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Comparison of visual acuity measurement by Smartphone based application vs. conventional Snellen visual acuity chart

Dr. Virendra Singh Lodha

M.S., D.N.B. (Ophthalmology), Asst. Prof. Ophthalmology, Pacific Medical College and Hospital, Udaipur

ABSTRACT

Background: The use of Smartphone and tablet have become very common in the present era and these gadgets have found many uses other than telephony specially in medical science where they can be used for online reference, diagnosis, patients records and monitoring. Many applications are available or developed to be used for diagnostic purposes in ophthalmology, particularly for visual acuity testing which reflects the functional status of the eyes and related nervous system.

Objective: To compare results of visual acuity measurement by a Smartphone and conventional Snellen visual acuity chart.

Methods: Distance visual acuity of 92 eyes of 46 persons was measured in outpatient department of ophthalmology with Snellen chart at 6meters distance and with an application made for 2 meters distance on a Smartphone.

Results: The results of visual acuity measured by Smartphone with Snellen optotypes configured for 2 meter distance were reliable, with 92.35% results matching the results obtained with standard Snellen chart at 6 meters distance and remaining results within one line of difference.

Conclusions: The results of visual acuity measurement with Smartphone are reliable and this method can be used for screening in community health programme anywhere especially in rural areas and schools, without the need of setting up Snellen chart. This is a convenient and inexpensive method and can be used by trained health workers.

Key Words: Smartphone, Visual acuity.

INTRODUCTION

Ever increasing advancement in mobile technology and Smart phones have brought a great change in life and work environment in the present era including medical science. Many applications have been developed for professional use by physicians and patients for monitoring and management of diseases.[1,2,3] In Ophthalmology Smart phones can be used for diagnostic, reference, patient education purposes and as administrative tools.[4,5,6] Smartphone based applications (Apps) are being developed and assessed for use in community health programmes for vision check up in rural areas so that visual acuity can be measured by a trained health worker anywhere in the field without setting up Snellen chart. Many applications for self assessment of visual acuity and colour vision testing have been introduced by software developers for Android OS or iOS based Smart phones, but have not been studied for reliability of results. Snellen chart is the most commonly used tool for measuring visual acuity in clinical practice. Snellen chart consists of letters of different sizes (optotypes) which are to be read from a distance of 6 meters and is used either as box type or LCD screens or projectors. Studies done using tablets have found that the results of testing distance visual acuity measurement were reliable. The present study is proposed to compare the results of Smartphone based visual acuity measurement done at a distance of 2 meters with visual acuity measurement by Snellen chart at 6 meters.

MATERIAL AND METHODS

After obtaining institute's ethics committee approval 46 patients and companions visiting eye department of Pacific Medical College and Hospital, Udaipur, India were included in this study. Persons with evidence of present or past ocular pathology other than refractive error were not included in this study and persons having vision <6 /36 on Snellen Chart test at 6 meters were also excluded for statistical reasons as minimal visual acuity which can be recorded by Snellen chart is 6/60 (if a person cannot read 6/60 on Smartphone then to convert visual acuity in logMAR units would not be possible). Only persons who could read English alphabets were included because the author has made a power point application for android based Smartphone in English alphabets only. The visual acuity was measured by the following methods-

1. Snellen Visual acuity chart at 6 meters
2. Smartphone Snellen chart for 2 meters – an interactive visual acuity chart (IVAC) was prepared by using "Interactive Visual Acuity Chart" (IVAC) from University at Buffalo's online software.[7] Seven lines of English alphabets of decreasing size and calibrated for 2 meter distance (optotypes) was made online and saved on an Android operating system (OS) based Smartphone. These were put in a single folder and presented as slides with black letters on white background to the person being examined.

Visual acuity was measured first on Snellen visual acuity chart at 6 meters distance followed by measurement by Smartphone application at 2 meters distance without any change in the sitting position of the person being examined. It was ensured that there was no glare from the screen of Smartphone.

RESULTS AND ANALYSIS

Table 1: Visual Acuity Measured by Snellen 6 meter chart and Smartphone 2 meter chart

	Snellen 6 meter		Smarphone 2 Meter	
n	Snellen Acuity	Mean logMAR	Snellen Acuity	Mean logMAR
10	6/36	0.78	6/36	0.78
14	6/24	0.6	6/24	0.6
18	6/18	0.48	6/18	0.493
14	6/12	0.3	6/12	0.312
16	6/9	0.18	6/9	0.195
20	6/6	0	6/6	0.018

n= number of patients

As shown in Table 1, a total of 92 eyes of 46 persons were examined in the study. Mean visual acuity was 0.34 with a range of 0 – 0.78 log MAR in Snellen chart group and 0.35 with a range of 0 – 0.78 log MAR in Smartphone group with a difference of 0.01 log MAR units between the mean of two groups. The results of visual acuity measured by Smartphone matched in 92.3% (85) persons when compared with their measurement on standard Snellen chart at 6 meters. Bland-Atman analysis shows a Mean difference of .01 log MAR units between the two groups with 95% limits of agreement of 0.067 to 0.089 and SD of 0.04.

DISCUSSION

Apps are available for Smartphones to test colour vision, contrast sensitivity, macular functions etc., which when analysed and standardised can be of great help in outreach eye health care programmes. Attachments are being developed to take fundus photographs with a smartphone so that a trained health worker can examine a patient for diabetic retinopathy, glaucoma and maculopathies and transmit the images to an ophthalmologist for opinion. Such Apps can be used by trained ophthalmic technician or paramedical staff for screening of patients in community health services and selected persons can be referred for detailed examination. Present study was undertaken to find out the reliability of Smartphone based visual acuity testing.

Earlier studies using iPad tablet for measuring visual acuity found that the results were comparable with the standard visual acuity measured in office / clinic settings.[8, 9] However these gadgets are expensive for countries like India, hence the present study was done using an Android operating system based Smartphone which is much less expensive and most commonly used type of mobile phone. Results of this study are consistent with the results of the above mentioned studies and also show that visual acuity can be measured with a simple and inexpensive Smartphone. In this study the results of visual acuity measurement taken at 2 meters distance with a Smartphone were same in 92.3% persons and within one line of measurement in the remaining, when compared with the standard visual acuity test done at 6 meters in hospital settings. In one study it was observed that glare from the screen of tablet resulted in errors in the measurement which were eliminated when an antiglare screen was put on the tablet being used.[10] However glare from the screen of the Smartphone is not a problem because of improvements in the quality of screens being used in present day Smart phones. Only English alphabets were used as optotypes in this study but tumbling "E" test types can also be made in an application for use to test persons unable to read English alphabets.

CONCLUSION

A standardised application (App) developed for Smartphone can give reliable results of visual acuity measurement and can be used in outreach community health check up and school health programmes by trained health workers and teachers etc. It can also be useful for bed side recording of visual acuity if required.

Conflict of interest: None

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