QUANTIFYING GLARE DISABILITY IN NON-CATARACTOUS PATIENTS

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ABSTRACT:

Many studies have shown the correlation between cataracts and glare disability. This study measures glare disability in 88 non - cataractous patients via a simple in - office procedure using a transilluminator and a nearpoint contrast acuity chart. Our findings demonstrate that a significant portion of the non - cataractous population experiences decreased contrast acuity when a glare source is introduced.

INTRODUCTION:

Snellen acuity has been widely accepted as the standard for measuring visual performance. It allows us to single out from the general population those with less than optimum vision. It must be noted though, that this test data is being obtained under artificial conditions. Everyday vision seldom enjoys the luxury of high contrast and proper illumination. Various tests including the Brightness Acuity Tester and contrast acuity charts have been developed in an effort to determine the true limitations on a patient's visual system. While these methods are certainly effective and reliable, cost may hinder availability in smaller practices. Our study was geared toward finding a method of determining the true visual limitations in a reliable yet inexpensive and timely manner. The method discussed involves the use of standard handheld equipment and can be done during a routine testing sequence.

METHODS and MATERIALS:

Eighty-eight patients received a general examination including refraction, ophthalmoscopy, and slit - lamp evaluation to rule out the presence of cataracts, corneal and retinal defects, and to assure optimum acuity.

The eighty-eight test subjects were divided into groups by age (twenties, thirties, forties, and fifty to sixties). Each age grouping consisted of twenty-two subjects.

Data was obtained through monocular testing of the patients' best corrected vision using a nearpoint contrast acuity chart developed at Ferris State University (Figure 1). This chart utilizes a graded contrast Landolt C format with contour interaction bars and is designed for use at thirteen inches. The chart was evaluated in a study by M.J. Ferrence[1] and was found to be reliable and valid. A correlation coefficient was calculated relative to the standard snellen chart. Testing results showed a high correlation in both adults and children with r=0.98 and r=0.84 respectively. In instances during Ferrence's study where a discrepency existed between the snellen and Landolt C acuities, the Landolt C acuity was less than that of the snellen acuity. Therefore, one can be reasonably confident in assuming that the subjects acuity is at least that which is determined by the graded contrast Landolt C acuity chart.

The testing was modeled after a study by Maltzman, Horan, and Rengel[2]. With one eye occluded, baseline acuity was obtained under general room illumination. After baseline data was obtained, a handheld transilluminator was used to introduce a glare source at 10 - 12 inches from the corneal plane and 15 degrees (+/- 5 degrees) off the line of sight (Figure 2). A second acuity was taken immediately after introduction of the glare source. The final measurement was taken after fifteen seconds of exposure to the light to determine if adaptation was occurring.

In addition to the quantitative measurements, the patient was also asked to make a comparative statement as to the quality of the chart characters before and after presentation of the glare source.

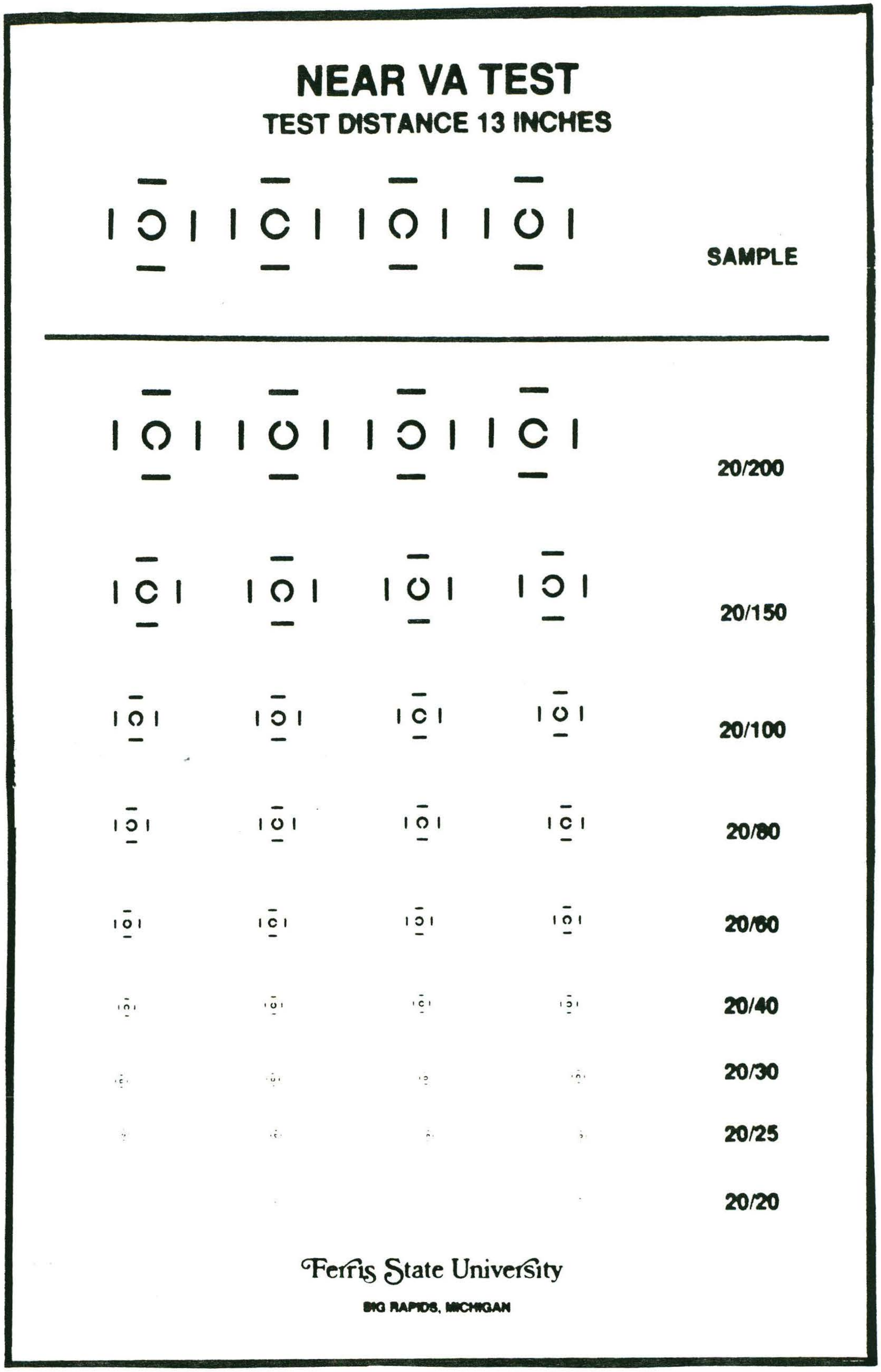


FIGURE 1 — ACUITY CHART

RESULTS:

Of the 88 patients tested, all were free of ocular pathology. Those with cataracts were excluded. However, psuedophakes with no evidence of secondary membrane formation were not. All subjects included in this study possess baseline contrast acuity of 20/200 or better. Figure 3 is a grid comparison of the baseline acuity to the initial glare measurement.

Of the 88 patients tested, 34 (38.6%) demonstrated an acuity loss of one line or greater upon introduction of the glare source. A total of 16 patients (18.2%) dropped two or more lines, and 8 patients (9.1%) exhibited an acuity reduction of three lines from their baseline value. One third of the subjects demonstrating a glare disability displayed a recovery after fifteen seconds of exposure. It was also noted that when recovery occurred, it was absolute (patient returned to baseline acuity).

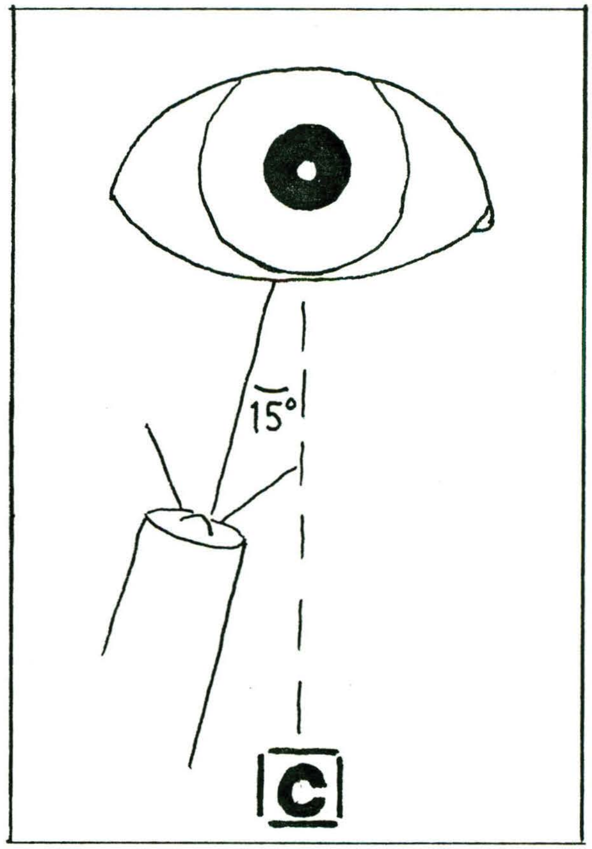


FIGURE 2: Glare Test Set-up

The relationship between age and level of disability is shown in a scatter graph (Figure 4). This graph demonstrates the increase in glare disability with age despite the absence of ocular pathology or cataractous changes.

Findings unique to age grouping include the fact that approximately twenty percent of those patients in the late thirties/early forties age category noted an improvement in quality of vision (no quantitative difference noted) upon introduction of the glare source. Also, of the twenty-two patients in the fifties and sixties age bracket, six were pseudophakes. All six of the pseudophakes exhibited an acuity loss after introduction of the glare source.

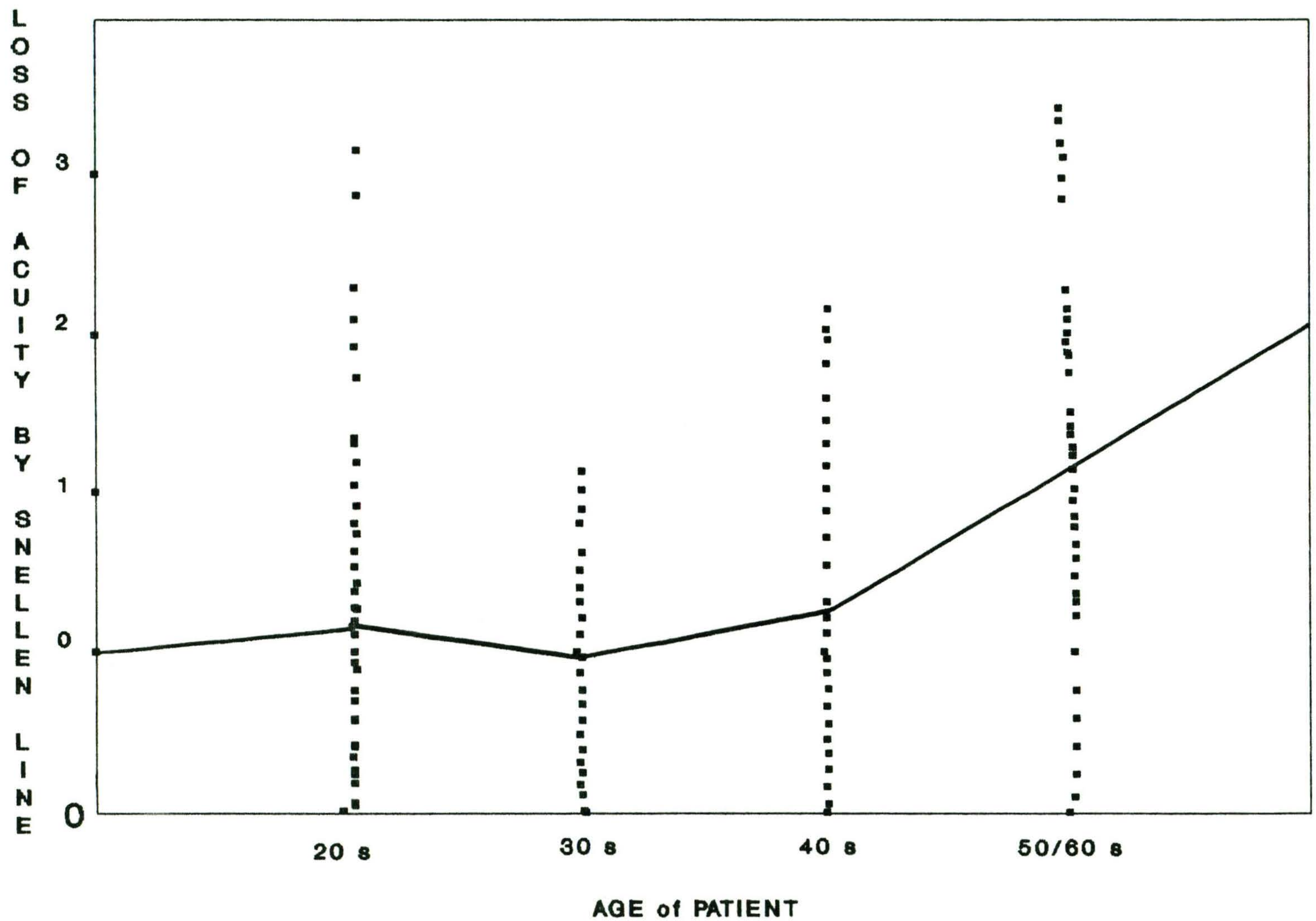
FIGURE 3 : COMPARISON TABLE

PRE TEST ACUITY

	20/20	20/25	20/30	20/40	20/60	20/80	20/100	20/150	20/200	TOTAL
20/20	20	4								24
20/25		8	2	2	2					14
20/30			6		2	2				10
20/40				8	6	2	2			18
20/60					6	4	2	2		14
20/80						4	2			6
20/100										
20/150								2		2
20/200										
TOTAL	20	12	8	10	16	12	6	4		88

GLARE DISABILITY MEASURE

FIGURE 4: SCATTER GRAPH



DISCUSSION:

Glare disability is a decrease in contrast caused by light scatter within the optical system[3]. The amount of scatter dictates the degree of disability and is a function of the transmission properties of the ocular structures.

The cornea, in it's normal state, scatters approximately ten percent of the light encountered. Any corneal condition producing edema and/or scarring significantly increases the amount of light scattered.

The next structure to affect the traveling rays is the lens. The normal healthy lens is composed of tightly packed high protein fibers. Large proteins accumulate within the lens fibers with age and increase the amount of light scatter. When the protein aggregates become very large and fluid pockets develope between the fibers, enough light is scattered to produce turbidity. At this point the lens is described as cataractous. However, even before the turbid appearance can be detected with biomicroscopy, light scatter and subsequent glare is occurring. This is believed to be the mechanism by which glare disability occurs. Figure 4 is a graph of the test results showing how glare tolerance drops off with age. Though all age groups demonstrated some degree of glare disability, our results support the theory that protein aggregates build up in the lens over time, increasing light scatter and in turn, glare disability.

The vitreous contains collagen fibers so small that only 0.1% of the incident light rays are scattered here. Of course, as fibers coalesce the scattering effect increases, but the patient complaint is more often of floaters than disability glare. The retinal elements are homogenous from a refractive index standpoint, having much the same effect on light scatter as the cornea, which is minimal. Therefore, it is obviously the lens which plays the key role in glare disability. It should also be noted that transmission characteristics of the normal crystalline lens vs. an intraocular lens implant differ markedly. Intraocular lens implants are found to scatter approximately 2.3 times as much light as the normal crystalline lens[4]. Two significant differences are cited as a possible explanation for the increase in scatter effect. The larger refractive index of the intraocular lens is thought to produce more pronounced internal reflections. Also, the crystalline lens is layered to produce a gradual decrease in refractive index toward the periphery which tends to minimize internal reflections.

CONCLUSION:

Often, patients present with complaints of "difficulty seeing in bright lights"; ie. driving at night/headlights, bright sunlight, etc. Such complaints voiced in a case history cause us to closely observe for uncorrected myopia, cataracts, and a myriad of other conditions which might bring on this complaint. It is not unusual to complete a patient examination without finding a cause for such complaints. Obviously, glare tolerance and recovery varies from individual to individual, and although the exact mechanism for glare disability in non-cataractous patients is not known, it's consequences can be very profound. Since complaints of decreased vision associated with glare are common, it is helpful to be able to quantitate the degree of disability. This enables the practitioner to determine the severity of the vision impairment and also provides a method of evaluating the success of interventions. A study performed by students at the Indiana University School of Optometry suggests antireflection coating of lenses can reduce glare disability in some cases[5]. Testing such as that discussed in this paper could allow the practitioner a method of determining which patients might benefit from AR coatings, and also provide a means of demonstrating this improvement to the patient in the office. And while treatment options are still very limited, it is always in the patient's best interest to be knowledgeable of their visual limitations.

REFERENCES:

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