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Virtually controlled computerised visual acuity screening in a multilingual Indian population

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ABSTRACT

Introduction: The efficacy of tele-based (virtually monitored) visual acuity (VA) examination in a hospital-based multilingual population was assessed based on subjects from the Outpatient Department of Optometry, School of Allied Health Sciences, Manipal University and Department of Ophthalmology, Kasturba Medical College, Manipal, India.

Methods: Visual acuity measurement using a computerized VA chart (COMPlog) was done using a telemethod and face-to-face method in a randomized fashion for all subjects. Virtual (remotely operated) control of examination procedure and video-conferencing helped the optometrist positioned elsewhere (different physical location) to remotely operate the COMPlog VA chart and also interact with the subjects. The connection was facilitated using Lync software connected through local area network connections. During tele-examination, instructions were given on subject's language preference (Kannada, Malayalam or English).

Results: Mean age of 96 subjects (three language groups) was 40.3±14.1 years and a Bland–Altman plot showed good agreement with clinically acceptable limits of agreement. The mean difference in VA between the telemethod and face-to-face method was 0.00 logMAR (±0.16), p=0.844. Two methods had good intra-class correlation (0.912, 95% confidence interval 0.868–0.941) and had good agreement across the language groups (kappa>0.7).

Conclusions: Visual acuity measurements using the telemethod along with native dialect was comparable to conventional face-to-face method in a hospital-based multilingual population. Digital VA testing systems along with communication in native dialect can be effectively integrated into a tele-eyecare model.

Key words: computerized visual acuity (COMPlog), multilingual, telebased visual acuity, tele-ophthalmology.

Introduction

According to global estimates of visual impairment by WHO, 285 million people are visually impaired worldwide[1]. The distribution of visual impairment is not uniform throughout the world. The least developed and developing countries have the highest burden of visual impairment. Among these populations the distribution of visual impairment varies across different age groups and gender; adults older than 50 years and females are at higher risk[2].

India is geographically, linguistically, ethnically and socioeconomically diverse, so the need for and uptake of health care vary significantly throughout the population[3,4]. Currently in India and other developing countries, the task of providing standard eye examinations to every individual is limited by the lack of qualified eyecare practitioners and proper infrastructure[3]. There are only 12 eyecare practitioners per million population in Asia[5] and in India there is only one ophthalmologist per 100 000 population[3,6]. Comprehensive eye examinations using an effective screening method would be appropriate to detect populations at risk. In India, telemedicine activities have been emerging since 1999 and it is one of the feasible strategies to provide quality care[7].

Currently there are many successful teleophthalmology models in India, such as the Sankara Nethralaya Tele-Ophthalmology Project (SNTOP) and Aravind Tele Network (ATN)[8]. Studies have reported that such models are effective in detecting the diseases early and provide timely intervention[9]. Currently these tele-eyecare models aim at detecting structural changes through imaging techniques. The basic functional parameter that is used to quantify visual impairment is visual acuity (VA). In India, and in countries with similar demographics where there is high demand for detection of avoidable blindness, basic VA screening is provided by trained personnel (a vision technician), school teachers and social workers. Owing to these logistics issues, quality of eye care can be impaired. A recent study assessing the accuracy of vision and refractive error estimation by a non-formally trained technician showed poor accuracy in refraction and good VA evaluation[10]. There is a need for innovative methods in tele-eye care that could aid in providing quality primary eye care to the population at large. The technology should also facilitate proper utilization of manpower and provide culturally competent service to meet the needs of a multilingual population[11].

Visual acuity measurement is the most important clinical parameter in ocular examination. Systematic approach of VA measurement helps in effective screening of populations at risk. Exploring the possibility of incorporating the standard technique of VA measurement (real time, virtual platform) in a tele-eyecare model would be a step towards reducing the burden of visual impairment.

Computerized logMAR (COMPlog; http://www.complog-acuity.com) is a digital portable, user-friendly and validated VA testing system. Studies have shown that the efficacy of digital VA charts is as good as the conventional VA charts[12]. The authors of the present study have previously reported good agreement of telebased VA measurement among a normal young literate university population[13]. This computer-savvy, literate young student population responded well to the virtually monitored VA test. The results showed good agreement between virtual and face-to-face examination. Such a virtual vision examination model would face more challenges in rural applications due to various factors such as illiteracy, multilingual local vernacular languages and acceptance of telebased methods. Thus the current study evaluates the efficacy and applicability of virtually controlled telebased VA methods among a multilingual hospital-based population using the COMPlog VA system.

Methods

Subjects were recruited from the Outpatient Department of Optometry, School of Allied Health Sciences, Manipal University and Department of Ophthalmology, Kasturba

Medical College, Manipal, India. In this cross-sectional study a sample size of 96 subjects was estimated, considering a mean difference of 0.01 logMAR and standard deviation of 0.16 logMAR, alpha error at 5% and power of 80%. Eligible subjects were enrolled for the study and categorized into three language groups: Malayalam-speaking group (*n*=32), English-speaking group (*n*=32) and Kannada-speaking group (*n*=32). This cross-sectional study was conducted between June 2012 and April 2013.

Subjects aged greater than 18 years with a presenting VA of better than 6/60 (1.0 logMAR) were included. Subjects were also recruited according to their language preference, which was based on dialect or mother tongue (Kannada, Malayalam or English language). Subjects with any history of ocular surgery were excluded.

Presenting VA was measured by both face-to-face and telemethods by two experienced optometrists. The order of testing was randomized and the examining optometrist was masked from the previous VA readings.

Visual acuity measurement

COMPlog is a VA measurement software operated through a laptop computer (Windows system). The patient views the optotypes on a secondary monitor (24 inch, 1600x1200 resolution LED flat panel). For this study, the secondary monitor was calibrated for a 3 m distance for performing VA measurements. The optometrist controlled the test and recorded on the laptop whether the patient's responses were correct or incorrect. The software runs an acuity screening to quickly identify the rough VA of the patient and further refines using a thresholding technique. The detailed methodology of VA estimation using COMPlog is available elsewhere[12,13]. In both the methods, VA was measured in the COMPlog system using Landolt 'C', a type of visual acuity chart used to estimate acuity among illiterate patients. Prior to the measurements all the subjects received uniform formatted instructions. Visual acuity was measured first for the right eye for all the subjects.

Face-to-face method: This was similar to the method that would be used at a conventional eye clinic. The VA examination was performed by an optometrist (SK) physically present in the clinic. Instruction was predominantly provided in English with a few dialects from the local vernacular language for better understanding of the test instructions. Such a limitation prevails in a regular clinic, as the clinician's proficiency towards the vernacular language has a significant effect, from history-taking to patient counselling.

Telemethod: Subjects were examined by another optometrist (masked) and located elsewhere (different premises). The optometrists (JJ, MD) were comfortable speaking and comprehending all three languages (Kannada, Malayalam and English). The mode of communications and instructions were made as per patients' choice of comfort. In telemode, the examining optometrist who was fluent in the respective languages communicated with the patient and completed the examination. Lync software (Microsoft; http://office.microsoft.com/en-us), laptops with specific internet protocol (IP) addresses and internet connectivity were used to create a virtual interface between the subject and examining optometrist elsewhere and to have remote control of the COMPlog system. Virtual (remotely operated) control of examination procedures and videoconferencing aided the optometrist positioned elsewhere (different physical location) to remotely operate the COMPlog VA chart and to interact with the subjects.

Patient feedback was assessed for both the methods using a questionnaire. The questions addressed clarity, understandability, quickness, acceptability and overall satisfaction of both the methods. The response was given using a five-point scale ranging from 0 to 4 (worse to best). The presenting VA measurement of the left eye of every subject was considered for analysis. Data collected for the analysis were logMAR VA, duration of measurement and questionnaire responses for both the procedures (face-to-face and telemethod).

Ethics approval

The study was approved by the Institutional Research Board, School of Allied Health Sciences, Manipal University

(IEC175/2013). Written informed consent was obtained from all participants and the study was performed in accordance with the tenets of the Declaration of Helsinki.

Results

The mean age of 96 subjects was 40.3 (standard deviation=14.1, range=18–71) years. There was no statistically significant variability in age distribution across language groups (p=0.345). Male-to-female ratio was 45:51. Gender distribution among the language groups was not statistically significant (p=0.806).

Table 1 shows the mean VA of 96 subjects and of the language groups using both face-to-face and telemethod. The mean difference in VA between the two methods was –0.00 (±0.16) logMAR. The difference in VA measurement using the two methods was not statistically significant for the overall data (p=0.844). One-way analysis of variance (ANOVA) was done to analyse the variation in the VA difference across language groups, which was not statistically significant (p=0.140; Table 1).

The two methods had good intra-class correlation (0.912, 95% confidence interval (CI) 0.868–0.941). A Bland–Altman plot showed good agreement between the two methods (F1). The 95% limit of agreement for the mean difference in VA ranged from 0.31 to –0.32 logMAR.

When classifying the subjects with VA better than 0.3 logMAR (6/12) and worse or equal to 0.3 logMAR, the two methods had good agreement, Kappa statistic 0.742 (95%CI 0.601–0.895). The VA (better or worse) across language groups also had good statistical agreement (Table 2).

The variability of VA measures with the three language subset population across various VA ranges is shown in Figure 2. The changes in VA for all three groups were well within the clinically accepted test–retest variability of ±0.2 logMAR values. Language-specific instruction showed the least variability for the Kannada and English groups. Among the Malayalam group there was improvement in telebased methods for poorer VA, but the association was not statistically significant.

Mean time in seconds taken for the face-to-face method (64.63±30.24) was less than for the telemethod (76.65±32.69) and showed statistical significance (p=0.001). The difference in time between the two procedures did not statistically vary across language groups (p=0.355). Seventy six percent of the participants completed all of the questionnaire. More than 87% reported high satisfaction with the telemethod and 89% were satisfied with the face-to-face method (p=0.149). Other parameters in the questionnaire did not suggest statistical significance between the two methods (p=0.157). Only one subject was dissatisfied with the acceptance of the telemethod. The medical records of that particular subject revealed moderate to severe hearing impairment.

Discussion

The present study examines various aspects (comparability, efficacy, time taken, easiness, acceptability and satisfaction during the procedure) of VA measurement that can be incorporated in a telebased model. The mean difference in VA between the two methods was 0.00 (SD±0.016) logMAR units. The VA measurements done in the telebased method were comparable to that of the face-to-face method. The 95% limit of agreement between the two methods ranged from +0.31 to –0.32 logMAR units. Srinivasan et al., who performed a similar study among young computer-literate university students and staff population, reported slightly less variability in 95% limits of agreement (+0.26 to –0.26 logMAR units)[13]. The variability reported could be due to the diverse and older population in the current study. However the COMPlog validation study done by Laidlaw et al[12] reported a 95% limit of agreement (2 SD) on test–retest variability as ±0.10 logMAR. This large variability for the telemethod of VA may be attributed to the varying examining technique/methodology (face-to-face and telemethod) using the COMPlog system.

Table 1: Comparison of face-to-face method and telemethod for measuring visual acuity

Language group	Visual acuity mean (SD) logMAR		Mean difference (SD)	*p* value
	Face to face	Telemethod		
English (*n*=32)	0.15 (0.28)	0.10 (0.26)	0.05 (0.17)	
Kannada (*n*=33)	0.08 (0.29)	0.09 (0.28)	–0.01 (0.15)	0.140*
Malayalam (*n*=31)	0.08 (0.28)	0.10 (0.25)	–0.02(0.13)	

* One-way ANOVA and statistical significance at $p<0.05$
SD, standard deviation

Table 2: Kappa statistic across the three language groups for visual acuity better than logMAR 0.3

Language group	Kappa (95% confidence interval)
English	0.714 (0.463–0.965)
Kannada	0.696 (0.422–0.970)
Malayalam	0.844 (0.638–1.05)

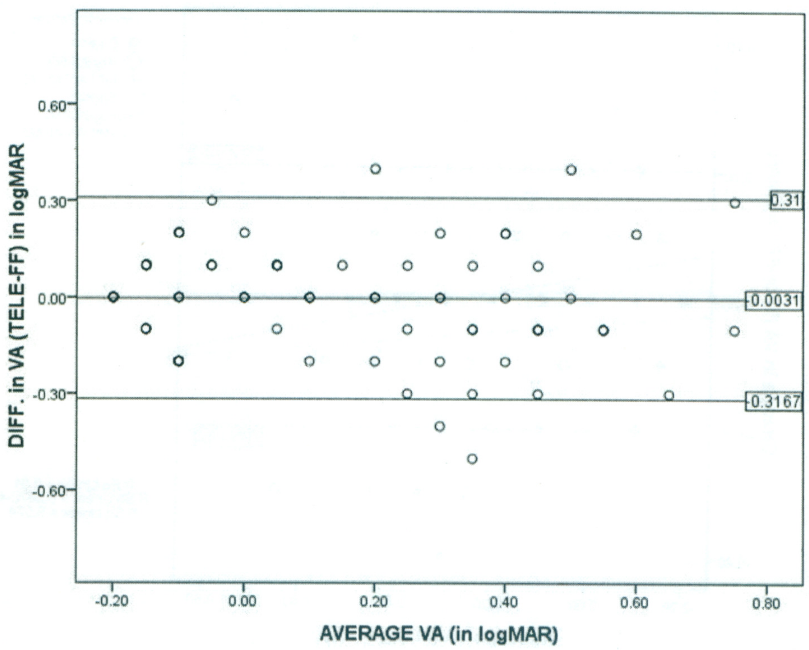

Figure 1: Bland–Altman plot of the COMPlog visual acuity for face-to-face method and telemethod.

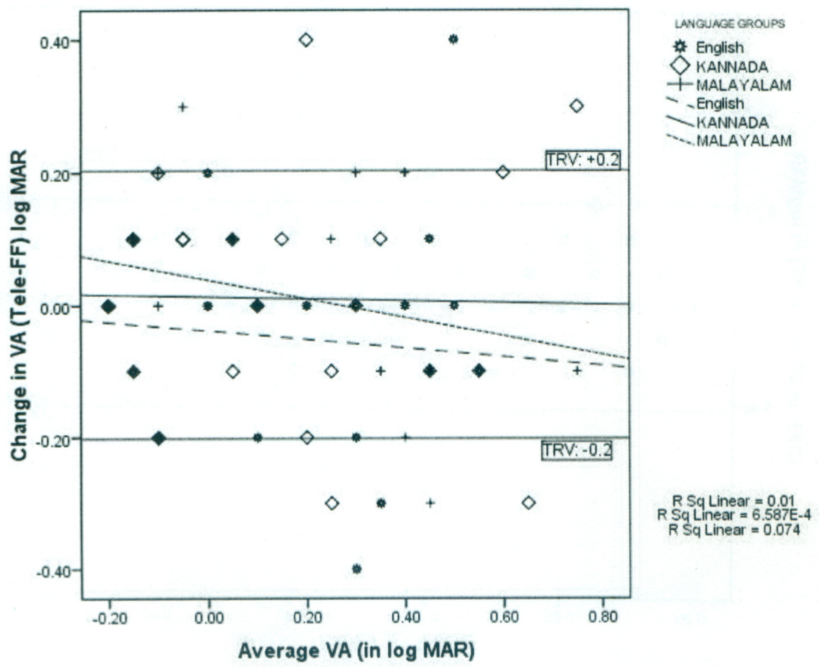

Figure 2: Change in COMPlog visual acuity between face-to-face method and telemethod across three different language instruction groups. (Test–retest variability of ±0.2 logMAR)

The kappa statistic showed a substantial agreement between the two methods for a referral cut-off of VA worse than 0.30 logMAR (6/12), demonstrating the applicability of the telemethod of VA measurement as an effective screening tool. The present study reports the clinical acceptability of the telebased VA measurement compared to face-to-face, with a variability (1 SD) of 0.16 logMAR unit. Rosser et al. reported that a test–retest variability in VA of logMAR 0.2 or greater is considered as clinically significant change using the ETDRS eye chart[14]. The changes in VA for all three groups were well within the clinically accepted test–retest variability of ±0.2 logMAR. The influence of language-specific instructions in the telemethod showed a positive effect on the variability of VA (Fig2).

The quality of VA examination and refraction performed by semi-trained tecnicians, even with the use of autorefractors, was reported to be limited[10]. Often the clinician gets assistance from colleagues or translators to communicate with patient in instances where language is an issue. The limitation of this would be availability of other clinicians at the premises and lack of knowledge about the condition among translators, resulting in poor translation ability. The limitation of the examining optometrist unable to speak the mother tongue or local dialect has an indirect effect on the quality of care provided in a multilingual Indian population.

The authors report on a novel method of telebased consultation providing the option of connecting an available professional eyecare provider (without geographical boundaries) who can perform a virtual eye examination. This telebased virtually controlled model explores the versatility of connecting clinician and patient based on language preferences, thus establishing a better customer relationship and thereby improve quality of eye care.

Studies have reported good patient satisfaction with tele-ophthalmology methods[15]. Multiple applicability of the telebased model is yet to be explored for effective utilization of human resources[8,9,16]. The scope of application includes businesses such as optical shops, satellite centres of base hospitals and rural outreach programs for effective eyecare delivery[16]. This particular virtually controlled tele-eyecare model has limited application in people with severe hearing deficit and non-verbal persons, hence the acceptability may be less in those population as reported in this study.

Virtual eye examination could eventually become a universal eyecare model, where an eyecare practitioner could perform comprehensive eye screening in a virtual platform without being physically present with a patient. The future of such a model would include refractive services through automated (virtually operated) refractometers and phoropters, anterior and posterior segment imaging technology, along with telebased VA examination. Incorporating vernacular instruction and native dialect during the examination procedure would increase acceptability and aid in culturally competent eyecare services in such a model in rural and remote areas.

The possible limitation of this model would probably be high capital investment, internet data connectivity and electricity supply in remote and rural locations. The authors hope that the capital investment would be compensated by low recurring cost, compared to the mobile tele-eye screening model; this cost-effectiveness needs to be studied. The growth in alternative energy sources would meet the needs for continuous power supply in rural regions, but would add to the initial capital cost. Growing interest of government (services such as National Knowledge Network, India) and private organisations towards better data connectivity could aid in implementing such virtual eyecare units.

Conclusions

Visual acuity measurements in the telemethod along with native dialect were comparable to conventional face-to-face methods in a hospital-based multilingual population. The COMPlog VA testing system can be effectively integrated in to a tele-eyecare model.

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