Glare sensitivity in early cataracts

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Abstract

In a previous study significant glare sensitivity (using Vistech MCT8000) was found only in patients with posterior subcapsular cataracts (PSC) beyond the very early (LOCS II grade 1) stage. The aim of the present study was to evaluate glare sensitivity in patients with early cataracts. The brightness acuity tester (BAT) was used with the Pelli-Robson chart on 50 patients with early cataracts (LOCS II grade 1 or 2) and on 14 normal volunteers. Only age and PSC were found to be associated with change in contrast sensitivity at high glare. Eyes with grade 1 PSC were not significantly different from eyes with grade 0 PSC after adjusting for age. Eyes with grade 2 PSC had significant glare effect compared with eyes having grade 0 PSC. Thus, glare sensitivity is associated only with early (grade 2) PSC. Other tests still need to be developed to assess visual function changes in patients with early cortical and nuclear cataracts.

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Patients with early cataracts may complain of poor performance in certain visual tasks like face recognition and driving in spite of normal visual acuity. Several studies have shown impairment of contrast and glare sensitivity unrelated to visual acuity in patients with cataracts.[1-13] The assessment of visual function now commonly includes contrast and glare sensitivity testing as adjuncts to visual acuity tests.

In a previous study,[14] we obtained contrast and glare sensitivity measurements on 128 patients with various types and severity of cataracts using the Pelli-Robson chart and the Vistech MCT 8000. Cataracts were graded using the Lens Opacities Classification System II (LOCS II).[15] We found significant contrast sensitivity loss only in patients with cortical (LOCS II grade 3 or greater) and posterior subcapsular (LOCS II grade 2 or greater) cataracts. Glare sensitivity was significantly increased only in patients with posterior subcapsular cataracts (LOCS II grade 2 or greater). Elliott and Hurst[16] studied 54 cataract patients with visual acuities 20/80 or better using the Oxford Clinical Cataract Classification and Grading System. They tested glare disability using the brightness acuity tester (BAT) in conjunction with the logMAR visual acuity chart and the Pelli-Robson chart. Overall, 13% of their subjects had impairment of contrast sensitivity and glare disability. However, no classification of the early cataract types was given.

The aim of the present study was to evaluate visual function changes presenting as glare sensitivity in patients with early cataracts.

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Materials and methods

The study included 50 patients (age range 20–86) with early cataracts (defined as LOCS II grades 1 and 2) and 14 normal volunteers (age range 21–62). The cataracts were age-related or secondary to steroid use. All subjects had visual acuities of 20/40 or better. Thirty one out of the 50 patients (62%) with cataracts were symptomatic with complaints ranging from difficulty driving at night, difficulty distinguishing faces and objects especially in bright sunlight, etc. Patients had no ocular disease other than cataract. All subjects gave informed consent and were entered into a research protocol approved by the National Eye Institute Clinical Research Review Board.

Complete eye examinations including visual acuity, contrast, and glare sensitivity tests were done on all subjects. Refractive errors were optimally corrected for the test distance and an undilated pupil was used. Visual acuity was tested monocularly using the ETDRS chart.[17]

Contrast sensitivity measurements were obtained using the Pelli-Robson chart.[18] This is a letter chart where the letters are arranged in groups of three; successive groups decrease in contrast by a factor of 1/1·41, from a very high contrast down to a contrast below the threshold of normal observers. A subject's threshold is taken to be the lowest contrast for which at least two letters in a group are correctly reported. We used the BAT[19] in conjunction with the Pelli-Robson chart under three conditions: without glare (CS), with medium glare (MG), and with high glare (HG). The BAT is hand-held, illuminated hemispherical bowl with a central 12 mm aperture through which the patient looks to read the Pelli-Robson chart. Measurement units are log contrast sensitivity.

Slit-lamp examination with dilated pupils was done on all subjects. The cataracts were graded by ophthalmologists trained in using the Lens Opacities Classification System II (LOCS II).[15] Only data from the left eyes were analysed. There were eight eyes with pure nuclear catar-

Table 1 Characteristics of 64 study persons by nuclear opacity grading

	Nuclear opacity grade		
	0	*1*	*2*
Number of eyes	33	15	16
Age (years)	44 (15)*	67 (10)	71 (11)
No female (%)	19 (58)	8 (53)	8 (50)
Visual acuity (logMAR)	−0·04 (0·09)	−0·02 (0·12)	−0·02 (0·12)
No taking steroids (%)	13 (39)	0 (0)	2 (12)
CS (log contrast sensitivity)†	1·74 (0·17)	1·67 (0·16)	1·55 (0·24)
Medium glare (log contrast sensitivity)	1·61 (0·21)	1·52 (0·21)	1·44 (0·24)
High glare (log contrast sensitivity)	1·40 (0·32)	1·20 (0·29)	1·01 (0·38)
MG-CS (log contrast sensitivity)‡	−0·12 (0·15)	−0·15 (0·15)	−0·10 (0·12)
HG-CS (log contrast sensitivity)§	−0·34 (0·23)	−0·47 (0·22)	−0·53 (0·19)

*Except for No female and No taking steroids, results are presented as mean (SD).
†Contrast sensitivity using the brightness acuity tester (BAT) without glare.
‡Difference in contrast sensitivity measurements under medium glare and no glare using the BAT.
§Difference in contrast sensitivity measurement under high glare and no glare using the BAT.

acts, five eyes with pure cortical cataracts, 12 eyes with pure posterior subcapsular cataracts, and 25 eyes with mixed cataracts.

Grading of lens colour was not included in the evaluation. Trace cortical opacities were considered as grade 0. The differences in log contrast sensitivity with and without medium glare (MG-CS) and with and without high glare (HG-CS) were used as indices of glare effect. To assess associations, multiple linear regression analysis was used.

Results

The three contrast sensitivity assessments were highly associated, as demonstrated by the following correlation coefficients: $\varrho_{CS,MG}=0{\cdot}79$, $\varrho_{CS,HG}=0{\cdot}81$, and $\varrho_{HG,MG}=0{\cdot}89$ (each with $p<0{\cdot}001$).

Tables 1 to 3 show a summary of the data for the different opacity types. Because the results using medium glare were similar to, although weaker than, those using high glare, we are presenting only the analyses using high glare. Multiple linear regression was used with HG-CS as the dependent variable. Potential independent variables were age (years), sex, visual acuity (logMAR units), steroid use (no, yes), and three sets of indicator variables, one set for each of nuclear, cortical, and posterior subcapsular opacities. Specifically, each set consisted of two indicator variables: one contrasting grade 1 with grade 0 and the other contrasting grade 2 with grade 0. Both forward and backward stepwise regression yielded the model summarised in Table 4. Only age ($p<0{\cdot}001$) and posterior subcapsular opacity (PSC) ($p=0{\cdot}001$) were found to be associated with HG-CS. Eyes with grade 1 PSC were not significantly different ($Z=-1{\cdot}49$) from eyes with grade 0 PSC after adjusting for age. Note, however, that only eight eyes had grade 1 PSC (Table 3). Eyes with grade 2 PSC had significant glare effect ($Z=-3{\cdot}87$) compared to eyes with grade 0 PSC. On average, grade 2 PSC eyes had 0·2 log contrast sensitivity units more glare effect than grade 0 eyes. Figure 1 contains the scatter plot of HG-CS by age, with PSC grade noted (the points are jittered to slightly separate overlapping points). The figure shows that the difference in contrast sensitivity under no glare and high glare tends to be greater in eyes with PSC grade 2.

Table 2 Characteristics of 64 study persons by cortical opacity grading

	Cortical opacity grade		
	0	*1*	*2*
Number of eyes	41	16	7
Age (years)	50 (18)*	68 (10)	69 (13)
No female (%)	22 (54)	9 (56)	4 (57)
Visual acuity (logMAR)	−0·05 (0·10)	0·00 (0·09)	0·01 (0·09)
No taking steroids (%)	14 (34)	0 (0)	1 (14)
CS (log contrast sensitivity)†	1·70 (0·22)	1·66 (0·16)	1·54 (0·14)
Medium glare (log contrast sensitivity)	1·59 (0·22)	1·47 (0·23)	1·48 (0·20)
High glare (log contrast sensitivity)	1·35 (0·34)	1·10 (0·38)	1·07 (0·25)
MG-CS (log contrast sensitivity)‡	−0·11 (0·13)	−0·19 (0·18)	−0·06 (0·08)
HG-CS (log contrast sensitivity)§	−0·35 (0·19)	−0·56 (0·28)	−0·47 (0·16)

*Except for No female and No taking steroids, results are presented as mean (SD).
†Contrast sensitivity using the brightness acuity tester (BAT) without glare.
‡Difference in contrast sensitivity measurements under medium glare and no glare using the BAT.
§Difference in contrast sensitivity measurement under high glare and no glare using the BAT.

Table 3 Characteristics of 64 study persons by posterior subcapsular opacity grading

	Posterior subcapsular opacity grade		
	0	*1*	*2*
Number of eyes	39	8	17
Age (years)	59 (16)*	58 (18)	49 (21)
No female (%)	20 (51)	3 (38)	12 (71)
Visual acuity (logMAR)	−0·03 (0·11)	−0·01 (0·08)	−0·03 (0·08)
No taking steroids (%)	7 (18)	1 (12)	7 (41)
CS (log contrast sensitivity)†	1·70 (0·19)	1·71 (0·20)	1·61 (0·22)
Medium glare (log contrast sensitivity)	1·60 (0·20)	1·61 (0·16)	1·41 (0·26)
High glare (log contrast sensitivity)	1·33 (0·30)	1·24 (0·38)	1·10 (0·45)
MG-CS (log contrast sensitivity)‡	−0·10 (0·13)	−0·09 (0·14)	−0·19 (0·16)
HG-CS (log contrast sensitivity)§	−0·37 (0·19)	−0·47 (0·22)	−0·50 (0·30)

*Except for No female and No taking steroids, results are presented as mean (SD).
†Contrast sensitivity using the brightness acuity tester (BAT) without glare.
‡Difference in contrast sensitivity measurements under medium glare and no glare using the BAT.
§Difference in contrast sensitivity measurement under high glare and no glare using the BAT.

Discussion

Persons with early opacities can have relatively good visual acuity but may have visual disabilities under bright light conditions. In this study, 48% of patients with nuclear cataracts, 48% with cortical cataracts, and 80% of patients with posterior subcapsular cataracts were symptomatic with complaints of difficulty driving at night and distinguishing faces and objects especially in bright sunlight, etc. Of these symptomatic patients, abnormal contrast and glare sensitivity were found in 22% with nuclear cataracts, 20% with cortical cataracts, and 55% with posterior subcapsular cataracts. Hence, documentation of these subjective visual function changes would be very helpful especially in patients with posterior subcapsular cataracts. Elliott and Hurst[16] have found that the BAT in conjunction with contrast sensitivity measurement is more sensitive than visual acuity measurement in assessing glare disability in cataract patients with visual acuities of 20/80 or better. In our previous study using the Vistech MCT 8000, we found significant glare sensitivity only in patients with posterior subcapsular cataracts with LOCS II grade of 2 or greater. The results of the present study using the BAT with the Pelli-Robson chart confirm our previous findings of glare disability in posterior subcapsular cataracts beyond the very early stage.

The BAT employs a broad field peripheral glare source that simulates outdoor bright light conditions and is therefore used to assess daytime glare disability. Posterior subcapsular cataracts, being central in location, may cause obstruction and light scattering especially with pupillary miosis even in the early stages. Other authors have described increased glare sensitivity in patients with posterior subcapsular cataracts.[9 13 20 21] However, no assessments regarding the stage or size of the opacity had been done. Early cortical cataracts are usually wedge-shaped spokes located at the periphery of the lens and thus may not significantly cause glare problems unless they have reached the

*Table 4 Results of multiple linear regression of HG-CS**

Variable	*Coefficient (SE)*	*Z value*
Age (years)	−0·008 (0·001)	−5·92
PSC opacity grade		
1 *vs* 0	−0·106 (0·071)	−1·49
2 *vs* 0	−0·214 (0·055)	−3·87

*Multiple $r^2=0{\cdot}40$, intercept=0·087; HG=contrast sensitivity measurement under high glare; CS=contrast sensitivity measurement without glare.

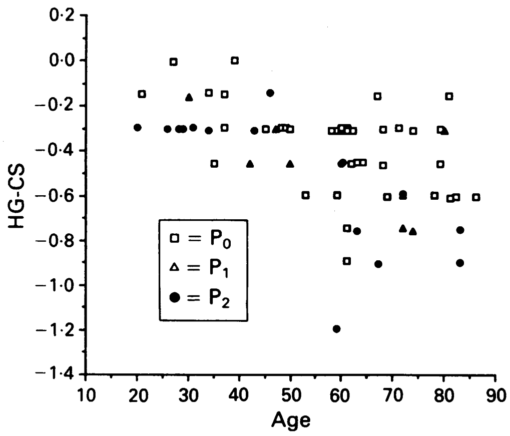

Figure 1 Scatter plot of the difference in contrast sensitivity measurements under high glare (HG) and no glare (CS) using the brightness acuity tester versus age for the 64 left eyes in the study. The symbols identify the LOCS II posterior subcapsular opacity grade for each eye.

visual axis. We note, however, that we have only seven patients with cortical grade 2. This may limit the power to detect an association with cortical opacities. Although nuclear cataracts are located centrally, they are more diffuse in nature (unlike posterior subcapsular cataracts which are usually more dense and discrete) and thus may not cause measurable glare sensitivity.

Previous studies have suggested that cataracts may predominantly affect contrast sensitivity at high spatial frequencies.[8,9,12] Because the Pelli-Robson chart was designed to measure low to intermediate frequencies, it may be unable to detect abnormalities in early cortical and nuclear cataracts. Hence, other tests of contrast and glare sensitivity at higher frequencies might better reflect visual function changes in early cortical and nuclear cataracts.

In summary, use of the BAT with the Pelli-Robson chart can detect glare sensitivity in patients with early posterior subcapsular cataracts. Other tests need to be developed and tried to assess visual function changes in patients with early cortical and nuclear cataracts.

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