Effectivity of the IRAS Interferometer vs the Potential Acuity Meter in RGP Fittings of the Partially Sighted

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The patient presenting with correctable acuity less than the standard 20/20 requires more than the standard vision examination. Optometrists involved in the management of these cases must explore innovative techniques and ideas of examination to fully address and understand the visual systems and needs encountered. Only then can an accurate treatment plan be established. This study explores a new facet in the care of these patients in the hopes of furthering the extensiveness and consistency in which they are managed.

This investigation involves two instruments, the Mentor Potential Acuity Meter and the SITE IRAS Interferometer. Both have traditional uses involving cataract patients; they are frequently employed to predict post-operative acuity of cataract patients prior to the lenticular extraction. Various studies have proven the instruments' effectiveness in this use. A different approach as to the utilization of these two instruments is presented here.

Evaluation of a patient presenting with a best visual acuity less than 20/20 must include refractive, pathological, binocular and monocular assessment. Still, the optometrist may wonder if the BVA correction is optimal for the patient. Is this the best acuity obtainable or can more be done? Perhaps the presenting condition responsible for the reduced acuity would be better approached with a contact lens correction as opposed to a spectacle lens correction. Would the time for a probable difficult contact lens fit be well spent? Knowing the patient's best possible acuity would give the optometrist a type of goal to work toward; it would let the optometrist know that he or she has done all that is possible to manage the case. If the spectacle lens correction will not produce this acuity, perhaps a contact lens correction will. The effectivities of the Mentor Potential Acuity Meter and the IRAS Interferometer to predict best obtainable acuity in patients with spectacle BVA's of less than 20/20 is explored.

Mentor Potential Acuity Meter

The Mentor Guyton-Minkowski Potential Acuity Meter (PAM) is sited as an instrument for determing visual acuity behind a cataract or other ocular opacity. The PAM, utilizing a Maxwellian view optical system, projects an acuity chart onto the retina via a beam of incandescent light convergent to an aerial aperture of 0.1mm diameter. This image bypasses the cataract by being passed through a clear zone in the cataract. Thus, the beam neglects the scattering effects of the opacity. The PAM is also

discuss as trade name

sited as useful with large, irregular or unknown refractive errors to predict best correctable acuity.

This instrument is mounted on a slit lamp and available in two different visual acuity charts: one of letters, one of numbers. Both visual acuity charts range from 20/20 to 20/400. Testing should be performed in a dimly lit room which usually renders occlusion of the opposite eye unnecessary. The sphere power control, ranging from -10.00D to +13.00D should be adjusted to the patient's spherical equivalent correction. The instrument has a long enough depth of focus to allow the dioptric control to be set to an approximate power rather than to the exact power. The patient may also be tested through a trial frame of the BVA refraction.

Instructions to the patient should include explanation of what will be seen as well as what needs to be reported, ie, reporting of the numbers or letters to the smallest distinguishable. In addition, the patient should be told to avoid unnecessary movement in order to maintain a steady focus. The examiner aims the beam at the iris initially. This small white dot of light is then viewed by looking through the lowest magnification of the microscope or viewed by looking outside of the slit lamp at the iris. The dot is brought into the pupil; the patient should be told to look at the light in order to assure alignment. Using a corresponding key, the examiner notes the acuity achieved. Testing should take between one and five minutes.

SITE IRAS Interferometer

The SITE IRAS Interferometer is designed to measure visual acuity independent of media opacities and refractive error. Utilizing Maxwellian view, this hand held instrument produces interference fringes through constructive and destructive interference of near-coherent beams of white light. Thus creating patterns of dark and light stripes directly on the retina, the spacing between these lines translates to an acuity level while bypassing media opacities and refractive error. Cataracts or other ocular opacities, as well as refractive error, should have no effect on acuity measured.

IRAS Interferometry should be performed in a room lit well enough to see the patient's pupil. The examiner holds the instrument parallel to the patient's forehead with his or her hand. This bridging effectively occludes the eye not being tested. Through the examiner's eye piece, the examiner views both the patient's pupil and the three slit sources. The slit sources should be centered in the pupil, or positioned so as to avoid the denser portions of an opacity. For maximum penetration, the source points should be focused in the plane of any presenting opacity. As the patient's

pattern line separation decreases, the slit source separation increases to a maximum of 1.4mm at 20/15 acuity. Pattern orientation can be altered 360° by rotating the body of the instrument. The pattern viewed by the patient is within a circular target which can be varied between 3° and 8°. While refractive error has no effect on the line pattern, refractive errors in excess of ±6.00D may disturb the clarity of the target boundary. It is suggested to use the 5° or 8° field in these instances.

Again, the patient should be instructed as to what will be seen and what responses are expected, that is, to report the pattern orientation. Unnecessary movement should be avoided to maintain fixation. Translation of line spacing to visual acuity can be read from a window in the instrument ranging from 20/15 to 20/800. Testing should take two to three minutes.

Patients and Methods

In this study, the PAM and IRAS Interferometer were used simultaneously to predict best correctable acuity of patrially sighted patients. Eyes tested in the study presented with ocular conditions assumed to be better addressed through the wear of rigid gas permeable contact lenses than through the wear of spectacle lens corrections. It is the goal of the study to determine which instrument more accurately predicts acuity of these patients prior to a proper fit with rigid gas permeable contact lenses. It is not the purpose of this study to imply that contact lenses are the only appropriate correction for these patients. As will presumably be inferred by the reader, various microscopic and telescopic systems could be of great assistance to many of these individuals; and in fact, these devices were incorporated in the management of several of the patients. This study investigated only one aspect of care of the partially sighted, that is, correction by rigid gas permeable contact lenses.

The term "partially sighted" in this study referred to a BVA spectacle correction resulting in less than 20/20 visual acuity. Patients presented without a contact lens correction and were not dilated during testing. Prior to taking IRAS Interferometer and PAM measurements, spectacle BVA was determined for each patient.

IRAS Interferometric testing utilized the 8° field with the power switch on the high position or 6.3 foot lamberts of illumination. It was necessary for the patient to discriminate line orientation from possible orientations of horizontal, vertical, 45° , and 135° . Acuity measurements were determined from the smallest discernable pattern of vertical lines. Vertical orientation was chosen for two reasons. First,

vertical lines are most easily distinguished by with-the-rule astigmats. Second, vertical or near vertical lines are more frequently encountered in the alphabet than are horizontal lines, which helped maintain consistency with PAM testing involving letters.

In testing with the PAM, the sphere power control was set at the patient's spherical equivalent. The visual acuity chart involved letters. Credit for acuity was given for three of four letters on a line correctly identified.

After testing, rigid gas permeable contact lens parameters for optimum fit were determined. At the dispense of the contact lenses, fit and power were verified to be correct for the patient. After a contact lens adaptation time, acuity was obtained under standard illumination with the Feinbloom Distance Test Chart for the Partially Sighted.

Results

Subject #1

The patient presented with ocular albinism with associated pendular nystagmus. Contact lenses were fit OU with similar powers and dimensions. Of note is the inconsistency of the IRAS to significantly underpredict the acuity OD and to slightly overpredict acuity OS. The PAM gave a consistent and moderate underprediction OU.

Subject#2

This compound myopic astigmat presented with a BVA correction of OD -6.00 / -1.25 x 180, OS -5.25 / -1.75 x 165. The IRAS and PAM both predicted accurately OU in this instance which gave the patient 20/20 acuity through the contact lenses.

Subject #3

Presenting with aphakia OU and pendular nystagmus due to congenital iatrogenic toxicity, this patient was only fit OS due to reasons unrelated to the scope of this report. Both instruments gave rather optimistic forecasts, the IRAS more so than the PAM. Perceived movement of the IRAS target due to the nystagmus may have provided clues as to pattern orientation, thus explaining the overly optimistic prediction.

Subject #4

The patient was diagnosed as having oculocutaneous albinism with associated pendular nystagmus. This patient, with -3.25D WTR cylinder, presented with the greatest astigmatic error in the study. This cylinder created some concern over the accuracy of the PAM in which the sphere-cylinder equivalent is utilized as opposed to the sphere and cylinder correction. Predicting accurately OS, the PAM predicted only one line

optimistically OD. The IRAS, while predicting only one line optimistically OS, gave a three line optimistic reading OD.

Subject #5

Presenting as a high myope of -9.50D OD and -9.25D OS with only a small amount of cylinder, the two instruments predicted rather equivocably. The PAM predicted correctly OU. The IRAS predicted a one and a half line better acuity OD and predicted correctly OS.

Subject #6

The patient presented with oculocutaneous albinism and associated pendular nystagmus. With nearly identical contact lens corrections OU, the IRAS predicted one line pessimistically OU. The PAM gave an accurate reading OD and a half line optimistic reading OS.

Subject #7

This fourteen year old patient presented with congenital nystagmus of unknown etiology. A contact lens correction of minor power was fit OU. The IRAS predicted a three line better vision than that obtained OD and predicted accurately OS. The PAM predicted accurately OD and one pessimistic line OS.

Discussion

Thirteen eyes were tested in this study. A false positive reading, final acuity worse than that predicted, was given by the IRAS in five of these thirteen cases. The amount of optimism ranged from one line to a single extreme of fourteen lines of acuity. There are various reasons for the false positive predictions of the IRAS in this study. One, as mentioned previously, is movement giving clues as to pattern orientation. Movement can occur from the patient, as in nystagmus, and also from the examiner despite efforts to stabilize the instrument during testing. Another testing clue occurs in cases of significant uncorrected hyperopia. A perceived doubling of the image may occur in these instances, again providing unwanted indications of orientation.

It has also been suggested that acuity necessary to detect line orientation is a more primative form of acuity than that needed to detect letters. Letter recognition requires detection of individual components as well as construction of these components into a whole. A final reason for false positives is proposed from the high contrast achieved with the IRAS as it bypasses optical defects. This contrast is not obtainable with convential acuity measures.

The PAM gave three false positive readings. Only one of these readings gave an optimistic prediction greater than one line of acuity.

One possible explanation for these readings as pertaining to this study involves the high illuminance level at the retina. Again, this illuminance is not procured with traditional acuity charts.

While the IRAS gave four false negative readings, or worse predictions of acuity than that actually obtained, only one of these were greater than one and a half lines of acuity. Possible explanations are presented. First, the IRAS predicts acuity with a rather unfamilar target. While patients are accustomed to acuity charts of letters or numbers, a stripe pattern may cause confusion and a less than true acuity reading. Second, using the large 8° field pattern covers a retinal area beyond the central macular region. In the absence of maculopathy, this may create a prediction of vision worse than the obtained vision.

Giving three false negatives, the PAM incorrectly predicted by one line of acuity in one of these readings, and by eight lines of acuity in the other two. Many of the study cases involved at least a mild amount of cylinder. The PAM, with the dioptric control set at the sphere/cylinder equivalent, may have given a more accurate prediction in the patient had been allowed to control or alter the setting, or if trial lenses with cylinder had been used. Also, a nystagmus or tremor would render the letters difficult to locate and detect by the patient, again creating a false negative reading.

Summary

Being limited by size, this study does not lend itself well to statistical analysis. However, implications can be drawn for those optometrists involved with the management of partially sighted individuals, particularly those to be fit with rigid gas permeable contact lenses.

First, in cases of pendular nystagmus, the PAM was a more accurate predictor of vision than was the IRAS in seven of the nine cases. In six of these nine cases, PAM predictions were within one line of achieved acuity. Two of the three readings not within one line of acuity predicted a worse vision than that obtained. IRAS predictions in the nystagmus presentations were within one line of acuity in four of the nine cases. Four of the five cases not predicted by the IRAS within one line of acuity gave overly optimistic readings.

Second, cases of high refractive error free of nystagmus revealed the two instruments to be roughly equivalent. More notably, both instruments were within one line of obtained acuity in all cases except one in which the IRAS prediction was one and a half lines pessimistic. Having an accurate prediction of vision achievable with high refractive errors can be an asset to the eye care practicioner. Acuity measured after the initial fit,

as compared to that predicted by the IRAS or PAM, should dictate any appropriate lens changes. Time spent with unnecessary lens changes in an effort to find maximum acuity through trial and error can thus be eliminated.

Third, in review of all cases, the PAM was the more accurate predictor in eight of the thirteen cases. The two instruments gave equivalent predictions in three of the thirteen. Thus, the IRAS gave two readings more accurate than PAM readings. The IRAS predicted overall within one line of acuity in seven cases. The PAM also predicted within one line of acuity in these seven cases, as well as in three other cases, for a total of ten of thirteen cases in which the PAM predicted within one line of acuity. When not within one line of acuity, the IRAS measured optimistically in two-thirds of the cases while the PAM measured pessimistically in two-thirds of the cases.

Closing Remarks

Being a study limited by number invites further investigation in this area. Future experimentation may wish to ponder these considerations. The population base in this study was not evenly distributed and was not all-inclusive of the conditions suitable to the study. Further research involving larger and more comprehensive population bases would certainly be of value.

Accuracy in these studies may be increased through certain measures. First, optical corrections of sphere and cylinder power while taking measurements with the PAM may create more accurate predictions. Second, accuracy of the IRAS Interferometer may be improved by varying the field size. Furthermore, measurement of pupil size and consistency of pupil size during testing could lend greater precision to the study. Additional exploration of this area is necessary to establish the instruments' full potentials and limitations.

SUBJECT	AGE	PRESENTING CONDITION	IRAS	PAM	ACHIEVED ACUITY
#1	22	ocular albinism	OD 20/400 OS 20/100	20/200 20/200	20/120 20/120
#2	38	compound myopic astigmatism	OD 20/20 OS 20/20	20/20 20/20	20/20 20/20
#3	43	aphakia/pendular nystagmus	OS 20/60	20/100	20/200
#4	19	oculocutaneous albinism	OD 20/50 OS 20/70	20/70 20/80	20/80 20/80
#5	14	compound myopic astigmatism	OD 20/40 OS 20/25	20/25 20/25	20/25 20/25
#6	33	oculocutaneous albinism	OD 20/40 OS 20/40	20/30 20/25	20/30 20/30
#7	14	congenital nystagmus	OD 20/30 OS 20/60	20/60 20/70	20/60 20/60

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