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Original Article

DOI: 10.55735/4kz37x15

HJPRS

The Healer Journal of Physiotherapy and Rehabilitation Sciences

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Journal homepage: www.thehealerjournal.com

Efficacy of Peek Acuity versus ETDRS Chart for Assessment of Visual Acuity and Refractive Error

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KEYWORDS

Peek acuity
EDTRS chart
Refractive error
Visual acuity

DECLARATIONS

Conflict of Interest: None

Funding Source: None

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ABSTRACT

Background: The early treatment diabetic retinopathy study chart is the gold standard in visual acuity tests, was the prototype for the logarithm of the minimum angle of resolution card, which is a smartphone-based application called portable eye examination kit/peek acuity. **Objective:** To compare the Peek Acuity application with the early treatment diabetic retinopathy study chart in assessing visual acuity and refractive error, focusing on time efficiency, patient satisfaction, ease of use and comfort. **Methodology:** In this comparative cross-sectional study, the sample size taken was 58, with a 10% dropout. Two applications applied Peek acuity and diabetic retinopathy study chart assessment, 51 patients met eligibility criteria and were enrolled in the study. Both adult males and females aged 18 years and above, those with either normal vision or those with refractive errors, who were already using corrective glasses, were recruited in the study. Participants with conjunctivitis, uveitis, keratitis, or corneal ulcers or vision loss secondary to corneal opacities, cataracts, glaucoma, retinal disorders, or optic nerve pathologies, postoperative or intraoperative complications, use of mydriatic drops or undergoing refractive surgery were excluded from the study. Outcome measurement tools were the Patient Satisfaction Questionnaire Short Form, and topic-related questions were added from these two Ease of Care questionnaires for assessment of ease and comfort level and the Comfort Questionnaire. The Shapiro-Wilk test was used to check normality, showing significant p-values for all variables and non-normal distribution. Therefore, non-parametric tests were applied. The chi-square test was applied to find the Pearson correlation between different variables. Mann-Whitney U test and one-sample Wilcoxon signed-rank test were used to measure differences. **Results:** The chi-square test showed a significant association between gender and affected eyes and refractive error. One-sample Wilcoxon ranked test results reject the null hypothesis for all tests ($p \leq 0.05$). **Conclusion:** Both methods were effective in enhancing patient outcomes. However, the early treatment diabetic retinopathy study chart was associated with superior performance in terms of visual acuity accuracy and patient satisfaction, while Peek Acuity demonstrated advantages in reduced testing time and improved patient comfort and ease of use.

How to cite the article: Khan Z, Awan MA, Khan MAS, Naseem S, Sajid A, Mehronisa. Efficacy of Peek Acuity versus ETDRS Chart for Assessment of Visual Acuity and Refractive Error. The Healer Journal of Physiotherapy and Rehabilitation Sciences. 2025;5(2): 310-316.

INTRODUCTION

Visual acuity is a visual quality parameter used to describe the spatial resolving power of a visual system. It is related to the smallest angle subtended by an object that can be identified by the observer. In clinical practice, the term "visual acuity" usually corresponds to the best corrected visual acuity, which is defined as measured with sphero-cylindrical correction (glasses or contact lenses).[1,2] The refractive power of the cornea and lens divided by the axial length of the eyeball is called refraction, and it influences how light is focused on the retina. Blurred vision results from refractive error, also known as ametropia, which is caused by an imbalance between the axial length of the eye and the cornea's and lens's focusing capabilities.[3,4]

The early treatment diabetic retinopathy study (ETDRS) chart, which is today the gold standard in visual acuity tests, was the prototype for the logarithm of the minimum angle of resolution (logMAR) card. Visual acuity testing with the ETDRS chart generally requires a 4-meter distance, and its use may be limited by its relatively high cost, large chart size, poor availability and applicability. Each line of the chart contains five optotypes, and the optotype size is changed on each line by a constant proportion.[5,6] A logMAR style smartphone-based application called portable eye examination kit/peek acuity is already known to be accessible, reliable and easy to use. Peek acuity uses only 2-3 meters in distance to measure visual acuity, much shorter than the Chart requires. It has the logMAR measurement option built into the application. The examination is quicker because the results will be automatically converted into logMAR.[7,8]

Despite the growing adoption of mobile health technologies, there is limited empirical evidence comparing the performance of portable tools like the Peek Acuity app to gold-standard clinical instruments such as the ETDRS visual acuity chart. While the ETDRS chart remains the benchmark in controlled clinical environments, it is often impractical for use in low-resource or remote settings. Conversely, the Peek app offers a potentially transformative alternative due to its portability and accessibility via smartphones. However, few studies have rigorously evaluated the Peek app's effectiveness across critical dimensions such as diagnostic accuracy, time efficiency, user satisfaction, ease of use, and patient comfort. This study addresses this gap by directly comparing the Peek app and the ETDRS chart, offering insights into the feasibility of integrating mobile-based vision assessment into routine and outreach eye care services. This innovative approach may inform broader strategies for expanding equitable eye care access through digital health solutions.

METHODOLOGY

This was a double-blinded comparative cross-sectional study conducted at Eagle Eyes Relief Trust, Lahore, for six months after BASAR approval. Non-probability convenience sampling technique was applied. Sample size calculated from g* power 3.1.9.7 (n=51).[9] Both adult males and females aged 18 years and above,[9,10] those with either normal vision or those with refractive errors who were already using corrective glasses were recruited in the study.

Participants with active anterior segment pathology, such as conjunctivitis, uveitis, keratitis, or corneal ulcers or if they had vision loss secondary to corneal opacities, cataracts, glaucoma, retinal disorders, or optic nerve pathologies,[11] individuals with recent postoperative or intraoperative complications, those who had received mydriatic drops[10], or who had undergone refractive surgery within the past six months,[10] patients with neurological conditions affecting vision or with cognitive/language impairments that could interfere with visual testing were also excluded from the study.

After recruitment, each participant underwent visual acuity and refractive error assessment first by the Peek Acuity application and then by the ETDRS chart. For the Peek method, an Android mobile device was used with the Peek acuity application (version 3.7.0) freely downloaded from the Google Play Store.[11] The device's screen was properly illuminated and calibrated before each use, and the testing environment was also adjusted to minimise external light sources, reflections, or distractions that could influence the participant's performance. Participants were positioned precisely two meters away from the device, as recommended by the Peek protocol. Using a sterile occluder, one eye was covered while the other was tested. The application presented optotypes that automatically adjusted in size based on participant responses, providing an automated, calibrated assessment of visual acuity. This procedure was

repeated for the second eye, and binocular acuity was also measured.

In contrast, the ETDRS chart was used as the conventional method of visual acuity assessment.[12] The chart was positioned at a fixed distance of four meters from the participant, and appropriate room lighting was ensured to meet clinical standards. Participants were asked to occlude one eye to measure visual acuity. Visual acuity was recorded using the ETDRS chart.[13,14] The procedure was then repeated for the fellow eye, and binocular acuity was also assessed. A digital stopwatch was used to measure the time from the start of instructions to the final recording of visual acuity. Apply the same timing protocol for both the Peek Acuity app and the ETDRS chart.[15] Optometrists recorded time separately for each eye to ensure consistency and accuracy. Outcome measurement tools were Refractive error, visual acuity (logMar), Patient Satisfaction Questionnaire (PSQ-18), the Ease of Care (EOC) Questionnaire, and the General Comfort Questionnaire (GCQ).[16]

Data was collected within 12 weeks and analysed through SPSS-23. The Shapiro-Wilk test was used to check normality, showing significant p-values for all variables and non-normal distribution. Therefore, non-parametric tests were applied. The chi-square test was applied to find the Pearson correlation between different variables. Mann-Whitney U test and one-sample Wilcoxon signed-rank test were used to measure differences. The p-value ≤0.005 was considered significant.

RESULTS

The total number of participants was 51, 20 males and 31 females. All together, these findings suggest a balanced gender distribution of the participants in the sample with slight female dominance. 35 participants with myopia (68.6%) and 8 participants with hyperopia (15.7%) and 7 participants with emmetropia (normal) 13.7% and only one patient with astigmatism. About 7 participants were with the right side affected and 8 were left side affected and 36 with both eyes affected. Mean age (33.6±9.8), gender (1.61±0.49), affected side (2.57±0.72) and refractive error (2.59±0.75).

The Shapiro-Wilk test showed significant p-values for all variables; the data were not normally distributed. Therefore, non-parametric tests were applied. The one-sample Wilcoxon signed-rank test was used to determine whether the median of a single sample differed significantly from a hypothesised value.

The chi-square test was employed to examine associations between two categorical variables. For comparing differences in the distribution of continuous or ordinal variables between two independent groups, the Mann-Whitney U-test (also known as the Wilcoxon rank-sum test) was used. The chi-square test showed a significant association between refractive error and gender and the affected eye. The Pearson chi-square value is 16.72 with a p-value less than 0.05, indicating a statistically significant association between refractive error and gender. The Pearson chi-square value is 102 with a p-value less than 0.05, indicating a statistically significant association between refractive error and affected eye. The Pearson chi-square value is 16.15a with a p-value less than 0.05, indicating a statistically significant association between gender and affected eye (Table 1).

The ETDRS chart was associated with more significance in terms of visual acuity accuracy and patient satisfaction, while Peek Acuity demonstrated advantages in reduced testing time and improved patient comfort and ease of use.

Table 1: Chi-square test

		Value	Asymptotic Sig (2-sided)
Refractive Error * Gender	Pearson Chi-Square	16.72[a]	0.00
	Likelihood Ratio	22.13	0.00
	Linear-by-Linear Association	4.82	0.02
Refractive Error * Affected Eye	Pearson Chi-Square	102[a]	0.00
	Likelihood Ratio	82.51	0.00
	Linear-by-Linear Association	48.28	0.00
Gender * Affected Eye	Pearson Chi-Square	16.15[a]	0.00
	Likelihood Ratio	21.21	0.00
	Linear-by-Linear Association	4.47	0.03

Table 2: Mann-Whitney test for comparison of Peek acuity and ETDRS chart

	Gender	Mean Rank	Sum of Ranks	p-value
VA Peek LogMar	Male	20.88	417.5	0.04
	Female	29.31	908.5	
VA ETDRS LogMar	Male	20.33	406.5	0.02
	Female	29.66	919.5	
ETDRS Testing Time	Male	31.33	626.5	0.03
	Female	22.56	699.5	
Peek Testing Time	Male	20.45	409.0	0.03
	Female	29.58	917.0	
PSQ-18 Score Peek Acuity	Male	32.15	643.0	0.01
	Female	22.03	683.0	
EOC Score Peek Acuity	Male	19.80	396.0	0.01
	Female	30.00	930.0	
GCQ Score Peek Acuity	Male	19.70	394.0	0.01
	Female	30.06	932.0	
PSQ-18 ETDRS Chart	Male	20.58	411.5	0.03
	Female	20.58	914.5	
EOC Score ETDRS Chart	Male	20.90	418.0	0.04
	Female	29.29	908.0	
GCQ Score ETDRS Chart	Male	20.25	405.0	0.02
	Female	29.71	921.0	

DISCUSSION

The purpose of our study was to compare the efficacy of the Peek acuity and ETDRS chart for assessment of visual acuity and refractive error. For this purpose ETDRS Chart and, Peek acuity app were used. In addition, subjects completed a post-intervention questionnaire (PSQ-18) EOC and GCQ to determine the difference between patients' levels of comfort. The results of this study have shown that both methods were effective in enhancing patient outcomes. However, the ETDRS chart was associated with superior performance in terms of visual acuity accuracy and patient satisfaction, while Peek Acuity demonstrated advantages in reduced testing time and improved patient comfort and ease (<0.05) for analysis.

Overall, less value in the ETDRS chart acuity. A lower score shows good vision. The ETDRS chart shows a significant value of VA over PA, with a $p<0.05$. ETDRS testing time (31.33, 22.56) and PA testing time (20.45, 29.58). Overall less testing time value in Peek acuity. A lower score shows time efficiency. Peek acuity shows a significantly shorter value of testing time than the ETDRS chart. The p-value <0.05. PSQ1 score of Peek acuity (32.15, 22.03) and ETDRS chart (20.58, 20.58). This shows less value in ETDRS. A lower score shows a greater satisfaction ratio. ETDRS shows a significantly higher value of satisfaction than Peek Acuity. The $p<0.05$ EOC score mean Peek acuity (19.80, 30.00) and EOC in ETDRS chart (20.90, 29.29). Overall, less value in Peek acuity. A lower score shows more ease of care. Peek Acuity shows a significant value of ease on the ETDRS chart. The $p<0.05$ mean of GCQ of Peek acuity (19.70, 30.06) and GCQ of ETDRS chart is (20.25, 29.71). A lower score shows more comfort. Peek Acuity shows a significant value of comfort in the ETDRS chart, a $p<0.05$.

The studies collectively highlight the growing utility of the smartphone-based Peek Acuity app as a reliable alternative to conventional visual acuity testing methods such as the logMAR and Snellen charts, particularly in settings where access to standard clinical tools is limited. Anitha et al. demonstrated a strong positive correlation between Peek Acuity and the conventional logMAR chart ($p=0.001$), both with and without pinhole correction, confirming the app's accuracy and validity in adult populations. Their findings further suggest minimal inter-eye variability and high clarity with full spectacle correction, reinforcing

Peek Acuity's consistency and reliability in replicating traditional test outcomes. This positions the app as a viable solution for remote and resource-constrained environments.[11,17,18]

In contrast, Aritonang et al. focused on Peek Acuity's performance in a school-based screening context. While the app showed lower sensitivity, its high specificity, particularly in older children (10-12 years), suggests it is effective at correctly identifying those without visual impairment. This makes it a practical tool for mass screenings, where minimising false positives is often more important than catching every single case in the first round. Furthermore, its speed and ease of use make it especially appealing in environments where quick, contactless testing is preferred, such as in schools or during public health emergencies like pandemics.

Morjaria et al. aimed to boost spectacle compliance among schoolchildren through an educational and Health-based intervention using the Peek system in Hyderabad. Although the study design was a cluster-randomised controlled trial, the intervention showed minimal impact on spectacle wear rates compared to the control (53.6% vs. 52.9%). A notable limitation was the low parental engagement, as only 13.9% received the Peek Sim image, suggesting that message delivery and parental involvement were inadequate. The study's key insight is the need to design more engaging, better-targeted health education strategies that consider cultural, logistical, and technological barriers to impact behavioural outcomes like spectacle use.[19]

In contrast, Rono et al. explored the system-level integration of Health tools to improve community eye health delivery in Kenya. Their customised Peek Community Eye Health system facilitated real-time referrals, service tracking, and SMS communication via community health workers. Unlike Morjaria's focus on individual behaviour change, this intervention targeted systemic efficiency and referral uptake. The findings showed the potential of such digital platforms to enhance service delivery and reduce the burden on secondary care facilities. This study underscores how mHealth tools can be effectively embedded within existing health systems to streamline workflows and extend reach, especially in rural or under-resourced areas.[19]

In Indonesia, Irawati et al. (2020) examined the reliability of Peek Acuity in a unique clinical population of leprosy patients. Despite the specific challenges of this group, the app performed on par with the Snellen Chart, with a non-significant mean logMAR difference (p=0.98) and strong agreement (Cohen's Kappa=0.65). This suggests that Peek Acuity is not only accurate but also versatile across clinical subgroups, reinforcing its practicality in underserved and marginalised communities where conventional eye care tools are often unavailable.[20]

CONCLUSION

The study comparing the efficacy of Peek acuity and the early treatment diabetic retinopathy study chart for assessment of visual acuity and refractive error shows significant improvements in visual acuity assessment level, Refractive error, ease, comfort and testing time, satisfaction time for all participants. Both techniques were effective in improving patient outcomes, as the early treatment diabetic retinopathy study shows greater effect in patient satisfaction, visual acuity, while Peek acuity shows less time, patients' ease and comfort.

DECLARATIONS

Consent to participate: Written consent had been obtained from patients. All methods were performed following the relevant guidelines and regulations.

Availability of Data and Materials: Data will be made available upon request. The corresponding author will submit all dataset files.

Competing interests: None

Funding: No funding source involved.

Authors' contributions: All authors had read and approved the final manuscript.

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