Brightness acuity test and outdoor visual acuity in cataract patients

Jack T. Holladay, M.D. Thomas C. Prager, Ph.D.
Jorge Trujillo, M.D. Richard S. Ruiz, M.D.
Houston, Texas

ABSTRACT

The disparity between functional outdoor vision and the acuity measured in the standard refracting lane is well known among clinicians. A simple device, the brightness acuity tester (B.A.T.), was developed to predict a patient's functional outdoor acuity. The B.A.T. has an illuminated hemispheric bowl, 60 mm in diameter, with a 12-mm aperture. Fourteen normals and 50 patients with cataracts were tested using the B.A.T. and then tested outside in bright sunlight. The B.A.T. correlated extremely well ($r = +0.84$, $P < .0001$) with the acuities measured outside. There was no decrease in visual acuity in the 14 normal patients, but there was a one to ten line decrease in vision among the cataract patients. Upon retesting, the B.A.T. scores did not vary, while outside testing scores did change due to variable outdoor ambient light levels on sunny days. The B.A.T. is a simple, repeatable, useful test for predicting functional outdoor acuity.

Key Words: brightness acuity tester, cataract, functional outdoor acuity, visual acuity

The disparity between functional outdoor acuity and that measured in a standard dark refracting lane with a high-contrast projected acuity chart is well known to most clinicians.[1-4] Ocular media opacities are the primary cause of this disparity,[5] with the posterior subcapsular cataract being the most common. These patients may be legally blind in sunlight and yet have better than 20/40 in the standard refracting acuity lane.[6]

Although several new tests for functional vision assessment are available,[7,8] the results are often in a form unfamiliar to the clinician. Additionally, conversion to standard visual acuity is not exact or, with some tests, not possible. While these tests have heightened awareness of the need for measuring functional outdoor acuity, ambiguity still exists when trying to decide the need for surgery, evaluating the safety of operating a motor vehicle, or quantitating the percentage of visual impairment for industrial situations.

A seemingly simple solution is to take the patient outside on a sunny day and test the visual acuity. With many elderly patients, however, this is impractical, not to mention its dependency on good weather. We present a technique for testing patients in a standard refracting lane which yields results similar to taking the patient outside on a sunny day and measuring Snellen acuity.

MATERIALS AND METHODS

A 60-mm diameter hemisphere with a diffusing surface was fabricated with a 12-mm central aperture and a shielded light bulb located superiorly, as shown in Figure 1. The intensity of the bulb was adjusted so the hemisphere would provide an average luminance of 400 ft. lamberts. This instrument, the brightness acuity tester (B.A.T.), was then used to test each patient as shown in Figure 2.

Sixty-four patients were selected to participate in the study. Fourteen subjects had no ocular pathology

From the University of Texas Health Science Center at Houston, Hermann Eye Center, Houston, Texas.

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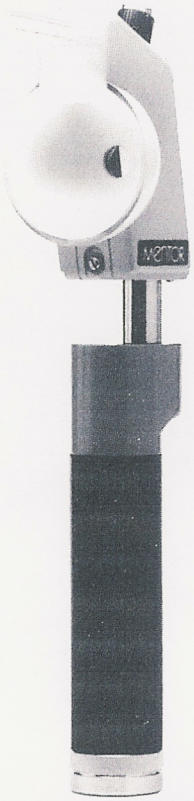

Fig. 1. (Holladay) Brightness acuity tester (B.A.T.), an illuminated hemispheric bowl, 60 mm in diameter with a 12-mm aperture.

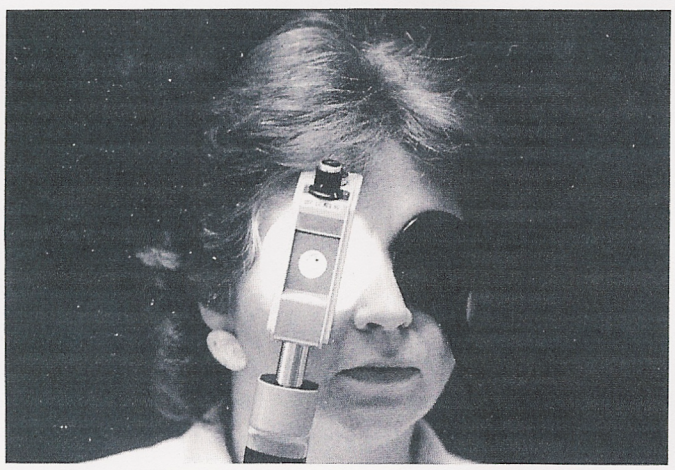

Fig. 2. (Holladay) Appearance of brightness acuity tester (B.A.T.) when used for measuring functional outdoor acuity.

other than refractive error and 50 patients had cataracts. Each individual's acuity was measured in the standard manner using their best correction.

The patient's visual acuity was then remeasured looking through the B.A.T. at the same acuity chart. Patients were given sufficient time (usually 15 to 30 seconds) to adjust to the bright light as evidenced by a stable acuity. When these conditions were met, the acuity was recorded.

The patient was then taken outside on a sunny day in which the illumination was no less than 5,000 ft. candles (range 5,358 to 13,198 ft. candles). A wall chart was mounted on a concrete wall reflecting approximately 50% of the incident light as shown in Figure 3. Patients were given time to adjust to the bright outside light, then visual acuity and exact outdoor illuminance were recorded.

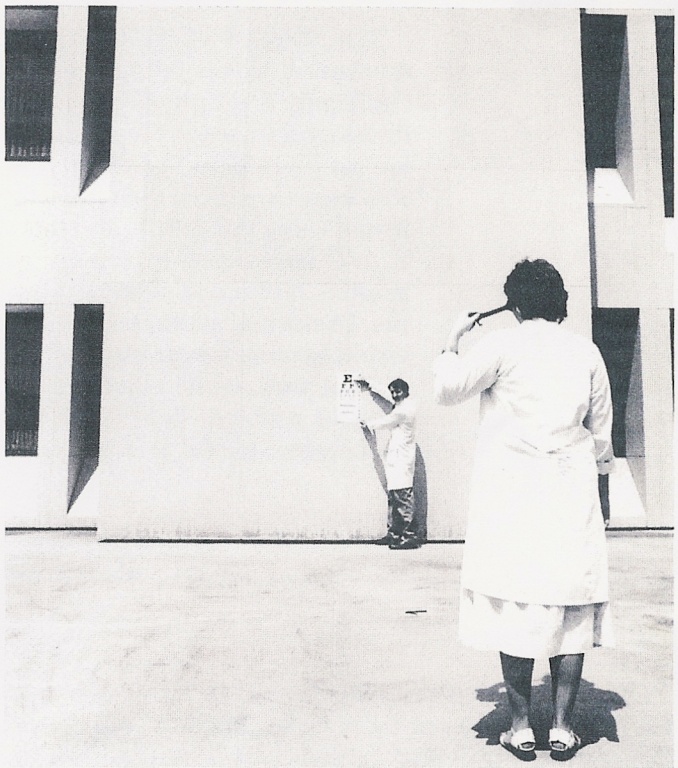

Fig. 3. (Holladay) Actual conditions for outdoor acuity measurements. Sun was always within two clock hours of its zenith and the illumination was from 5,358 to 13,198 ft. candles. The patient was 20 feet from the wall chart, which was mounted on an eight story, 50% reflecting concrete wall.

RESULTS

None of the 14 normals had any reduction in visual acuity with the B.A.T. or outdoor testing. Patients with cataracts, however, had a one to ten line reduction in acuity. Figure 4 shows the correlation between the outdoor acuity and that measured with the B.A.T.; Figure 5 shows the correlation in reduction in lines of acuity between outdoor acuity and the B.A.T. The correlation coefficient between the B.A.T. and outdoor acuity was excellent ($r = +0.84$, $P < .0001$). Unaccounted variability in the data was only 29% ($R^2 = 0.71$).

DISCUSSION

The 84% correlation demonstrated in Figure 4 confirms that the B.A.T. was a good indicator of outdoor acuity. Analysis of those patients who had the

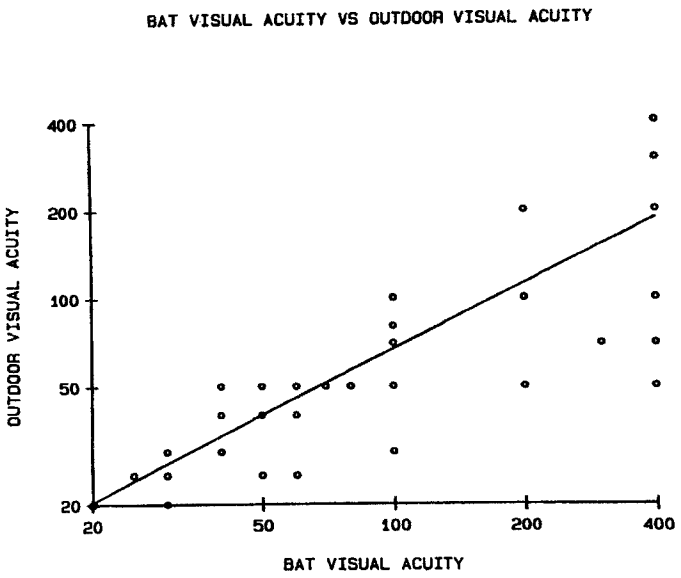

Fig. 4. (Holladay) Scattergram comparing visual acuities using the B.A.T. and actual outdoor measurements ($r = +0.84$, $P < .0001$).

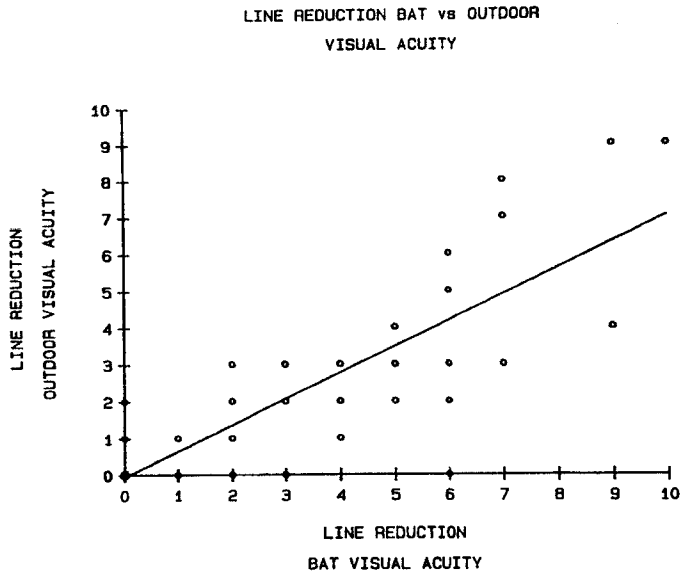

Fig. 5. (Holladay) Scattergram comparing the reduction in lines of visual acuity using the B.A.T. and actual outdoor measurements.

greatest difference between outdoor acuity and B.A.T. revealed that most of them were tested on partly cloudy days in which the illuminance was at the lower limits of acceptable brightness (5,000 ft. candles). Ten of these patients were retested on brighter days and they demonstrated worse outdoor acuities than when originally tested, a finding that was closer to the original B.A.T. measurements. The B.A.T. acuities with the ten patients retested did not change.

We have recommended adding medium and low light level settings on the B.A.T. so that conditions on overcast days and bright indoor lighting (commercial settings) can be simulated. The availability of three light levels (low, medium, and high) would provide more information for determining a patient's functional disability in these various lighting situations.

Testing patients with the B.A.T. closely simulates outdoor bright light conditions and provides the clinician with a simple method of obtaining a patient's outdoor visual acuity. Since our standards for driving, percentage of visual impairment, and indications for surgery are most often expressed in Snellen acuities, the clinician can easily assess these problems using familiar standards that have evolved over many years.

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