Comparison of pseudophakic dysphotopsia with Akreos Adapt and SN60-AT intraocular lenses

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PURPOSE: To determine the relative incidence of unwanted light images with the AcrySof SN60-AT intraocular lens (IOL) (Alcon) and the Akreos Adapt (Bausch & Lomb) IOL.

SETTING: The Eye Clinic, Sir Charles Gairdner Hospital, Nedlands, Australia.

METHODS: In a prospective randomized study of 61 patients who had cataract surgery, the relative incidence of unwanted light images with 2 biconvex acrylic double square-edged IOLs, the SN60-AT and Akreos Adapt, was compared. Patients were followed at 1 week and for a minimum of 6 weeks. At both follow-ups, patients were asked to rate their experience of dysphotopic phenomenon according to a set of questionnaire criteria. The Mann-Whitney test was used to analyze the ordinal data.

RESULTS: All 61 patients were interviewed at both stages of follow-up. The mean follow-up was 8 weeks $\pm$ 2 (SD). At 1 week, there was significantly more dysphotopsia (positive and negative) with the SN60-AT IOL (37.5%) than with the Akreos Adapt IOL (24.1%) ($P = .042$). Significantly more patients with the SN60-AT IOL reported negative dysphotopsia at 1 week only. At 8 weeks, the incidence of positive and negative dysphotopsia declined to 31.3% and 20.7% in the SN60-AT group and Akreos Adapt group, respectively, and there was no longer a statistically significant difference between the 2 groups.

CONCLUSIONS: More patients with the SN60-AT IOL than with the Akreos Adapt IOL reported dysphotopsia. One week postoperatively, the difference was significant. The difference was primarily a result of the higher incidence of negative dysphotopsia with the SN60-AT IOL. At 8 weeks, the incidence of all types of light phenomena was significantly lower in both groups.

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Dysphotopsia is a common complication of cataract surgery[1] that in some cases requires intraocular lens (IOL) explantation.[2–5] The fundamental etiology of pseudophakic dysphotopsia remains elusive and is likely multifactorial. Reports to date implicate IOLs with square-edged optics,[6,7] flat anterior surfaces,[8,9] and high-refractive-index polymers such as hydrophobic acrylic materials[2,7,10] in the formation of positive and negative dysphotopsia. However, although round-edged designs cause less dysphotopsia,[6,7,11] they are associated with a higher incidence of posterior capsule opacification (PCO).[10,12,13] As a result, optics with truncated edges or IOLs with a round anterior edge or sharp posterior design have become popular for IOL implantation. These IOLs prevent adverse light reflections from the lens edge while providing maximum PCO protection.

Shambhu et al.[14] recently compared 3 truncated-edged IOLs: the AcrySof MA30BA and MA60BM (Alcon) and Akreos Fit single-piece (Bausch & Lomb). They performed a combined assessment of a patient questionnaire and an incident light test to provoke dysphotopic symptoms. They found more dysphotopsia with the MA30BA and MA60BM IOLs but did not differentiate between positive dysphotopsia and negative dysphotopsia. Uncombined data for the questionnaire or light test alone would be useful to make a direct correlation with clinical significance.

Negative dysphotopsia, defined as a dark shadow or an absence of light in a portion of vision,[2] is generally more poorly tolerated than positive dysphotopsia and is more likely to lead to IOL explantation.[3] Thus, the aim of this study was to compare 2 truncated-edged IOL designs to determine whether there is a difference in the incidence of negative dysphotopsia and to provide support for other reports of the incidence of positive dysphotopsia with acrylic square-edged IOLs.

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PATIENTS AND METHODS

Sixty-one patients were prospectively recruited over a 10-month period. Only patients with well-centered IOLs, a visual acuity better than 6/12, and the absence of concomitant ocular co-morbidity were included in the study. All patients provided verbal informed consent, and local ethics approval was obtained.

All patients were randomized to receive an SN60-AT IOL (Alcon) or Akreos Adapt IOL (Bausch & Lomb). Surgery was performed by 1 of 4 surgeons using a clear temporal or superior scleral tunnel incision. The incision size for insertion of both IOLs was 3.0 mm.

A slitlamp examination was performed in all patients 1 week and 1 month after surgery. The examination included evaluation of the presence of iridodonesis (at 1 month) and whether the lenses were well centered with good overlapping of the capsulorhexis on the edge of the IOL.[15,16]

Patients were assessed using a questionnaire that graded symptoms of positive and negative dysphotopsia on a scale of 1 to 5 (Figure 1). Patients were also asked to rate their overall level of satisfaction and to relate this, if relevant, to the presence of unwanted images. All patients were interviewed in person 1 week postoperatively by 1 of 3 interviewers. They were followed for at least 6 weeks postoperatively, at which time they were asked the same questions in a telephone interview.

The results were analyzed using SPSS for Windows V13. The Mann-Whitney test was used as the nonparametric statistical method for ordinal data. The level of significance was set at 5%.

RESULTS

Seventy-two patients were interviewed; 11 did not meet the inclusion criteria and were excluded from the study. Of the remaining 61 patients (32 right eyes, 29 left eyes), 27 were women and 34 were men. The mean patient age was 71 years ± 11 (SD). The Akreos Adapt IOL was implanted in 29 patients and the SN60-AT IOL in 32 patients. Forty-nine patients (51% Akreos, 49% SN60-AT) had a clear temporal incision, and 12 patients (33% Akreos, 67% SN60-AT) had a superior scleral incision.

The mean time of the first postoperative follow-up was 1 ± 0 week and of the second follow-up, 8 ± 2 weeks. All 61 patients were interviewed at both stages of follow-up.

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One Week Postoperatively

One week after IOL implantation, 30.8% of patients reported dysphotopsia (positive and negative). The overall incidence of dysphotopsia was 37.5% (12 patients) in the SN60-AT group and 24.1% (7 patients) in the Akreos group; this difference between groups was statistically significant. No patient in the Akreos group and 8 patients in the SN60-AT group described symptoms of negative dysphotopsia (Figure 2).

Table 1 shows the mean ranks and their calculated Z statistic and significance values, corrected for ties, for questions 2 to 5 (Asymptotic Significance 2-tailed test). There was a highly significant difference between the 2 groups for question 1 (negative dysphotopsia); there were no significant differences for any other question.

Although 22% of patients who had a clear temporal incision and 66% of patients who had a superior scleral incision reported symptoms of dysphotopsia (positive and negative) at 1 week, the difference between groups was not statistically significant ($P = .11$, 2-tailed t test). Six of the 8 patients reporting symptoms of negative dysphotopsia had a clear temporal incision and 2 had a superior scleral incision; the difference was not statistically significant ($P = .12$, 2-tailed t test).

Eight Weeks Postoperatively

Of all patients, 26% reported dysphotopsia (positive and negative) at 8 weeks. The overall incidence was 31.3% in the SN60-AT group and 20.7% in the Akreos group; the between-group difference was not significant. No patient in the Akreos group and 3 patients (9.4%) in the SN60-AT group described symptoms of negative dysphotopsia (Figure 3); the between-group difference was not significant.

Table 2 shows the mean ranks and their calculated Z statistic and significance values, corrected for ties, for questions 2 to 5 (Asymptotic Significance 2-tailed test). There was no statistically significant difference between the 2 groups.

At 8 ± 2 weeks, 16% of patients who had a clear temporal incision and 42% of patients who had a superior scleral incision reported symptoms of dysphotopsia (positive and negative); however, the difference was not statistically significant ($P = .131$, 2-tailed t test). Of the 3 patients reporting negative dysphotopsia, 2 had a clear temporal incision and 1 had a superior scleral incision.

Iridodonesis was not detected in any case at the 1-month examination. All lenses were well centered with good overlapping of the capsulorhexis on the IOL edge.

DISCUSSION

Much discussion has highlighted the importance of dysphotopsia as a common complication of cataract

Questionnaire for assessment of dysphotopsia in the pseudophakic patient.

1. Have not noticed.
2. Have noticed but not bothersome.
3. Have noticed and is mildly annoying.
4. Have noticed and is annoying.
5. Have noticed and is debilitating.

1) Since your operation have you noticed any shadows/graininess/dark crescents on the outside of your vision?
2) Driving at night do you notice halos/circles around lights?
3) Driving at night do you notice streaks of light/or starbursts when looking at the headlights of oncoming traffic?
4) Haveyou noticed that your reading is affected by bright lights, for example in a supermarket or at midday?
5) Have you noticed increased difficulty with reading in dim lights, such as at dawn or dusk?
6) Have you noticed any unwanted images?

Please circle one answer to each of the following questions

7) In regards to your current corrected vision how satisfied are you?

Extremely Satisfied	Satisfied	Disappointed	Distressed

8) If you are disappointed or distressed with your current corrected vision how much of this is due to unwanted images?

None	Minimal	Around Half	All

Figure 1. Dysphotopsia questionnaire.

surgery.[1] Our data support this, showing a combined overall incidence (SN60-AT IOL and Akreos Adapt IOL) of dysphotopsia of 30.8% at 1 week. The overall incidence significantly decreased to 26% with both lenses and remained at that level at 8 weeks.

One week postoperatively, 37.5% of patients with the SN60-AT IOL reported some symptoms of dysphotopsia compared with 24.1% of patients with the Akreos IOL ($P = .042$). Although more patients with the SN60-AT IOL reported symptoms of glare, light sensitivity, halos, and star bursts (questions 2 and 3), the differences between groups were not statistically significant. No patient in either IOL group considered their symptoms severe.

Although none of the 29 patients with the Akreos IOL reported symptoms of negative dysphotopsia, defined as a dark shadow or an absence of light in a portion of vision,[2] 8 patients with the SN60-AT IOL reported this phenomenon and the difference between groups was highly

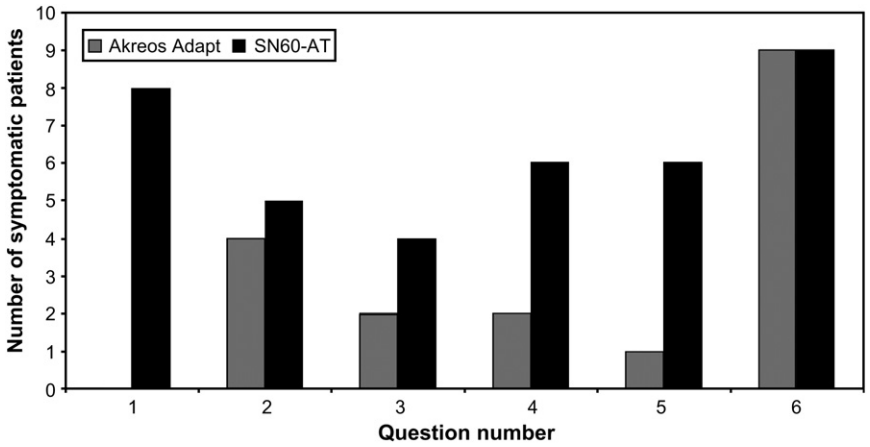

Figure 2. Patients with symptomatic dysphotopsia at 1 week.

Table 1. Mann-Whitney test, 1-week data.

Statistic	Q1	Q2	Q3	Q4	Q5	Q6
Mann Whitney U	337.5	444.5	424.5	400.0	380.0	404.5
Wilcoxon W	715.5	822.5	802.5	778	758	965.5
Z	−2.719	−0.024	−0.6	−1.146	−1.747	−0.758
Asymp Sig (2 tailed)	0.007	0.981	0.548	0.252	0.081	0.449

Asymp Sig (2 tailed) = Asymptotic Significance 2-tailed test; Q = question number

significant ($P = .007$). It would appear, therefore, that the overall difference in dysphotopsia between the 2 groups was caused by the significantly greater reported incidence of negative, but not positive, dysphotopsia in the SN60-AT group.

At 8 weeks, the differences between groups diminished. Moreover, 20.7% of patients with the Akreos IOL reported persistent dysphotopsia at 8 weeks. This is similar to the figure recently reported by Shambhu et al.,[14] who found a 75% incidence of mild or no symptoms. Because their data used combined questionnaire and provocation light test criteria, it is difficult to directly correlate this with clinically relevant symptoms. Furthermore, preliminary data in another study show an incidence of unwanted light images of 30% with the AcrySof SA60-AT IOL and 10% with the Akreos Adapt IOL but equal amounts of glare and light sensitivity (P. Rozot, "A Multicentre Randomized Study to Assess Quality of Vision and PCO of the Akreos Adapt Compared With AcrySof SA60AT," poster presented at the XXIInd Congress of the European Society of Cataract & Refractive Surgeons, Paris, France, September 2004); we found an incidence of 21.3% and 20.7%, respectively, persisting at 8 weeks. Although there appeared to be more unwanted light images with the SA60-AT IOL, the differences between the 2 groups in our study were not statistically significant at the 5% significance level, nor were the differences in glare and light sensitivity (questions 2 and 3).

The 8-week data also show that at 8 weeks, 3 patients in the SA60-AT group reported symptoms of persistent negative dysphotopsia; no patient in the Akreos group reported this phenomenon. The difference between groups was not, however, statistically significant ($P = .105$). Because the persistent incidence of negative dysphotopsia only was low at 8 weeks, more work with a larger series is required to truly ascertain whether the difference is significant.

Table 3 shows the characteristics of the SN60-AT and Akreos Adapt 21.0 diopter IOLs. Both are single-piece acrylic with the same optic diameter, although this is not thought to affect the incidence of dysphotopsia,[2,17] and they have similar A-constants. The Akreos Adapt IOL has a low radius of curvature and a lower refractive index design, which are theoretically superior to those of the SN60-AT IOL.[8] Both IOLs are square edged, although the Akreos IOL has a 50% greater edge thickness, which one would expect to be a significant factor in a positive dysphotopsia edge effect.[6,7]

A previous study[14] showed the incidence of dysphotopsia to be lower with the SN60-AT IOL (68.7% asymptomatic at 8 weeks) than with MA30BA and MA60BM IOLs (48% had mild or no symptoms). As Shambhu et al.[14] state, the SN60-AT is a yellow-tinted acrylic IOL

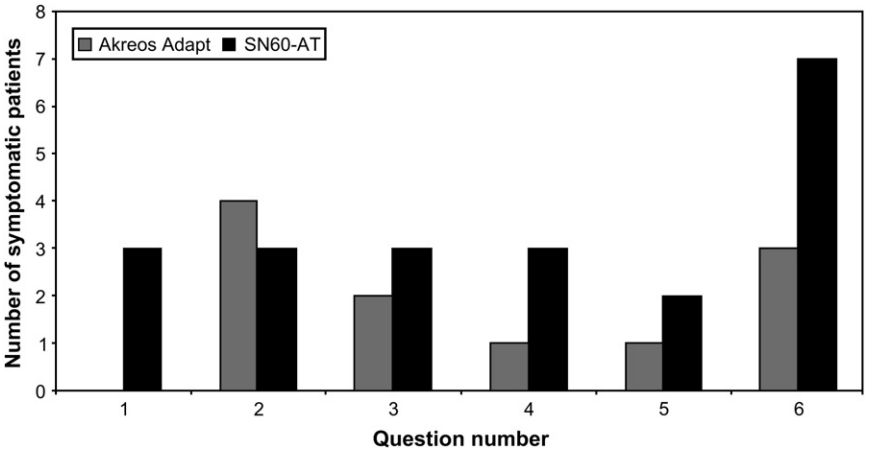

Figure 3. Patients with symptomatic dysphotopsia at 8 weeks.

Table 2. Mann-Whitney test, 8-week data.

Statistic	Q1	Q2	Q3	Q4	Q5	Q6
Mann Whitney U	420.0	436.5	439.5	437.5	449.5	414.0
Wilcoxon W	826.0	997.5	817.5	843.5	855.5	820.0
Z	−1.622	−0.668	−0.186	−0.826	−0.483	−1.080
Asymp Sig (2 tailed)	0.105	0.504	0.852	0.409	0.629	0.280

Asymp Sig (2 tailed) = Asymptotic Significance 2-tailed test; Q = question number

with a frosted edge design, which could explain the lower incidence of dysphotopsia with this lens.[18]

The reasons for the differences in the incidences of negative dysphotopsia are not clear, and the cause of such light phenomenon has remained elusive. Some propose that differential adaptation of areas of the nasal retina, as an antagonistic receptive field center-surround phenomenon, may be responsible; the zones between the areas of intense illumination project to the temporal visual field as areas of darkness.[19] Others propose that negative dysphotopsia is, at least partially, a ring scotoma,[20] similar to that found in patients who wear aphakic spectacles.[21] In this case, most of the ring is blocked by facial anatomy (best elicited by shining a very peripheral light on the eye). We believe this is the most likely mechanism in this case. It would follow that one would predict a higher preponderance for such a scotoma with IOLs with a higher refractive index,[19–21] such as the SN60-AT, than with the Akreos Adapt IOL. It might also be accentuated by a fully truncated IOL edge[19] and higher plus lenses.[21]

Recent studies highlight the importance of incision type as a contributing factor to the production of a dark temporal visual crescent after cataract surgery. In our study, we found no statistically significant difference in the reporting of such visual symptoms between patients with a clear corneal temporal incision and those with a superior scleral tunnel incision.

Trattler et al.[22] suggest that negative dysphotopsia is not dependent on IOL type. They present 3 case reports that suggest IOL material, edge design, or refractive material does not play a role in the patient's perception of this subjective phenomenon. Our data, however, showed a statistically significant increased incidence of negative dysphotopsia 1 week postoperatively with the Akreos Adapt IOL compared to the SN60-AT IOL, which suggests that, at least early on, IOL type is important in this regard. This effect disappeared by 8 weeks. Also, although negative dysphotopsia is often poorly tolerated,[3,19,20] all patients in our study reporting this phenomenon were satisfied or extremely satisfied with their surgical outcomes. Thus, no patient required an IOL exchange and no IOL modification had to be made to address these symptoms.

In conclusion, our data indicate that early symptoms of negative dysphotopsia after cataract surgery are dependent on IOL type and that the Akreos Adapt lens appears to be superior to the SN60-AT in this regard. This effect declined over time. Moreover, at 8 weeks, although there was no statistically significant difference in negative dysphotopsia

Table 3. Characteristics of the 2 study IOLs.

Characteristic	Akreos Adapt (21.0 D)	Acrysoft SN-60 (21.0 D)
Total diameter (mm)	10.7	13.0
Optic diameter (mm)	6.0	6.0
Optic design	Equiconvex	Biconvex
Radius curvature (mm)		
Anterior	11.671	19.609
Posterior (mm)	−11.671	−22.000
Thickness (mm)		
Central	1.019	0.614
Edge	0.30	0.21
Edge design	Double square	Double square
Haptics	Four, no angulation	Two, no angulation
Material	26% hydrophilic acrylic, single piece	Hydrophobic acrylic, single piece
Refractive index (20°C in BSS)	1.459	1.55
A-constant	118.0	118.4

BSS = balanced salt solution

between the 2 IOL groups, the incidences were low and a larger study may be required. In addition, more detailed analysis (eg, ray-tracing techniques) of the refractive properties of the 2 IOLs used in this study may help uncover the mechanism of negative dysphotopsia.

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