Original Article

Comparison of an Italian Chart with an Iranian Chart in Visual Acuity Measurement

Haleh Kangari[1], Alireza Akbarzadeh-Bagheban[1], Atiyeh Khomamizadeh[1], Saeed Rahmani[1]

[1] Faculty of Rehabilitation, Shahid Beheshti University of Medical Sciences, Tehran, Iran

Abstract

Background: Taking visual acuity is an important part of an eye routine examination. This study was conducted to compare visual acuity measured using an Iranian digital tumbling E chart with visual acuity measured using an Italian digital tumbling E chart as a familiar foreign chart.

Materials and Methods: This study was carried out on 200 participants (400 eyes; healthy n=40, glaucoma n=40, retinal disorders n=40, post lasik n=40, corneal n=40) with mean age 44.28 years. Visual acuity of both eyes in half of the subjects (n=100, n=20 from each group) was first measured using the Italian digital chart and then measured using Iranian digital chart. Visual acuity of the rest of subjects (n=100, n=200 from each group) was first measured using the Iranian digital chart and then measured using the Italian digital chart. Measured visual acuities were recorded in logMAR notation.

Results*:* Mean of the Iranian and Italian Tumbling E chart is 0.280 ± 0.012 and 0.277 ± 0.012, respectively. Paired t-test used to evaluate the mean difference between two groups (p=0.721) indicated that there was no statistically significant difference between means of the two tests. Spearman correlation coefficient for the results of both tests was 0.942 (p<0.001), which was statistically significant and could be categorized as a strong positive correlation.

Conclusion: The two digital Tumbling E charts acted similarly at different levels of acuity in different disorders. However, the Iranian chart requires a more accurate design for optotypes of the lower acuity lines in order to obtain more accurate measurement of visual acuities in healthy subjects.

Keywords*:* Tumbling E chart, Visual acuity, Digital chart

***Corresponding Author:** Saeed Rahmani. Department of Optometry, Faculty of Rehabilitation Sciences, Shahid Beheshti University of Medical Sciences, Tehran, Iran. Tel: +98-21-77458865, Email: medicalopto@yahoo.com.

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Introduction

Visual acuity is a criterion for spatial analysis of visual system for seeing details of things and defining angular size of the observed details[1]. Measurement of visual acuity is performed routinely as the most frequently used test in any eye examination to evaluate visual functioning. The results of visual acuity measurement are used in many cases, including prescription of eyeglasses, contact lenses, and visual aid equipment for patients with low vision; examinations before refractive surgery; examination for occupational medicine; and issuance of driver's license. Moreover, measurement of visual acuity is a baseline and one of the most important tests for examining patients' eye health status in terms of diseases, traumas, and congenital eye disorders[2,3].

The charts used for measuring visual acuity are often print charts, chart projector, and digital charts. Digital charts enable one to select various optotypes, change the sequence of optotypes, change stimulus parameters including the contrast, and adjust the distance and time. By using these charts, it is possible to repeat tests with a different order of optotypes of each line. This method prevents one from remembering optotypes when using print charts and projector charts[3].

Despite the mentioned advantages of digital charts, use of these charts is not common in Iran due to unfamiliarity with their advantages and method of using the device and also their high cost.

The present study was conducted to clinically evaluate a new Iranian digital chart through comparing the visual acuity measured using the chart with that measured using a popular digital chart in normal people and patients with different eye disorders. Reason is that although all charts should be made according to geometrical, optical, and dimensional specifications, they must be analyzed clinically[3].

The probable results of this study based on the accurate performance of the Iranian digital chart and its lower cost, compared to valid foreign chart, can promote the use of digital charts in Iran. This in turn can be effective in facilitating and developing visual examinations, standardizing visual acuity measurement, equalizing results of eye examinations in Iran, and saving time of examinations and money.

Methods

This cross-sectional study was conducted in the ophthalmology ward of Rasoul-e-Akram Hospital (in 2013). A total of 200 subjects (400 eyes), including healthy people and patients with different eye disorders, participated in the study. The people under 10 years old and those with visual acuity lower than 20/200 were excluded from the study. The subjects consisted of 40 patients with retinal disorders, 40 patients with glaucoma, 40 patients with a history of refractive surgery, 40 patients with a history of corneal transplantation, and 40 healthy people.

Using both of the digital charts, visual acuity of all subjects was evaluated by an examiner under equal and stable conditions, so the place of measurement with both charts was the same. The Italian chart was a 19-inch monitor with Windows XP OS. The Iranian digital chart was a 22-inch Samsung LED monitor with a built-in software package, which ran as separate slides. The visual acuity test with Italian chart and the Iranian chart consisted of various charts, including Tumbling E, Snellen, and Landolt. The Tumbling E chart was selected in this study because it is more common in Iran and does not require the knowledge of and familiarity with English letters.

The examinations were carried out under photopic conditions (day light), as the brightness of the patients' seat was 180-220 lux. The condition was verified by O.L.V.C.R (Ophthalmic Lenses Verification Centre of Shahid Beheshti University of Medical Sciences).

Lighting conditions of the examination room was almost steady with no dazzling light source in the area. Lighting range in center of the Italian chart and the Iranian chart was 290-310 lux and 250-270 lux, respectively (according to the recommended standard lighting range)[3-5]. The distance was adjustable and according to the conventional standards, it was intended 4 meters in this study for measuring the visual acuity[4].

First, the best-corrected visual acuity of the right eye and then, the best-corrected visual acuity of the left eye of all subjects were measured twice with each chart. As all the subjects were evaluated using Italian digital chart and the Iranian digital chart in this hospital for the first time, they knew and experienced both charts equally. However, 100 patients were first evaluated using the Italian digital chart and then evaluated using the Iranian digital chart and the other 100 patients were first evaluated using the Iranian digital chart and then evaluated using the Italian digital chart.

All the subjects were asked to identify, the direction of E limbs from the top row respectively to the last row where optotypes were identifiable for the subjects. During the examination, straightness of patients' head and covering the other eye were controlled. The visual acuity was recorded based on the logarithm scale and the method of scoring optotypes, as the last row where optotypes were identifiable for the patients was regarded as the visual acuity of patients, and the score of optotypes that might be read additionally from the next row was subtracted from the visual acuity total score[3].

This study applied the descriptive and analytical statistics. The descriptive statistics involved tables, figures, and concentration and dispersion indices. In the analytical statistics, one-sample Kolmogorov Smirnov test was used to examine normality of data; Spearman's correlation coefficient and the related test were used to study the correlation between test scores; and paired t-test was used to compare mean scores of the two tests in general and for each group. Type I error of the test in this study was considered as 0.05. Therefore, the probability values less than that was regarded statistically significant.

Results

The present study was conducted on 400 eyes of 200 people of whom 98 people (49%) were female and 102 people (51%) were male. The Chi square test did not show any significant difference in sex distribution of the five groups (p=0.07).

Mean and standard deviation of women and men's age were calculated as 44.28 and 18.74, respectively.

The range of visual acuity measured using the Italian chart and the Iranian chart for the right and left eyes was between 20/200 and 20/20. The paired t-test used to compare mean scores of both tests showed no statistically significant difference between mean scores of the two tests (p=0.721). Mean and standard error of the scores obtained from the Italian chart were 0.280 and 0.012, respectively, and those obtained from Iranian chart were 0.277 and 0.012, respectively. The results of the comparison of both tests using paired t-test for each of the five groups are shown in figure 1.

The Spearman's correlation coefficient for both tests was 0.942, which was statistically significant (p<0.001) and classified as a strong positive correlation. Comparison of correlation coefficients in subgroups showed that the highest correlations were related to the groups with corneal transplantation (0.967), and the lowest correlation was related to the healthy subjects (0.5). All the correlation coefficients in each of the five groups were significant at p<0.001, which indicated the consistency of scores in both tests (Table 1).

Discussion

The visual acuity measured using the Iranian digital chart was comparable to that measured using Italian digital chart, and the differences between the results of the two tests were not statistically significant. Regarding the Spearman's correlation coefficient, scores of the two tests showed a high correlation (0.942), that it is classified under strong positive correlations.

Generally, the reduced correlation of the results of both tests was more evident in the range of the higher visual acuity (close to 20/20), which existed more in the patients with a history of refractive surgery and healthy subjects. Possible reasons for the reduction of correlation in the groups were: 1) Difference in visual acuity measured using both charts in the patients with a history of refractive surgery and healthy subjects were marginal (no more than 1 or 2 optotypes differences were observed). Such a difference existed in the range of higher acuities due to the more sensitivity and difficulty of the visual acuity test. 2) In

Table 1: Spearman's correlation of the test scores for the five groups.

Group	Spearman's correlation coefficient	p value
Retinal diseases	0.923	<0.001
Glaucoma	0.933	<0.001
Corneal Transplantation	0.967	<0.001
Post-refractive surgery	0.756	<0.001
Healthy	0.500	<0.001

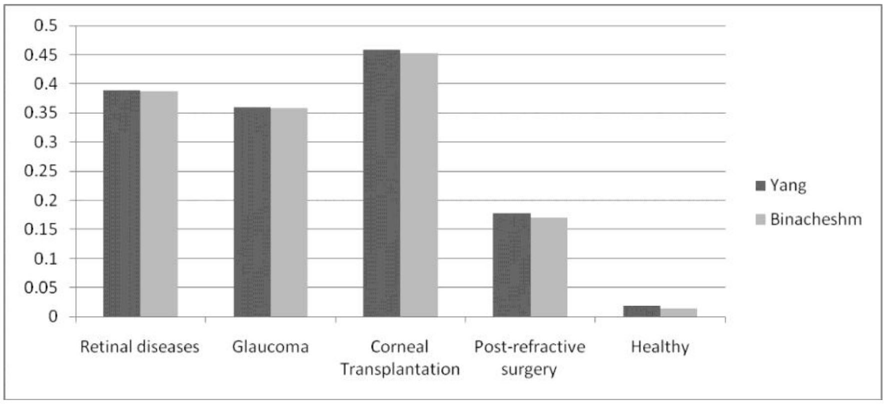

Figure 1. Mean visual acuity scores of the charts for the five group.

patients with a history of refractive surgery, dry eyes changed the quality of visual acuity, as the patients' vision improves to some extent after blinking. Varying visual acuity in these people may be a reason for the marginal differences in the visual acuity measured using the two charts, 3) Due to the changes in eye refractive conditions after the refractive surgery; the marginal difference in brightness and contrast of the charts might be more influential in the measured visual acuity of those people. 4) Finally the size of optotypes and the space between rows in each optotypes in the bottom of the Iranian chart (the rows related to the better acuities) were not equal. This might be a reason of the difference in the acuity measured in this range in healthy people.

Different studies have been performed on the comparison of visual acuity conventional charts[6-9], comparison of the conventional charts with digital ones, and also conventional charts with new ones for clinical evaluation of charts[10-16].

Having considered the importance of the visual acuity measurement as an important clinical test, all studies aimed to provide a solution for improvement of visual acuity measurement, which was also the objective of the present study. However, no similar study has been done in the field of the present study on the comparison of the Italian with Iranian digital Tumbling E chart.

It should be considered that only the Tumbling E charts of Italian and Iranian were compared in logarithm scale and the results of the present study do not confirm other Iranian digital chart tests. Thus, further studies should be performed to examine other charts.

Resolution of the rows on the bottom of the Iranian chart related to the range of better visual acuity (0.3 logMAR onward) was less than those on the top and this part of the chart and we believe that requires to re-designing.

Unlike the Italian chart, selection of rows and optotypes separately is not possible in the Iranian chart. In addition, the sequence of optotypes of the rows cannot be changed at the time of re-evaluation (so that the patients do not memorize the lines). To do so, we suggest that more slides should be designed.

Conclusion

The two digital Tumbling E charts acted similarly at different levels of acuity in different disorders. However, the Iranian chart requires a more accurate design for optotypes of the lower acuity lines in order to obtain more accurate measurement of visual acuities in healthy subjects.

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Conflict of Interest

The authors have no financial interest for the products presented in this article.

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