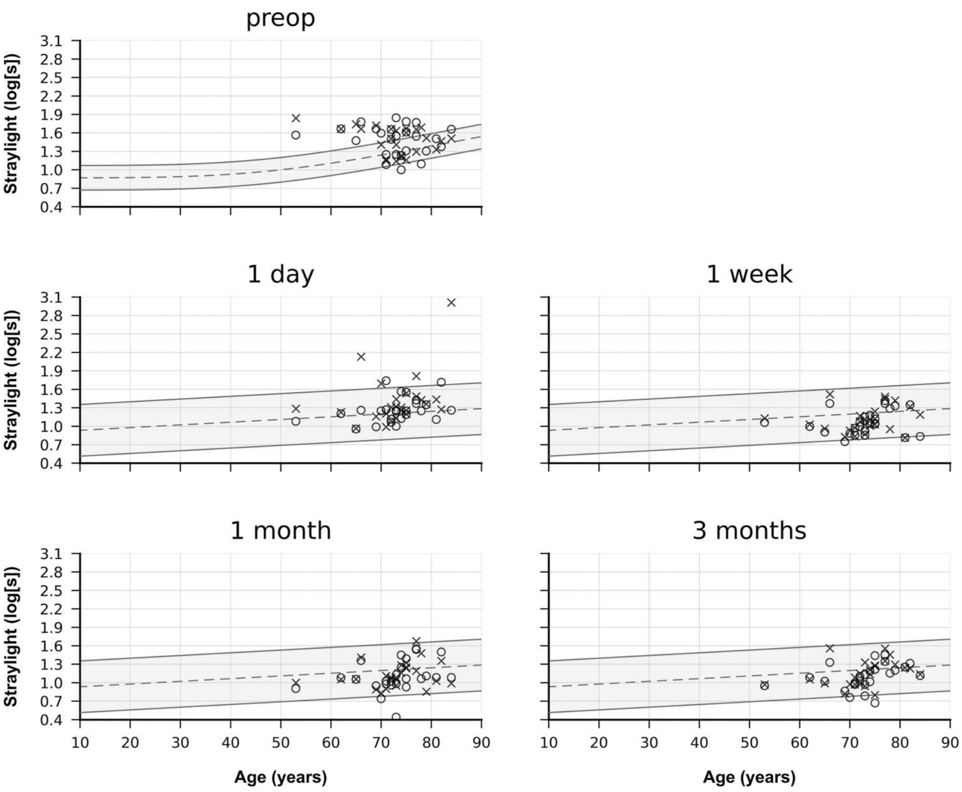

Figure 4. Straylight values as a function of subject age at different time points (ie, before and at 1 day, 1 week, 1 month, and 3 months after cataract surgery) in relation to the phakic (Van den Berg et al., 2007) and pseudophakic (Łabuz et al., 2014) reference norms, respectively, of straylight vs age and its 95% CI.[9,23] *Circular markers* represent eyes implanted with a CNA0T0 IOL; *cross markers* those with an XY1 IOL.

more patients might have allowed us to detect a statistically significant difference. Based on the mean and SD of the paired difference of straylight values at 3 months that we found (ie, 0.07 ± 0.13 log[s]), this would require at least 45 subjects to achieve a power of 80% and a level of significance of 1% (2-sided) (www.statulator.com/samplesize/ss2pm.html).

Both IOLs that we used are hydrophobic, have a blue light filter, and have very similar light transmission graphs.[14,15] The effect of a blue light filter in the IOL on straylight is uncertain: Werner et al. found straylight, when measured in vitro at a visual angle between 5 degrees and 10 degrees (corresponding to the visual angle assessed by the C-Quant) to be, on average, 0.015 log(s) higher in IOLs with a blue light filter than in clear IOLs.[27] This difference was not statistically significantly different. By contrast, Łabuz et al. found straylight to be 0.04 log(s) lower in IOLs with a blue light filter implanted in patients.[28] However, this was also not statistically significant. The use of hydrophobic vs hydrophilic material on straylight in IOLs is also inconclusive: In vivo measurements show that patients with hydrophobic IOLs have more straylight (in the order of 0.1 log[s]) than hydrophilic IOLs.[28,29] In vitro measurements, however, suggest that hydrophilic IOLs tend to have a higher amount of straylight than hydrophobic ones.[30] This difference might be due to the development of glistenings or other imperfections (eg, SSNGs) in the IOLs over time.[29] During the follow-up of patients in this study, we could not detect either SSNGs or glistenings in any IOL at any time point. Longer follow-up would be necessary to detect any change in the optical characteristics of these IOLs. Of note, recent studies with 3 years of follow-up found no glistenings in Clareon IOLs and none to only a few in Vivinex IOLs.[31,32]

The prediction error of eyes implanted with an XY1 IOL was, on average, slightly myopic, whereas that of eyes implanted with a CNA0T0 IOL was slightly hyperopic (−0.26 D vs 0.17 D). In this study, we used the lens constants as suggested by the manufacturer at the start of the study.

In conclusion, straylight values after cataract surgery decrease significantly after cataract surgery and can be considered stable at 1 week postoperatively. Therefore, we think it is generally safe to use straylight measurements at 1 month postoperatively for clinical studies.

WHAT WAS KNOWN

- Cataracts cause an increase in straylight, which leads to visual impairment.
- Cataract surgery significantly reduces the amount of straylight.

WHAT THIS PAPER ADDS

- We found that straylight levels can be considered stable 1 week after cataract surgery.
- For clinical studies, we think it is generally safe to use straylight measurements at 1 month postoperatively.
- Straylight is highly correlated between the 2 eyes of pseudophakic subjects.

REFERENCES

1. van den Berg TJTP, Hagenouw MPJ, Coppens JE. The ciliary corona: physical model and simulation of the fine needles radiating from point light sources. Invest Ophthalmol Vis Sci 2005;46:2627–2632
2. Vos JJ. Disability glare: a state of the art report. CIE J 1984;3:39–53
3. de Waard PW, IJspeert JK, van den Berg TJ, de Jong PT. Intraocular light scattering in age-related cataracts. Invest Ophthalmol Vis Sci 1992;33:618–625
4. van der Mooren M, Rosén R, Franssen L, Lundström L, Piers P. Degradation of visual performance with increasing levels of retinal stray light degradation of vision by increased retinal stray light. Invest Ophthalmol Vis Sci 2016;57:5443–5448
5. Aslam TM, Haider D, Murray IJ. Principles of disability glare measurement: an ophthalmological perspective. Acta Ophthalmol Scan 2007;85:354–360
6. van den Berg TJTP, Franssen L, Coppens JE. Ocular media clarity and straylight. In: Dartt DA, ed. Encyclopedia of the Eye. Oxford: Academic Press; 2010:173–183
7. Berg TJTP. The (lack of) relation between straylight and visual acuity. Two domains of the point-spread-function. Ophthalmic Physiol Opt 2017;37:333–341
8. van der Meulen IJE, Gjertsen J, Kruijt B, Witmer JP, Rulo A, Schlingemann RO, van den Berg TJTP. Straylight measurements as an indication for cataract surgery. J Cataract Refract Surg 2012;38:840–848
9. van den Berg TJTP, van Rijn LJR, Michael R, Heine C, Coeckelbergh T, Nischler C, Wilhelm H, Grabner G, Emesz M, Barraquer RI, Coppens JE, Franssen L. Straylight effects with aging and lens extraction. Am J Ophthalmol 2007;144:358–363.e1
10. van Gaalen KW, Koopmans SA, Jansonius NM, Kooijman AC. Clinical comparison of the optical performance of aspheric and spherical intraocular lenses. J Cataract Refract Surg 2010;36:34–43
11. Lapid-Gortzak R, van der Meulen IJE, van der Linden JW, Mourits MP, van den Berg TJTP. Straylight before and after phacoemulsification in eyes with preoperative corrected distance visual acuity better than 0.1 logMAR. J Cataract Refract Surg 2014;40:748–755
12. van der Meulen IJE, Engelbrecht LA, Riet TCTV, Lapid-Gortzak R, Nieuwendaal CP, Mourits MP, van den Berg TJTP. Contributions of the capsulorrhexis to straylight. Arch Ophthalmol 2009;127:1290–1295
13. Xu J, Zheng T, Lu Y. Effect of decentration on the optical quality of monofocal, extended depth of focus, and bifocal intraocular lenses. J Refract Surg 2019;35:484–492
14. Clareon IOL [Package Insert]. Alcon Laboratories, Inc., 2017
15. Vivinex ISert [Package Insert]. Hoya Surgical Optics GmbH, 2018
16. van den Berg TJTP, Franssen L, Kruijt B, Coppens JE. History of ocular straylight measurement: a review. Z Med Phys 2013;23:6–20
17. van den Berg TJTP, Franssen L, Coppens JE. Straylight in the human eye: testing objectivity and optical character of the psychophysical measurement. Ophthalmic Physiol Opt 2009;29:345–350
18. Cerviño A, Montes-Mico R, Hosking SL. Performance of the compensation comparison method for retinal straylight measurement: effect of patient's age on repeatability. Br J Ophthalmol 2008;92:788–791
19. Coppens JE, Franssen L, Rijn LJvan, van den Berg TJTP. Reliability of the compensation comparison stray-light measurement method. J Biomed Opt 2006;11:34027
20. Guber I, Bachmann LM, Guber J, Bochmann F, Lange AP, Thiel MA. Reproducibility of straylight measurement by C-Quant for assessment of retinal straylight using the compensation comparison method. Graefes Arch Clin Exp Ophthalmol 2011;249:1367–1371
21. Simpson MJ, Charman WN. The effect of testing distance on intraocular lens power calculation. J Refract Surg 2014;30:726
22. Langenbucher A. IOL Con. Available at: https://www.iolcon.org. Accessed March 26, 2023
23. Łabuz G, Reus NJ, van den Berg TJTP. Ocular straylight in the normal pseudophakic eye. J Cataract Refract Surg 2015;41:1406–1415
24. Lhuillier L, Jeancolas AL, Renaudin L, Goetz C, Ameloot F, Premy S, Ouamara N, Perone JM. Impact of ophthalmic surgeon experience on early postoperative central corneal thickness after cataract surgery. Cornea 2017;36:541–545
25. Łabuz G, Reus NJ, van den Berg TJTP. Straylight from glistenings in intraocular lenses: in vitro study. J Cataract Refract Surg 2017;43:102–108
26. Łabuz G, Knebel D, Auffarth GU, Fang H, van den Berg TJTP, Yildirim TM, Son HS, Khoramnia R. Glistening formation and light scattering in six hydrophobic-acrylic intraocular lenses. Am J Ophthalmol 2018;196:112–120
27. Werner L, Stover JC, Schwiegerling J, Das KK. Light scattering, straylight, and optical quality in hydrophobic acrylic intraocular lenses with subsurface nanoglistenings. J Cataract Refract Surg 2016;42:148–156
28. Łabuz G, Reus NJ, van den Berg TJTP. Comparison of ocular straylight after implantation of multifocal intraocular lenses. J Cataract Refract Surg 2016;42:618–625
29. Tang Y, Song H, Chen J, Tang X. Comparison of pseudophakic retinal straylight in spherical/aspherical and hydrophobic/hydrophilic intraocular lens. Int J Ophthalmol 2014;8:1146–1150
30. Langeslag MJM, van der Mooren M, Beiko GHH, Piers PA. Impact of intraocular lens material and design on light scatter: in vitro study. J Cataract Refract Surg 2014;40:2120–2127
31. Nuijts RMMA, Bhatt U, Nanavaty MA, Roberts TV, Peterson R, Teus MA. Three-year multinational clinical study on an aspheric hydrophobic acrylic intraocular lens. J Cataract Refract Surg 2023;49:672–678
32. Auffarth GU, Brézin A, Lignereux F, Khoramnia R, Yildirim TM, Kohnen T, Bianco J. Randomized multicenter trial to assess posterior capsule opacification and glistenings in two hydrophobic acrylic intraocular lenses. Sci Rep 2023;13:2822

Disclosures: *Research support by Alcon Laboratories, Inc. (N.J.R. and T.J.T.P.v.d.B.); consultancy for Alcon Laboratories, Inc. (N.J.R.), Johnson & Johnson Vision (N.J.R.), and Carl Zeiss Meditec AG (N.J.R.). The Netherlands Academy of Arts and Sciences owns a patent on straylight measurement, with T.J.T.P. van den Berg as the inventor, and licenses that to Oculus Optikgeräte GmbH for the C-Quant instrument.*

First author:
Nicolaas J. Reus, MD, PhD

Department of Ophthalmology, Amphia Hospital, Breda, the Netherlands