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Comparison of the Handy Eye Chart and the Lea Symbols Chart in a population of deaf children aged 7–18 years

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Abstract

Purpose—To compare the results of visual acuity testing in a population of deaf children using the Handy Eye Chart versus the Lea Symbols Chart and to compare testability and preference between charts.

Methods—A total of 24 participants were recruited at the Atlanta Area School for the Deaf. Visual Acuity was evaluated using the Handy Eye Chart and the Lea Symbols Chart. Patient preference and duration of testing were measured.

Results—The mean difference between the visual acuity as measured by each chart was –0.02 logMAR (95% CI, −0.06 to 0.03). Testing with the Handy Eye Chart was an average of 13.79 seconds faster than testing with the Lea Symbols Chart (95% CI, 1.1–26.47; $P = 0.03$). Of the 24 participants, 17 (71%) preferred the Handy Eye Chart (95% CI: 49%–87%; $P = 0.07$).

Conclusions—The Handy Eye Chart is a fast, valid, and preferred tool for measuring visual acuity in deaf children age 7–18 years. Additional research is needed to evaluate the utility of the Handy Eye Chart in younger children and deaf adults.

Vision screening among deaf children is essential to identify pathology that can affect school performance and quality of life. The rate of hyperopia, myopia, astigmatism, and binocular abnormalities, is higher among deaf individuals compared with hearing individuals.[1] Further, studies have shown that deaf students have high rates of undiagnosed or inadequately treated refractive errors.[2] This recognized combination of high prevalence of refractive pathology and inadequate treatment highlights the importance of thorough vision screening of deaf children.

Currently available visual acuity charts designed for pediatric patients include the Lea Symbols Chart, Snellen Tumbling E, HOTV and several others. These charts require deaf

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Dr. Hutchinson has a proprietary interest in the Handy Eye Chart.

patients to sign to an interpreter or to use a matching card to indicate their recognition of a symbol, which slows down testing and requires the patient to break fixation during manifest refraction. The Handy Eye Chart optotypes (Figure 1) were designed for use in non-English-speaking and deaf individuals and uses hand gesture symbols as optotypes to assess visual acuity.[3] Each sign is one-handed, and is based on a commonly used hand signal such as a "high-five" or a "thumbs-up." The Handy Eye Chart has been validated against the ETDRS chart[3] and the Landolt C chart (unpublished data). The purpose of this study was to assess utility of the chart in a population of deaf students by comparing participant preference, visual acuity outcomes, and duration of testing between the Lea Symbols chart and the Handy Eye Chart.

Subjects and Methods

This study was approved by the Emory University Institutional Review Board and complied with the US Health Insurance Portability and Accountability Act of 1996. Informed consent was obtained from the participant's parent, and assent was obtained from all participants. Patients were recruited for the study at the Atlanta Area School for the Deaf Registration Day. Parents and their children were informed about the study and invited to participate. The school nurse then brought the participants to the designated study room according to grade level, with the earliest grades evaluated first and the high school students evaluated last. An American Sign Language (ASL) interpreter was available to assist with testing and the consent/assent process.

Each participant underwent testing with both the Lea Symbols Chart and the Handy Eye Chart. The students were evaluated at a distance of 10 feet with a linear chart. The order of administration of the charts alternated between participants. The participants used a handheld occluder during the measurement of monocular visual acuity. The participants were given a standard set of instructions in ASL for each chart. Visual acuity and duration of testing with each chart were recorded. Timing started at the end of instruction and continued until visual acuity testing was compete. The total number of correctly identified optotypes in each line was recorded, and the subject's visual acuity was scored according to the following formula:

$$\mathrm{logMAR\ acuity\ score} = 1.10 - 0.02\mathrm{T_c}$$

Where T_c represents the total number of correctly identified optotypes. The test administrator was not masked to the results of the first test during the administration of the second test.

After completion of testing, the participants were asked the following two questions:

1. Which vision chart used today did you like better and why?
2. What did you like and what did you dislike about each eye chart?

Their responses were recorded. Data were analyzed using R (version 3.2.1; R Foundation for Statistical Computing, Vienna, Austria). The methods were compared using paired *t* tests, a

Bland-Altman plot, and linear regression. The authors included 24 participants to ensure adequate statistical power to detect a 15-second time difference between the groups (with alpha set at 0.05, power at 80%, and assuming a standard deviation of differences within the pair of 25 seconds).

Results

A total of 24 participants (14 boys) were recruited from the Atlanta Area School for the Deaf. The age and sex distribution of the study participants are provided in Table 1. Of the 24 participants, 21 used their hands to communicate during the testing, either through gestures or ASL, and 3 of the participants communicated with spoken English. The raw visual acuity distribution is shown in Figure 2. The difference in visual acuity as determined by each chart was calculated for each participant. The mean difference in visual acuity as determined by each chart was −0.02 logMAR (95% CI, −0.06 to 0.03; $P = 0.44$), which equates to one optotype.

A Bland-Altman analysis was performed to assess the agreement between the charts across the range of visual acuities and shows the 95% limits of agreement between the two charts to be −0.18 to 0.21 logMAR, which represents a range of 0.39 logMAR (Figure 3). A linear regression was performed to evaluate the linear relationship between the two charts measurements of visual acuity, and this analysis can be found in Figure 4. The r^2 value was 0.85.

The difference between the duration of each administration was calculated by the equation:

$$\text{Lea Symbols Duration (secs)} - \text{Handy Eye Chart Duration (secs)} = \text{Difference.}$$

The mean difference between the duration of each evaluation was found to be 13.79 seconds (95% CI, 1.1–26.47 sec; $P = 0.03$).

When asked which chart they preferred, 17/24 participants (71%) indicated that they preferred the Handy Eye Chart (95% CI, 49%–87%; $P = 0.07$). When asked why, 8/17 students included the word “easy” or “easier” in their responses and 2/17 noted that the hand symbols were similar to ASL signs. Of the students who preferred the Lea Symbols Chart, 2 of 7 noted that the Lea symbols appeared bigger and “easier to see.”

Discussion

There was no clinically or statistically significant difference in visual acuity as measured with each chart; the mean difference was 1 optotype. The relationship between the visual acuities as determined by each chart showed a strong correlation as evidenced by the r^2 value of 0.85. The 95% limits of agreement were shown to be −0.18 and 0.21 logMAR. These data illustrate that both charts provide comparable measurement of visual acuity and confirm our previous[3] and ongoing validation studies.

Testing with the Handy Eye Chart was 13.79 seconds faster than testing with the Lea Symbols Chart. One reason for this difference may have been the additional time and effort required by the participant to sign the Lea symbols, which then had to be interpreted, slowing down the testing. Had a Lea matching card been available, testing times might have been more comparable between the two tests.

The majority of participants preferred the Handy Eye Chart to the Lea Symbols Chart. It is possible some students might have preferred the Lea symbols if a matching card had been available; however, we found that 17 of 24 participants (71%) preferred testing with the Handy Eye Chart (95% CI, 49%–87%; $P = 0.07$), although the difference was not statistically significant and was likely a function of the sample size. Furthermore, 2 of 7 participants (29%) who preferred the Lea Symbols Chart spoke English during the test and did not use ASL to sign the chart. The data presented support the theory that among those with nonstandard communication styles, the Handy Eye Chart appears to be preferred.

There is a need for more tools to evaluate vision accurately and efficiently in deaf populations, given that the prevalence of refractive errors is higher compared with their hearing counterparts and that they rely more heavily on vision for communication.[1,2,4] Furthermore, many deaf individuals have other types of undiagnosed or inadequately corrected visual disturbances.[2] Inadequate recognition and treatment of vision problems may exacerbate the challenges that deaf individuals already face in seeking healthcare services, which can include communication barriers, physician distrust, and inadequate insurance coverage.[5]

The Handy Eye Chart can help healthcare providers ensure accurate communication during the evaluation of visual acuity. Deaf individuals often create “homesigns,” or gestural signs designed to convey concepts, for use with family and friends who do not understand ASL.[6] The optotypes used in the Handy Eye Chart are examples of such signs, allowing for direct communication between the patient and the provider and providing a common ground to ensure mutual understanding.

One potential weakness of this study was the performance of vision screening with the Lea Symbols Chart without using the matching card. However, as previously stated, multiple studies have shown that deaf individuals have higher rates of refractive error than hearing individuals.[1,4,7] Accordingly, any chart that aims to serve deaf individuals should also be suitable for use during manifest refraction. The Handy Eye Chart is well suited for manifest refraction, because the patients can use one hand to mimic the optotype while maintaining fixation on the chart. Because the Lea Symbols Chart (with matching card) involves patients breaking fixation on the chart to look down at the matching card, the patient loses the necessary fixation required for manifest refraction. For this reason, testing participants in the study without the matching card provided a more accurate representation of a common and essential clinical encounter.

We chose to compare our chart to the Lea Symbols Chart in this study so that we could assess the similarity in visual acuity outcomes between the two methods. We acknowledge that comparison to other commonly used charts, specifically the HOTV and Sloan Charts might have allowed for rapid, one-handed communication of visual acuity, and it is possible that these other charts might have proved equally fast, accurate, and acceptable for the participants in this age group.

The authors would like to emphasize that the use of the Handy Eye Chart in no way obviates the need for full and thorough interpretation for deaf individuals during medical encounters as outlined in the Americans with Disabilities Act.

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FIG 1.
The Handy Eye Chart optotypes.

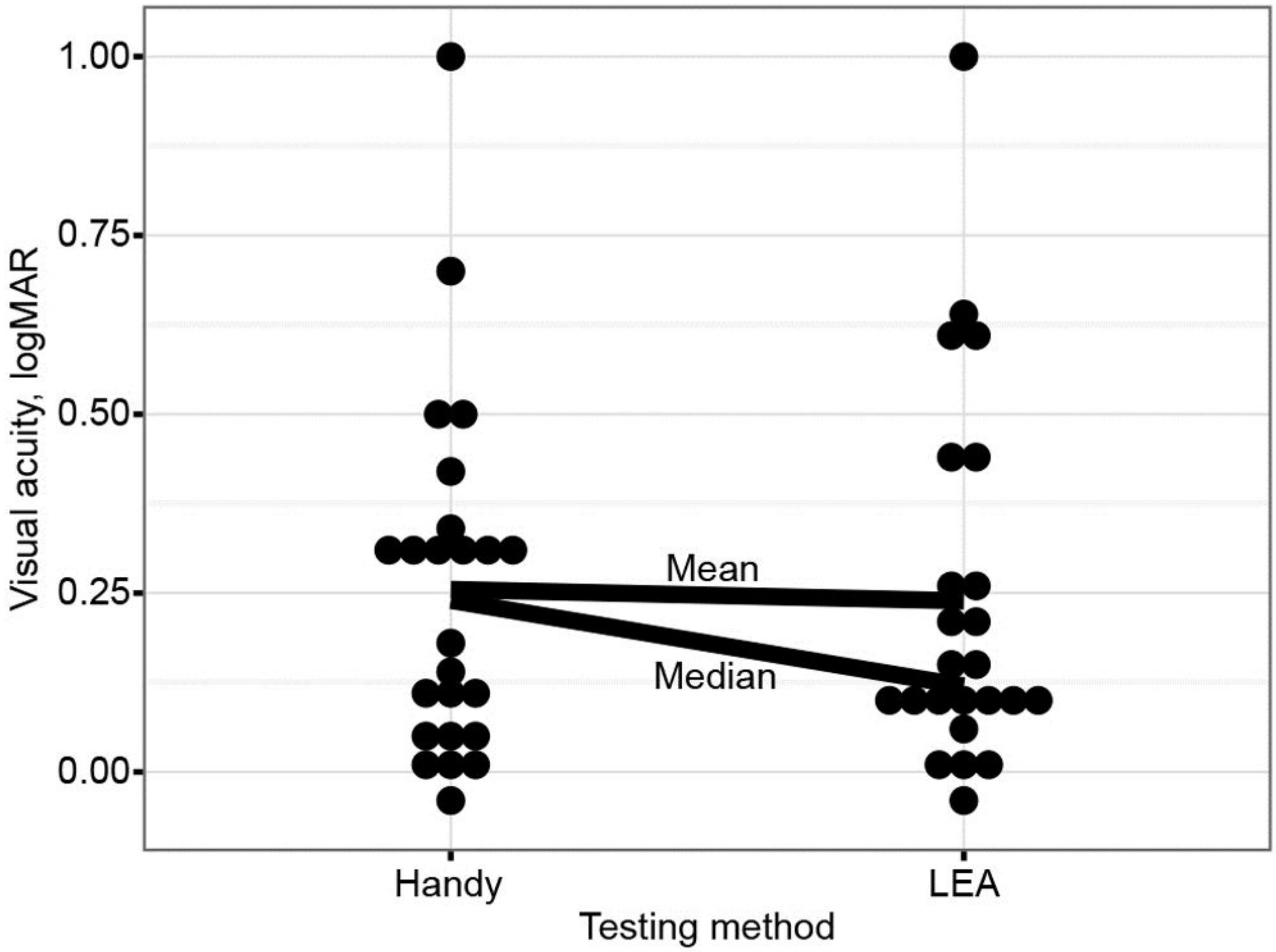

FIG 2.

Raw visual acuity data from each chart. The mean and median values for each test are shown graphically. The mean acuity difference was −0.02 logMAR (95% CI: −0.06 to 0.03; P = 0.44) or approximately 1 letter better on the Handy Eye Chart.

logMAR, logarithm of the minimum angle of resolution; *VA*, visual acuity.

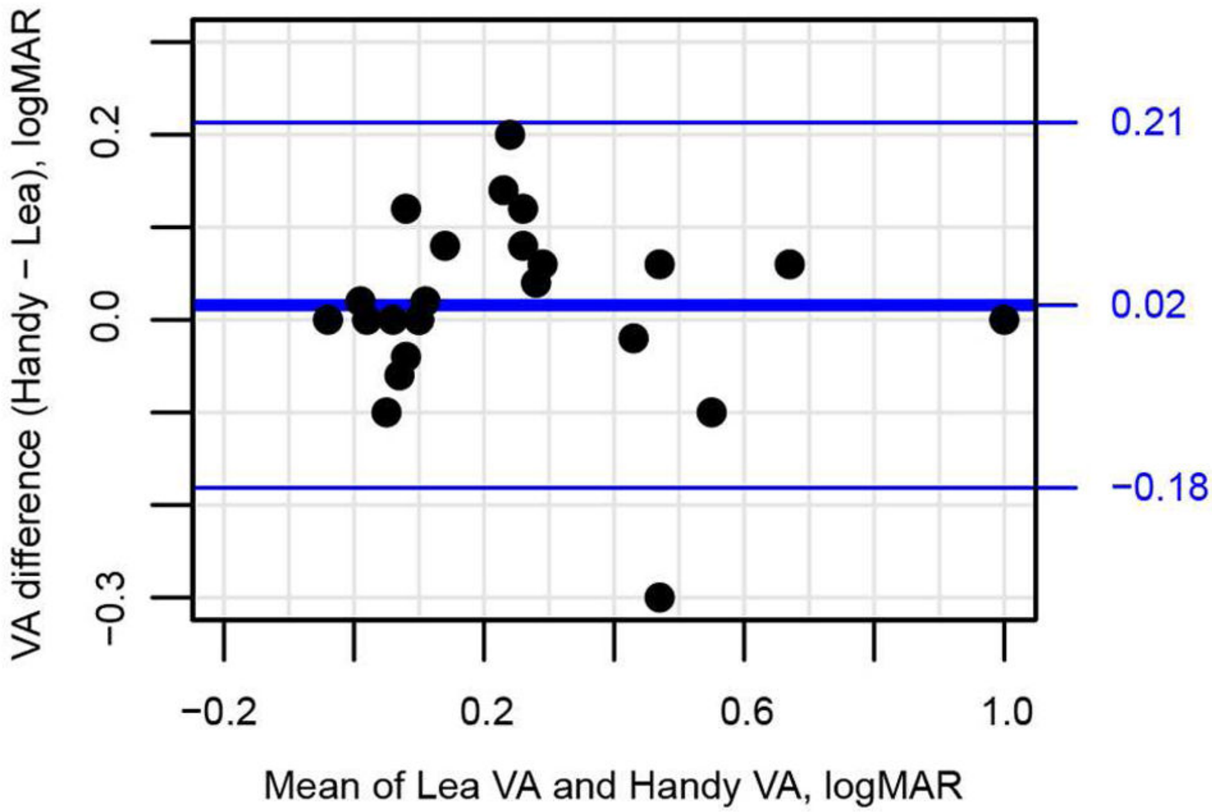

FIG 3.

Bland-Altman style plot showing the monocular acuity difference as a function of the mean visual acuity for each participant. The lines represent the mean and 2 standard deviations (SD). The difference between visual acuity measurements of the two charts remains similar across the range of visual acuity tested.

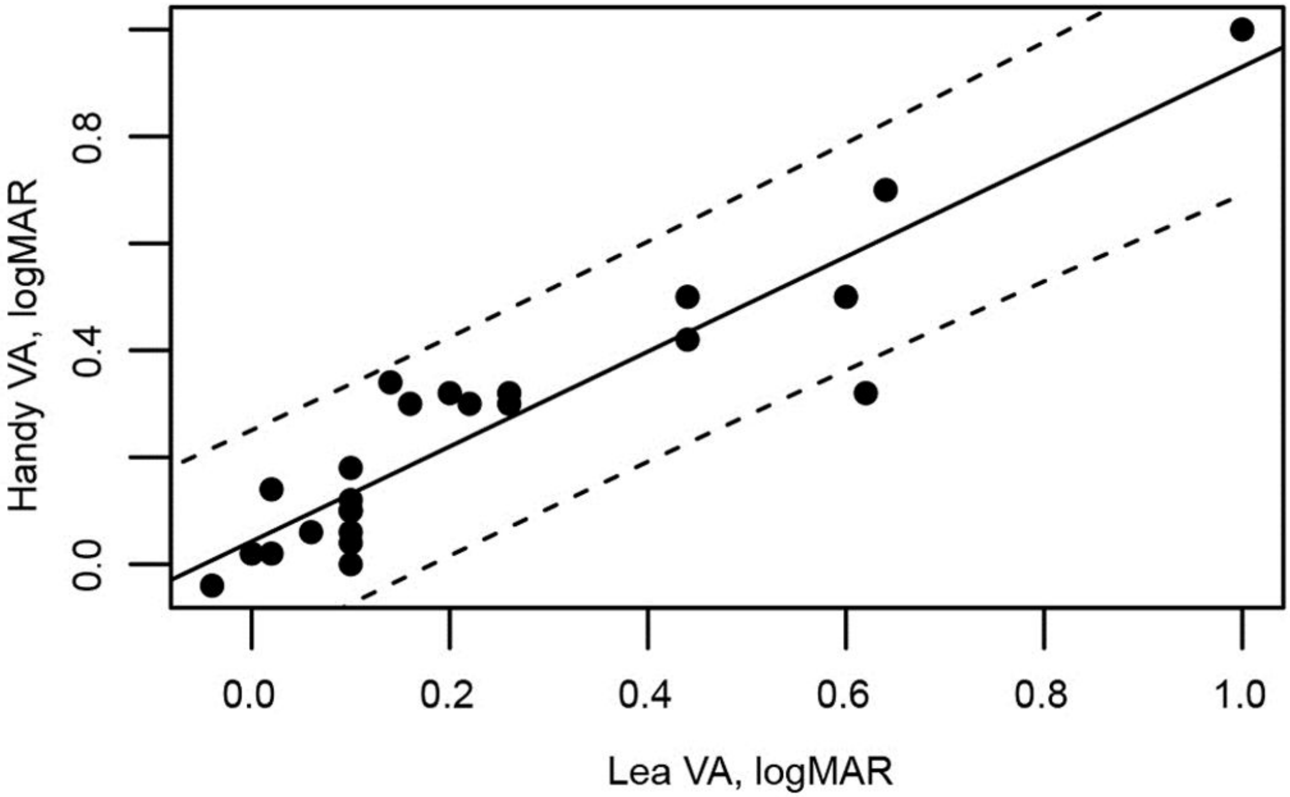

FIG 4.

Linear regression of Handy Eye Chart and Lea Symbols Chart visual acuities. The r^2 value of 0.85 supports the linear relationship between the charts. The dotted lines represent the 95% prediction interval. The equation for the regression is Handy visual acuity = 0.04 + 0.89 Lea visual acuity.

Table 1

Age and sex of the study participants

Age range	Number of participants
7–8	3
9–10	6
11–12	4
13–14	5
15–16	4
17–18	2