Potential Acuity Assessment:
A Comparison of the Mentor Potential Acuity Meter and the IRAS Portable Interferometer

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With the advancement of surgical techniques and the public's increasing demand for clear vision, we are beginning to see a remarkable increase in the number of cataract extractions with intraocular lens implants. In addition, the cataract patient is more knowledgeable about the techniques and interested in the possible improvement after surgery. Modern instrumentation now allows us to accurately predict the prognosis for good visual acuity after surgery. Two of these instruments will be discussed in detail and compared to determine which one provides a better prognosis when both are used on the same eye.

Several methods are available to the optometrist for estimating visual acuity behind a cataract. These methods include on/off tests, recorded signal tests and retinal acuity tests.

On/off tests, such as Marcus Gunn swinging penlight, Haidinger brush and other entoptic phenomenon tests are relatively easy, quick and inexpensive to perform. However, these tests only provide a gross estimate of macular function.

Recorded signal tests include ultrasonography, electro-oculograms, electroretinograms and visual evoked potentials. All of these tests are independent of media density and there are no subjective responses required from the patient. The disadvantage is that the equipment needed to perform the tests is sophisticated and expensive. The testing procedures are lengthly to perform. In addition, the foveal health is inferred from the retinal and optic nerve health. Disease specific to the fovea may be missed.

Retinal acuity tests include refraction and pinhole, interferometers and potential acuity meters (PAM). These are designed to measure visual acuity by bypassing the media opacities. As the obstruction of the media increases, the accuracy of these tests decreases. However, the potential acuity indicated by these tests always equals or underestimates true retinal acuity, so that the postoperative result will be equal to the prediction or better[1]. This assumes that there is no complication during surgery. The equipment needed for these tests is relatively inexpensive and the tests are quick and easy to run.

Based on the information above, we chose the Mentor PAM and IRAS laser interferometer for a comparison study to determine which instrument predicts a better potential acuity on a given eye and to find which instrument is more practical to incorporate into the average optometrist's practice.

Before discussing the methods used during the comparison study we will elaborate on the two individual instruments and how they work. The potential acuity meter was developed by Guyton and Minkowski in 1980 and was first presented in 1981[2]. A pinpoint light source transilluminates the target. An achromatic condensing lens images the point source at the plane of the opacity and the target (Snellen letters) at the plane of the retina. The effect is a minimal amount of light scatter produced by the opacity. The PAM is designed to be mounted on a slit lamp such that the image of the point source corresponds to the viewing point of the slit lamp. This enables the examiner to focus the point source on a "window" in the cataract and project a chart of Snellen letters onto the retina. The laser interferometer uses a low power helium-neon laser split to create two point sources. These point sources are directed through the pupil to create interference grating patterns of varying frequency on the retina. The pattern's frequency correllates well with Snellen visual acuity and is independent of refractive error. The laser interferometer is a portable, hand-held instrument and it is not necessary to find a "window" in the cataract.

The PAM and IRAS interferometer were compared in the following manner. Twenty four eyes with varying degrees of lens opacification and maculopathy were randomly selected from the population of patients seen at the eye clinic at Ferris State College of Optometry. The subjects varied in age from 13 to 82 years old. All of the subjects were given a complete visual exam and visual acuities were taken with the subject's best visual acuity (BVA) correction being worn. Potential acuity was then measured with the PAM through a dilated pupil. The subjects were seated comfortably at the slit lamp table. Refractive errors were compensated for on the PAM. The subjects were instructed that an eye chart would be projected into their eye and that it may appear to be hazy and may move around slightly. They were told to read as many letters as they could from the smallest line they could see.

When three letters were read correctly, that acuity level was considered achieved and the subject was instructed to go to the next smaller line. The pinpoint source was moved in a scanning manner over the entire area of the dilated pupil. The maximum line acuity was then recorded. IRAS interferometer acuity was then measured on the same subjects. The subjects were pre-educated about the appearance of the grating patterns. The subjects were seated and the examiner projected the patterns into the eye in one of four orientations (vertical, horizontal, left and right diagonal). Upon presentation of a grating the subjects responded with one of the four orientations. The testing started with large gratings. Four random orientations were presented to eliminate the possibility of the subject guessing. When three of four presentations were correctly determined, the grating frequency was increased and again four random orientations were presented. This was continued until a maximum acuity was achieved and recorded.

The above procedures were also performed on twenty normal eyes (20/20 BVA or better). The subjects were optometry students at Ferris State College of Optometry. These subjects had no medial opacities and no degree of maculopathy. This was done as a control test to determine if the examiners were performing the tests properly and if the tests adequately predicted a visual acuity consistent with that achieved on a Snellen acuity chart with BVA correction in place.

The data and results from the tests are on the following pages in graphical form. The first two graphs (fig. A & B) show the actual data obtained from the test subjects and the control subjects. More than eighty three percent of the test subjects demonstrated a potential acuity at or above the Snellen acuity measured with the subject's BVA correction in place. The control subjects had a similar percentage with a potential acuity at or above the Snellen acuity measured. The third graph (fig. C) shows an overlay of the ranges of acuity obtained with the two instruments for a given visual acuity. The last graph (fig. D) shows the average number of acuity lines improvement obtained with the two instruments for a given visual acuity. The graphical data shows that there is not much difference between the results obtained with the individual instruments.

Both instruments give accurate estimates for potential acuity following uncomplicated cataract extractions. In the absence of any significant difference in the results obtained from the two instruments, the comparison must be based on the advantages and disadvantages associated with the individual instruments.

The PAM has one major advantage over the interferometer. Snellen acuity letters are used with the PAM. Both the examiner and the subject are familiar with the meaning of Snellen acuity and can relate it to daily visual tasks. Several disadvantages exist with the PAM. The correlation between true retinal acuity and predicted potential acuity falls off as the density of the cataract increases above a level of 20/300. Significant improvements are still predicted, however. In order for the test to be successful the patient must be able to sit at a slip lamp table. This makes it difficult for extremely young patients, old patients and patients with poor motor control. When reading the acuity lines, the subject's jaw movement often moves the pinpoint source out of the window it is being directed through. The PAM also requires that the patient know the alphabet, be able to communicate and be of average intelligence. This eliminates several patients in the general population. The PAM is dependent on the subject's refractive error. This decreases the test's validity on the subject that is difficult to refract.

The IRAS interferometer has several advantages. The instrument is hand-held and portable. This allows the examiner to perform the test nearly anywhere with the patient in either an upright or a prone position. The red monochromatic light used penetrates cataracts easily and it is not necessary for the subject's pupil to be dilated. The test is independent of refractive error. The grating targets provide an easy pattern for the subject to interpret. Illiterate populations can communicate the orientation of the pattern through the use of hand signals. The random orientation of the pattern eliminates the possibility of the subject memorizing the chart. Some of the disadvantages of the IRAS interferometer are similar to those of the PAM. Poor motor control, communication problems and low intelligence levels can affect the test results. In addition, the IRAS consistently over-predicts the visual acuity in amblyopes and frequently in cystoid macular edema. Variable results are obtained in patients with corneal disease. The reasons for these problems are unknown.

The cost of the PAM is approximately $2,700.00 and the IRAS is approximately $3,000.00.

Given the information contained in this article, it is our opinion that the IRAS interferometer is much more practical to use and more easily incorporated into the daily routine of the average optometrist's practice. The instrument is an excellent predictor of potential visual acuity. The use of this instrument coupled with the optometrist's knowledge of the specific case at hand allows him/her to refer patients for cataract surgery with the confidence that he/she has appropriately provided the patient with the best care available.

CONTROL GROUP																				
BVA OF CONTROL GROUP	ACUITY ACHIEVED WITH INSTRUMENTATION																			
	P.A.M.* n=12										LASER INTERFEROMETER n=12									
	20/15	20/20	20/25	20/30	20/40	20/50	20/60	20/70	20/80	20/200	20/15	20/20	20/25	20/30	20/40	20/50	20/60	20/70	20/80	20/200
20/15	0	0	0	0	0	0	0	0	0	0	8	0	2	0	0	0	0	0	0	0
20/20	0	12	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
20/25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20/30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTALS	0	12	0	0	0	0	0	0	0	0	8	2	2	0	0	0	0	0	0	0

* P.A.M. only measures visual acuity to 20/20.

FIG. A

EXPERIMENTAL GROUP																				
	ACUITY ACHIEVED WITH INSTRUMENTATION																			
BVA OF EXPERIMENTAL GROUP	P.A.M.* n=24										LASER INTERFEROMETER n=24									
	20/15	20/20	20/25	20/30	20/40	20/50	20/60	20/70	20/80	20/200	20/15	20/20	20/25	20/30	20/40	20/50	20/60	20/70	20/80	20/200
20/25	0	1	0	2	1	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0
20/30	0	0	3	0	1	0	0	0	0	0	0	1	0	2	1	0	0	0	0	0
20/40	0	0	4	1	0	0	0	0	0	0	0	2	0	3	0	0	0	0	0	0
20/50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20/60	0	1	0	2	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0
20/70	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0
20/80	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
20/100	0	0	0	0	1	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0
20/200	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	1	0	0	1	0
20/300	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0
10/700	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0
TOTALS	0	2	7	5	4	3	0	0	1	2	0	5	2	8	4	3	0	0	2	0

* P.A.M. only measures visual acuity to 20/20.

FIG. B

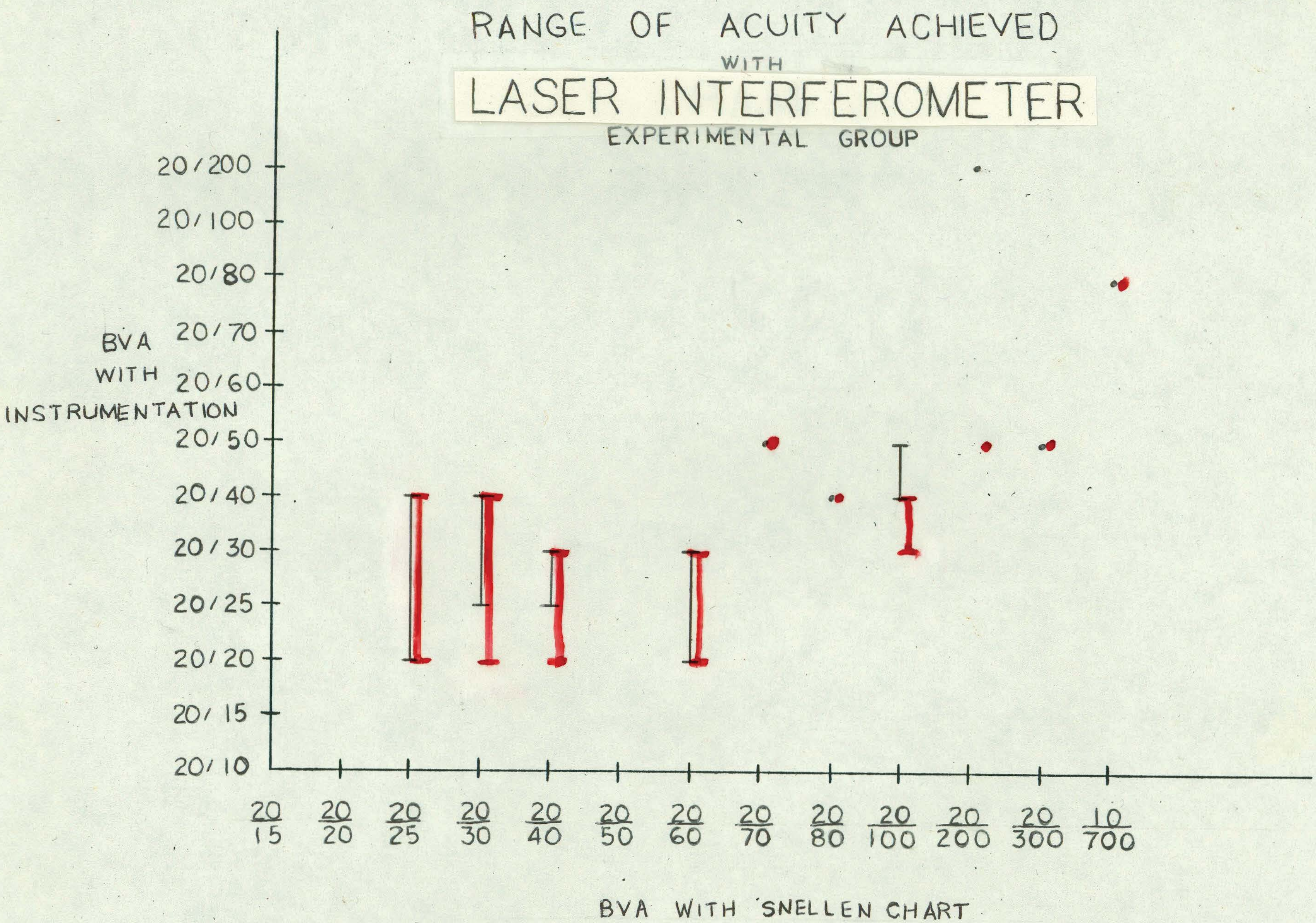
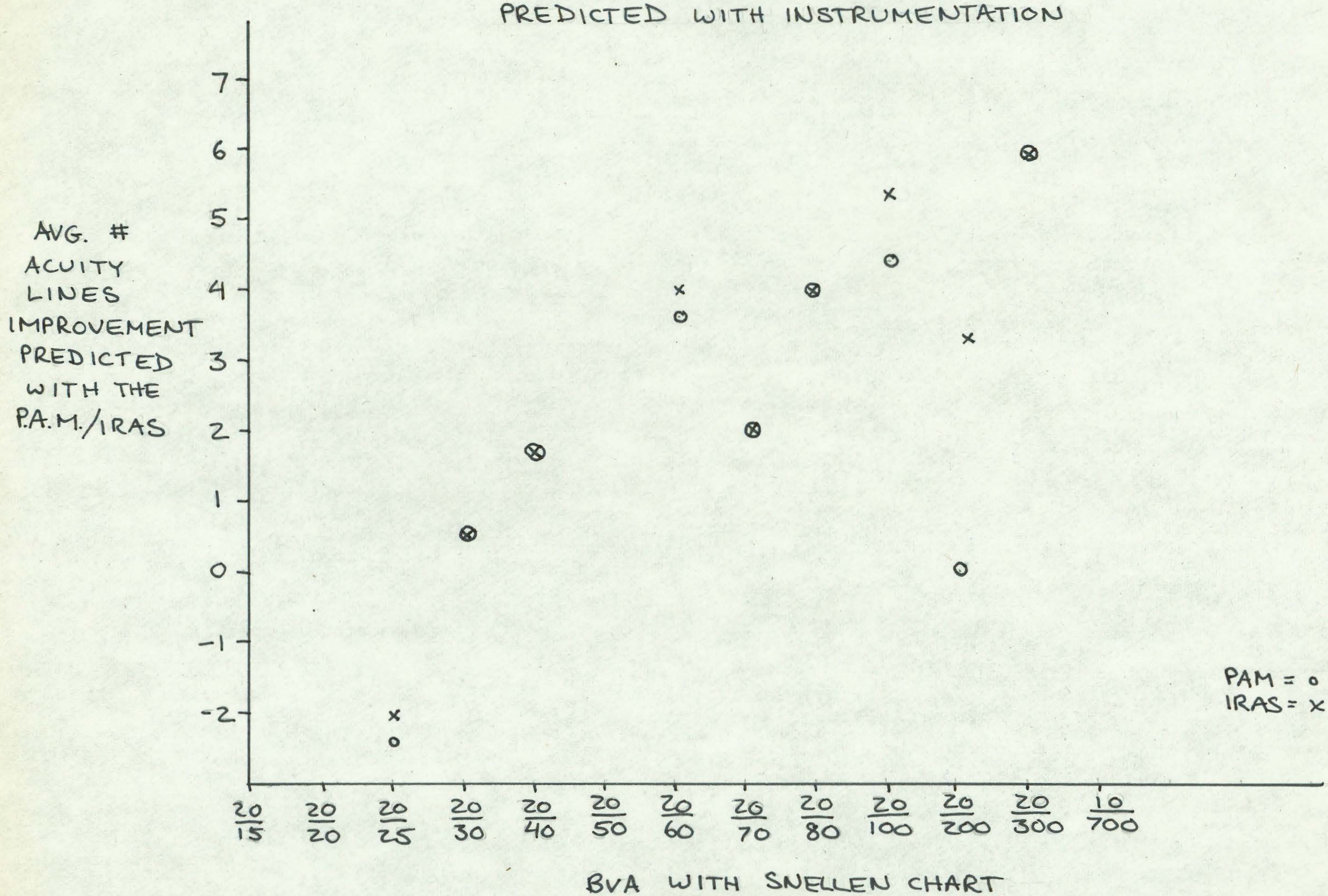

RANGE OF ACUITY ACHIEVED
WITH
LASER INTERFEROMETER
EXPERIMENTAL GROUP
20/200
20/100
20/80
20/70
20/60
20/50
20/40
20/30
20/25
20/20
20/15
20/10
BVA WITH INSTRUMENTATION
20/15
20/20
20/25
20/30
20/40
20/50
20/60
20/70
20/80
20/100
20/200
20/300
10/700
BVA WITH SNELLEN CHART

FIG. C

FIG. D

AVERAGE NUMBER OF ACUITY LINES IMPROVEMENT PREDICTED WITH INSTRUMENTATION



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