Senior Project

Pilot Project
Effectivity of IRAS Glare Source in Predicting Patients Sensitive to Glare with the BAT as the Standard for Outdoor Lighting

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Optometry has traditionally portrayed itself as a profession paramountly concerned with the functional aspects of patient vision. Yet, for the most part, optometrists still gauge visual systems with high contrast charts in ideally set background illuminations. Realistically, our patients maneuver in a surround of varying illuminations and consequently changing visual demands. On bright days, glare is one of the challenges our patients face. To visual normals, brightness and glare are usually only sources of discomfort or minimal hinderance. On the other hand, those with ~~with~~ ocular abnormalities involving the media or retina may become visually disabled in the presence of bright illuminations. Outdoor lighting is of constant concern for patients with posterior subcapsular cataracts(PSC), keratoconus, and longstanding macular edema. Patient care is not complete unless we can assess the effects glare has on our light sensitive patients.

A clinical system for setting a patient's sensitivity to brightness and glare in terms that we may readily understand and apply is desired. Ideally, it should predict a patient's enviornmental functioning when he/she is confronted with various illuminaion intensities. Such a system would replace escorting the patient outdoors and subjecting him/her to the inconvenience, and the testing to the invariability of the weather. Though many optometrists depend on the the patient's subjective report to define the range of brightness sensitivity for that particular individual, a more standard approach to analysis would eliminate the need for interpretation.

This investigation addresses two devices that are designed to comment on a patient's performance in the presence of glare. One is the Brightness Acuity Tester(BAT) by Mentor, and the other is the white light interferometer with glare source(IRAS/Glare). Both are now commercially available. The BAT was the first of the two instruments to be introduced and is currently gaining wide acceptance within the ophthalmological community.

The BAT

The BAT consists of a hemispheric 60mm diameter bowl with a diffusing surface and a 12mm aperture. The bowl configuration allows each eye to be tested as if the patient was submerged in the chosen illumination. A three-way bulb is recessed superiorly within the bowl to provide three illuminations; the patient is unable to directly view the bulb. The three levels of bowl illumination are designated by a switch located on the head of the instrument. Correspondingly, the bowl illuminations represent an average overcast day (low-12 foot lamberts), an

average day of moderate sun (medium-100 foot lamberts), and an average day of extreme sun (high-400 foot lamberts). Such instrumentation allows you to ascertain a true range of brightness sensitivity under repeatable conditions for your patient.

For testing, the open portion of the bowl is placed against the periorbital features, such that the patient is able to sight through the aperture located across the way.

IRAS/Glare

The white light interferometer used in this study is the same instrument that Randwal has formerly offered, but with the addition of a glare source accessory. In this instrument, near coherent beams of white light enter the pupil in Maxwellian view to produce the interference fringes this instrument utilizes in by-passing the effects of refractive and media status. The interference fringes projected onto the retina have an illumination of 3.15 foot lamberts with the low power setting, and 6.3 foot lamberts with the high power setting.

The target is a circular field containing light and dark lines whose spacing determines the corresponding Snellen acuity. By turning the acuity sleeve, you vary the line to line spacing to represent the Snellen acuity shown in the acuity window. To manipulate the field size, the iris diaphragm lever may be placed in a continuum from 3 degrees to 8 degrees with a middle setting of 5 degrees. Any orientation of the fringes may be obtained by rotating the body of the instrument while holding its head stationary.

The slit sources may be viewed through the examiner's eye piece, thus allowing the tester to monitor the orientation and spacing of the fringes. In addition, the image of the slit sources provides the tester a reference for aligning the target within the desired location of the pupil. For the best retinal illuminance, the slit sources should be placed in the pupil such that any existing opacities may be avoided. If this proves impossible, dilation of the pupil is recommended in order to maneuver around the opacifications. (Randwal also suggests focusing the slit sources in the plane of the of the opacity for peak penetrance.) A magnifier built into the head of the instrument permits scanning of the pupil.

The glare source consists of four distinct white lights located at the corners of a diamond pattern, and is readily visible to both examiner and patient. The illumination delivered to the patient's retina is 12,000 foot lamberts. The tester may choose to take acuity readings with or without the glare source.

While operating the instrument, the examiner should use his right eye when testing the patient's left eye and vice versa. The tester will then be able to use his hand opposite the patient's eye not being tested to bridge the instrument, and at the same

time occlude the patient's eye not being addressed. The other hand is used to hold the body and to perform the necessary adjustments. Once the examiner to patient posture is set, it need not be altered until testing is complete.

The Experiment

As a pilot project to determine the effectivity of the IRAS/Glare at predicting and quantifying patients symptomatic to bright illuminations, eight patients who were suspected to be, or were known to be hindered by glare, were chosen. In addition, a control group with members having moderate refractive errors were chosen to dispell any correlation between significant refractive error and glare. It has already been established that high sperical ametropia has little bearing on interferometer performance.

BAT findings are incorporated because they have been shown to represent interactions of enviornmental brightness with Snellen acuity at an accuracy of eighty-four percent amongst cataract patients. Before testing, it was presumed that this ability to mimic outdoor lighting would not be variable with different abnormalities of the media or retina. Therefore, the BAT offered a more standard and convenient comparison between the effects of enviornmental and IRAS glare illuminations on acuity.

The uses of the IRAS/Glare source are not well documented. In an attempt to guide further investigation into the clinical application of the IRAS/Glare, we offer you the following report.

The Procedure

Prior to testing, biomicroscopy and direct ophthalmoscopy was performed on each patient in order to document any significant pathology. Each subject's acuity was ascertained with Feinbloom charts for Low Vision patients under a standardized illumination. The testing distance was twenty feet for each patient, and the background illumination equaled that of a moderately lighted room. Most of the subjects were wearing either spectacles or contact lenses that potentiated their best corrected Snellen acuity. It was not necessary that they be optimally corrected for their refractive errors, since this investigation appeals to absolute values in detriment to visual function in the presence of glare; it is not concerned with specific pre- and post-measurements.

Next, with the subject in the same positon as used for baseline acuities, the BAT was placed over the eye of interest , and with the other eye occluded, acuities were measured with the three bowl illuminations. With the introduction of each illumination, each subject was allowed a time of adaptation to assure visual stability before testing.

After an approximately five minute period, interferometer testing

Data

Subject	Age	Race	Sex	Aided Acuity	Pathology
1	88	W	M	O.D. 600 O.S. 140	wet ARMD O.U.
2	92	W	M	O.D. 700	dense NSC cataracts O.U.
3	60	W	M	O.D. 60 O.S. 60	chloroquine maculopathy O.U.
4	22	W	M	O.S. 40	keratoconus
5	89	W	M	O.D. 40 O.S. 60	ECCE with IOL 3+ NSC with cortical spoking
6	59	W	M	O.S. 300	Gr. II hypertensive retinopathy
7	59	W	M	O.D. 100 O.S. 30	2+ NSC 3+ PSC 1+ NSC 2+ PSC
8	61	W	M	O.D. 20 O.S. 20	active paramacular POHS O.S.
Control					refractive status
1spec	17	W	M	O.D. 20 O.S. 20	-0.50=-4.00x025 -2.25=-1.75x155
2spec	15	W	M	O.D. 30 O.S. 25	+1.50=-1.50x125 +0.75=-1.75x164
3RGP	22	W	F	O.D. 20 O.S. 20	+3.75=-8.50x002 +3.75=-8.25x174
4SCL	24	W	F	O.D. 20 O.S. 20	-6.25=-0.75x030 -3.75=-0.75x165
5SCL	22	W	M	O.D. 25 O.S. 25	-3.75=-2.00x095 -2.25=-5.00x080

DATA

Subject		BAT			IRAS Standard			IRAS/Glare		
		lo	med	hi	hor	ver	obl	hor	ver	obl
1	O.D.	-	-	-	800	800	800	800	800	800
	O.S.	-	-	-	100	60	80	60	100	60
2	O.D.	-	-	-	50	100	80	60	80	80
3	O.D.	60	80	100	50	80	60	60	50	60
	O.S.	60	80	100	30	40	30	40	60	50
4	O.S.	40	60	60	30	15	15	15	15	15
5	O.D.	60	120	-	20	30	30	20	40	40
	O.S.	60	140	-	30	30	30	60	200	100
6	O.S.	300	300	350	50	40	50	60	40	40
7	O.D.	100	100	120	20	50	20	20	20	20
	O.S.	60	80	300	20	20	20	20	20	30
8	O.D.	20	20	20	20	20	20	20	20	30
	O.S.	15	15	20	15	15	15	20	15	20
Control										
1	O.D.	20	20	20	20	25	20	30	20	30
	O.S.	20	20	20	25	20	50	20	20	25
2	O.D.	25	30	40	20	25	20	25	20	25
	O.S.	25	25	25	20	20	25	20	20	25
3	O.D.	20	20	20	20	15	15	20	15	25
	O.S.	20	20	25	25	20	20	25	20	20
4	O.S.	20	20	25	20	15	25	15	15	15
5	O.D.	20	25	25	20	25	15	20	15	15
	O.S.	30	25	25	20	20	20	20	20	25

all acuities are assumed to be of Snellen representation (all with numerators of 20)

ARMD-age related macular degeneration
NSC-nuclear sclerotic cataracts
ECCE with IOL-extra-capsular cataract extraction with intraocular lens
spec-spectacle corrected patient
RGP-rigid gas permeable contact lens corrected patient
SCL-soft contact lens corrected patient

began. The subjects were educated as to the appearance of the target and the three orientations we limited ourselves in testing-horizontal, vertical, and oblique(at 45 or 135 degrees). Reinforcement of the procedure was accomplished with the interference fringes grossly separated at a level far above each patient's discernability. Readings were attained with a random presentation of fringe directionality. Each orientation presentation was begun with separations each particular subject could not detect. A progression through decreasing acuities followed until a level was reached at which they could first accurately report target orientation. This was recorded as their endpoint acuity. More than one progression was performed for each orientation in an attempt to discourage the patients from forecasting.

A field of 8 dgrees for the target was used uniformly throughout the testing. It has been reported that this parameter is negligible in acuity measurements. It was felt that subjects could more easily appreciate the target at this larger setting. Randwal notes that the 8 degree field is less susceptible to distortion at its edges when projected into visual systems greater than +/- 6 diopters.

Results: Cases

Subject #1
Subject #1, having Age Related Macular Degeneration and relatively clear media, could not even detect the presence of the Feinbloom chart with the BAT illuminations placed before either eye. The interferometry readings of his right eye were surprisingly less than his baseline acuities. It is usually a tendancy of interferometry to over read acuities in patients with retinal edema, due to its immunity to the Stiles-Crawford effect. In other words, they have a noted disregard for cone alignment. We summize that this patient had difficulty implementing his eccentric fixation. His left eye however, did demonstrate better acuity with interferometry and remained unaffected by the glare source.

Suject #2
This subject had dense bilateral nuclear sclerotic cataracts(NSC) that offered him a best corrected acuity of 20/700. He was unsuccessful in resolving the Feinbloom chart with the BAT placed before his right eye . The IRAS readings predicted a good potential Snellen acuity and were undiminished by glare presentation.

Subject #3
A diagnosis of maculopathy secondary to systemic chloroquine toxicity was issued to both eyes of this subject. His suboptimal acuity decreased stepwise with the medium and high settings of the BAT. For the right eye, interferometry offered an average acuity that correlated well with standard Snellen acuity, and was uneffected by IRAS/Glare. Acuity in the left eye improved approximately two lines with IRAS testing, and worsened by one

line during IRAS/Glare testing.

Subject #4
This subject had been recently diagnosed as having keratoconus. At first, he had noticed an increased sensitivity to light in his left eye, which was followed by a decrease in sharpness of vision out of the same eye. As data for this patient shows, he is significantly susceptible to the medium and high illumination levels of the BAT. IRAS and IRAS/Glare demonstrated excellent acuities for his left eye.

Subject #5
It is interesting to note that though this subject is pseudophakic in his right eye, he is still susceptible to the higher BAT illuminations. The right eye shows a slightly better acuity with interferometry, and is subtlely affected by IRAS/Glare. The cataractous left eye is visually handicapped with IRAS/Glare.

Subject #6
This patient's eyes carry the diagnosis of grade II hypertensive retinopathy. He was not corrected to his level of best corrected Snellen acuity. His uncorrected hyperopia did not make him more susceptible to glare with either the BAT or IRAS/Glare. And though interferometry predicted an increase in acuity following proper refraction, the endpoint was substandard. Amblyopia is suspected. The etiology of his sensitivity to glare is unknown.

Subject #7
The classic example of those thwarted by glare is the patient with subcapsular cataracts. This patient serves us well as a case study. His right eye shows a reduced acuity that is due to the NSC and PSC. This is substantiated by the right eye's excellent interferometry readings. The NSC of this eye filters much of the light that would otherwise be scattered by the PSC into a retinal veil of illumination. Stable acuity throughout BAT testing serves to prove this. In comparison, the left eye having less of a NSC formation is reactive to BAT testing. The PSC located along the visual axis of the left eye has a prominent role in diminishing acuity in this eye as the pupil constricts. Interferometry readings of the left eye point to excellent acuity potential. IRAS/Glare did not effect either eye. This patient is scheduled for bilateral cataract extraction in the near future. Though the right crystalline lens has been selected for extraction first, the patient feels the left lens is more disabling in terms of visual function.

Subject #8
This patient presented with Presumed Ocular Histoplasmosis Syndrome. The left eye demonstrated peripapillary atrophy and "Histo-spot" lesions peripheral to the posterior pole. Acuity in this eye was not indicted as a result of the disease process. In the right eye, an active paramacular lesion was observed. This lesion has had five episodes of exacberation and remission over the course of twenty years. At the time of each exacberation, a

therapy of retrobulbar steroid injections was administered. Systemic steroids had also been intermittently prescribed when the lesion periodically activated. The patient associates fluctuating visual clarity along with sensitivity to bright lights with the right eye. In comparison to the left eye, the right eye's acuity is slightly depressed. Interferometry compared well with best corrected Snellen acuity in both eyes. Neither eye was affected by either glare instrument. In order to further investigate this patient's sensitivity to bright illuminations, contrast sensitivity function should replace Snellen acuity.

The Control Group

None of the control sujects were susceptible to the effects of glare as assessed in this experiment. Interferometry readings correlated well with Snellen acuity. Subject #2 is probably not fully corrected for his ametropia.

Summary of Findings

The BAT, the instrument we defined earlier as our representative for outdoor lighting, by which we were to assess the IRAS/Glare's ability for identifying those hindered by glare, had successfully illicited a decrease in Snellen acuity in ten of thirteen glare sensitive subject eyes. On the other hand, the IRAS/Glare device only depicted one of the thirteen subject eyes as having worsened acuity in the presence of glare. Randwal claims that the IRAS/Glare is able to demonstrate the disabling characteristics of glare on cataract patients (especially those of the PSC type). They continue by adding that the instrument is useful in allowing the practitioner to substantiate a glare disability with etiologies of any media turbidity or maculopathy. According to this pilot project, this simply does not seem valid. I offer these conjectures.

First, perhaps the luminance of the slit sources is brilliant enough to penetrate the retinal veil produced by the interaction of the source with abnormal intraocular media. Secondly, it may be that the glare source, in its housing within the head of the instrument, is too far removed from the patient's visual system in order to deliver an effectual glare. Thirdly, the source itself in being composed of four single dot-like white spots is not large enough to mimic the encompassing effects of an enviornmental situation. Fourthly, the source diffuses poorly. Fifthly, the patient may simply disregard the lights after being initially disoriented by them. Patients seem to use them much like a pilot uses runway lighting. They just guide their vision straight past the lights and their annoying after-images, straight into the task. In some instances, the patients thanked the examiner for "lighting things up". Finally, the Maxwellian optics of the system, with its pinhole effect, may project the interference fringes through the glare source induced retinal veil.

In sum, there is great doubt as to whether a patient's visual

function in the midst of glare can be established with the IRAS/Glare.

Instrument Idiosynchracies

More times than not, the ease at which an instrument is manipulated in a clinical setting determines its frequency of implementation. In addition, the patient population must not show an aversion to the instrumentation. In contrasting the BAT with the IRAS/Glare in these terms, again I preferred working with the BAT. I offer these reasons.

The IRAS' dimensions interfere with the examiner's ability to steady the slit sources within the desired location of the patient's pupil. This brings about three possible scenarios. First, the target will move about and stimulate parafoveal retina recording false positives in cases of macular lesion and false negatives in eyes free of maculopathy. Second, the patient may be confused by a flickering target as it swings about the visual axis. This is especially true in patients whose media dictates a narrow window through which the coherent light might pass (for example dense NSC). Third, the jiggling of the target will supply clues for the patient.

Other clues seem to facilitate the patient's resolving of the target. Many of the subjects in this investigation spoke of a swimming of the interference fringes that they deducted moved perpendicular to orientation. Also, lateral chromatic abberation was such that the target consisted of an ever changing colorful spectrum.

Conversely, the BAT is easily positioned in front of the patient's eye. In fact, the patients may position it themselves and assure good apperture alignment. This device is much quicker to use because the endpoint does not have to be re-evaluated to assure accuracy. The BAT is not subject to visual clues.

Experimental Considerations

To begin, the patient population was limited in regards to number. The characteristics of the population were skewed within the test and control group. The majority of the test group was composed of elderly men from a Veteran's facility, whereas the control group was derived from the student body of an optometry school. The two groups were not age matched. It would have been noteworthy ta assay pupil constricture when using the IRAS/Glare and then adjusting the incidence retinal illumination accordingly.

Current Uses

Currently, the BAT is most frequently called upon to determine the need for cataract extraction in those patients with cataractous changes who function well visually until glare is introduced. Their glare handicap may be documented with some

standardization. This supports practitioner and third party insurance confidence in rationalizing extraction. It is easy to demonstrate and explain to patients how bright lights interact with their cataracts and hinder their daily activities.

The BAT is also serving as an illumination source for photo stress testing. An adaptation clipped to the front of the bowl closes off the apperture and completes the hemisphere. The patient then gazes into the bowl eliminating fixation as a variable in testing. Whereas the practitioner used a variety of illumination sources and source to patient distances, he may now have a standard non-invasive technique of following the course of macular edema.

A growing area of clinical application for the BAT is in the prescribing of filter or tinted lenses through demonstration. All clinicians have at one time or another experienced the frustration of attempting to recommend lenses of lower illumination transmittance to patients on a cloudy day. Mentor is now offering an accessory that clips in front of the apperture so that lens blanks may be inserted. The practitioner can work with the patient in deciding which transmittance lens is appropriate for that individual free of concern for the weather.

The IRAS/Glare, being relatively new on the market, is not yet accepted clinically. More research as to its reliability and implications is necessary. Though the IRAS overreads visual potential in pre-op cataract extraction candidates, its readings do correlate well with improved Snellen acuity post-op. The IRAS has gained respect in predicting the prognosis of treatable macular edema secondary to inflammatory disease process. If there is great disparity between Snellen and interferometry readings with the latter being better, the prognosis is good. The good interferometry findings indicate healthy retinal cells, while the corresponding poor Snellen acuity signals misalignment of the cones. With resorbing macular edema, the interval difference between the two acuities would collapse.

Optometric Implications

With optometry moving toward a primary visual care role, the optometrist must more carefully weigh his referrals to secondary and tertiary visual care providers. Many optometrists are performing A-scans for their cataract surgeons. The BAT and IRAS would enhance the optometrist's cataractous work-up.

The BAT and its use in demonstrating filters and tinted lenses has already been mentioned. Low vision patients would benefit greatly in having the luxury of choosing a variety of transmittance lenses to meet their varying visual requirements. The absolute effects of the lenses could be quantified using Snellen acuity. The BAT would also be invaluable in educating low vision patients as to their visual disposition with glare. For those cataract patients who desire an alternative to cataract extraction, the BAT would be beneficial in ascertaining the

appropriate filters that would enhance their vision. Financially, the optometrist will be able to promote sun and shooting lenses for visual normals.

To truly assess visual function in the presence of glare, the BAT could be used in conjunction with CSF charts and projections. Many patients may appear to be uneffected by BAT testing when using Snellen acuity, but may claim a high visual dysfunction with glare. In these cases, the CSF with BAT testing may substantiate their subjectivity. Contact lens patients tend to exhibit this profile (especially those with soiled lenses).

In conclusion, the IRAS/Glare is a device in need of further study. The next step should be in standardizing the instrument's glare source.

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