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Advancing Visual Assessment: An Eye-Tracking Approach for Progressive Lens Performance Evaluation

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Abstract

Progressive lenses are commonly prescribed to individuals with presbyopia, a natural age-related condition that affects near vision. These lenses provide a seamless transition from distance to near vision, allowing wearers to see clearly at various distances. However, the design of progressive lenses can significantly impact visual performance and user satisfaction. To evaluate the effectiveness of different progressive lens designs, researchers and eyecare professionals are increasingly turning to eye-tracking technology. In this article, we will explore the eye-tracking-based method for assessing visual performance with progressive lens designs and its implications for enhancing wearer experience. Progressive lenses are commonly prescribed to individuals with presbyopia, a natural age-related condition that affects near vision. These lenses provide a seamless transition from distance to near vision, allowing wearers to see clearly at various distances. However, the design of progressive lenses can significantly impact visual performance and user satisfaction. To evaluate the effectiveness of different progressive lens designs, researchers and eye care professionals are increasingly turning to eye-tracking technology. In this article, we will explore the eye-tracking-based method for assessing visual performance with progressive lens designs and its implications for enhancing wearer experience. The results showed no statistically significant differences between PPLs for VA. However, significant differences in eye-tracking parameters were observed between PPLs. Furthermore, PPL-Distance had lower test duration, complete fixation time, and number of fixations at distance evaluation. PPL-Near has a lower test duration, complete fixation time, and number of fixations for near vision. In conclusion, the quality of vision with PPLs can be better characterized by incorporating eye movement parameters than the traditional evaluation method.

Keywords: Eye-tracking; Eye-tracking; eye movement; Visual assessment

Introduction

Progressive lenses feature a gradual change in lens power, providing wearers with a range of vision correction for distance, intermediate, and near vision. These lenses eliminate the need for multiple pairs of glasses, offering wearers convenience and a more natural visual experience. However, the design of progressive lenses can introduce visual distortions, such as peripheral blur or areas of reduced clarity. These distortions can impact the wearer's visual acuity, depth perception, and overall visual comfort [1].

Some proposed methods to evaluate the quality of vision with PPLs are based on the representation of theoretical power distribution maps obtained with lens mappers or calculated using exact ray tracking to obtain user-perceived power distribution maps. They are based on geometrical magnitude calculations that estimate the theoretical fields of view. Although theoretical representations could be useful to characterize PPLs, the quality of vision varies depending on the subjective visual perception of the user [2]. In order to gain a better understanding of this topic, several studies have been carried out to evaluate the quality of vision with PPLs using different methods such as satisfaction questionnaires, contrast sensitivity, reading performance, skew distortion, or high contrast visual acuity. High-contrast VA is one of the main ways to assess the quality of vision with PPLs. VA refers to the ability to discern object details subtending a certain angle and is commonly employed in clinical practice to measure vision quality. It is also the standard measure to assess the quality of an optical correction. The measurement of VA has been extensively used to evaluate the impact of lateral refractive errors in PPLs on visual performance. However, these studies have not found significant differences in VA scores between different types of PPLs. This could be because the VA score does not consider other factors that impact visual perception, such as the time needed to recognize the optotypes [3]. For this reason, this work proposes the assessment of the visual quality provided by PPLs by means of parameters such as recognition speed or the number of eye fixations while recognizing the optotypes.

Eye tracking recording

Eye-tracking technology involves using specialized hardware and software to track and record eye movements and gaze patterns. By capturing where individuals look, how long they fixate on specific areas, and the sequence of their gaze, eye-tracking technology provides valuable insights into visual attention and perception. Binocular pupil position was recorded using a wearable eye-tracker system with a sampling rate of 50 Hz. Recordings were made while participants were performing VA tests at a distance and near vision using eye charts with logMAR unit notation and a scoring criterion that assigns to the subject the VA corresponding to a given line when at least three letters are correctly recognized [4].

Objective Measurement

Eye-tracking technology provides objective measurements of visual

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behavior, allowing researchers and eyecare professionals to quantify the wearer's gaze patterns, fixation durations, and transitions between focal points. This data offers a comprehensive understanding of how wearers interact with different areas of the lens and identify potential visual limitations. Eye movements captured by the eye-tracking device can indicate whether wearers experience discomfort, such as excessive head or eye movement [5], while using specific progressive lens designs. These insights help identify design factors that may cause visual fatigue or challenges in adapting to the lenses. By analyzing eye-tracking data, researchers can evaluate the effectiveness of progressive lens designs in providing clear vision at different distances. They can identify areas of visual distortions or incongruence and refine lens designs to improve visual acuity, minimize peripheral blur, and enhance wearer satisfaction [6]. Eye-tracking technology can aid in fitting progressive lenses more precisely by considering individual differences in eye movements and gaze patterns. This personalized approach helps optimize the lens design to align with the wearer's visual behavior, improving overall visual performance and comfort.

Discussion

In this paper, we present a way of assessing the quality of vision provided by PPLs with different power distributions using an eye-tracking-based system during the VA measurement [7]. It is important to note that VA is subjective and depends on the participant's answer, whereas eye-tracking data is objective and provides quantitative data about eye movements, adding more information about the quality of vision with PPLs compared to the traditional VA evaluation method. The method proposed is based on the analysis of test duration, fixation time, and the number of fixations required recognizing the different optotypes of standard eye charts. The study showed that when evaluating the far-distance VA of participants using a PPL design with a wider far-distance visual area, the test duration, fixation time, and the number of fixations are reduced [8, 9]. Similarly, a PPL design with a wider near area provided lower test duration, a lower fixation time, and a lower number of fixations during the evaluation of near-distance VA. It should be noted that the values of standard VA obtained with different PPL designs were not different with statistical significance.

Although VA is considered a gold standard for the evaluation of optical quality, it seems insufficient alone to evaluate the quality of vision. It is well known that sometimes clinicians report patients with high VA complaining about poor vision quality [10]. Specifically, regarding the performance of PPLs, several studies have tried to evaluate differences in VA between different PPL designs without success. Additionally, having a method that can determine differences in the visual performance provided by different PPL designs could help lens designers develop better lenses [11]. Based on previous studies, we presume that the evaluation of eye movements during the performance of a specific task could be a sensitive indicator of the quality of vision provided by these lenses. In another study, Han et al. evaluated differences between single-vision lenses and PPLs on 11 presbyopes. The subjects were required to read aloud a copy of printed text placed along their midline at 0.60 m. Eye movements were analyzed using the ISCAN computer-based system. The results showed an increase in fixation numbers when participants used PPLs compared to single-vision lenses. The results showed greater fixation time and the number of fixations in off-axis gaze directions in comparison with the central position [12].

Conclusion

Eye-tracking-based methods for assessing visual performance with progressive lens designs offer valuable insights into wearer behavior and perception. By objectively measuring gaze patterns, fixation durations, and transitions, eye care professionals and researchers can identify areas of visual limitations and design lenses that optimize visual acuity, comfort, and adaptation. This technology enables a more personalized approach to progressive lens fitting, leading to improved wearer satisfaction and visual performance. As eye-tracking technology continues to advance, it holds tremendous potential for enhancing the design and optimization of progressive lenses, ultimately benefiting individuals with presbyopia and their visual well-being. Although this method has been tested for the evaluation of the quality of vision provided by PPLs, it could be used in any other field in which the sheer capacity of letter recognition does not provide enough information about visual performance. Additionally, some examples could be the study of some visual conditions or specific visual tasks in which the visual quality is reduced but the visual acuity does not decrease.

References

1. Jimenez JR, Ortiz C, erez-Ocon FP, Jim enez R (2009) Optical image quality and visual performance for patients with keratitis. Cornea 28: 783–788.
2. Ortiz C, Jimenez JR, erez-Ocn FP, Castro JJ, Gonzlez Anera R (2010) Retinal-image quality and contrast-sensitivity function in age-related macular degeneration. Curr Eye Res 35: 757–761.
3. Anera RG, Castro JJ, Jimenez JR, Villa C (2011) Optical quality and visual discrimination capacity after myopic LASIK with a standard and aspheric ablation profile. J Refract Surg 27: 597–601.
4. Oshika T, Tokunaga T, Samejima T, Miyata K, Kawana K, et al. (2009) Influence of pupil diameter on the relation between ocular higher-order aberration and contrast sensitivity after laser in situ keratomileusis. Invest Ophthalmol Vis Sci 47: 1334–1338.
5. Fan R, He T, Qiu Y, Xu SY, Li YY, et al. (2012) Comparison of wave front aberrations under cycloplegic, scotopic and photopic conditions using Wave scan. Arquivos Brasileiros de Oftalmologia 75: 116–121.
6. Anera RG, Castro JJ, Jimenez JR, Villa C (2011) New testing software for quantifying discrimination capacity in subjects with ocular pathologies. J Biomed Opt 16: 123-127.
7. Jimenez JR, Ortiz C, erez-Ocon FP, Jim enez R (2000) Effects of alcohol and marijuana on dynamic visual acuity: I. Threshold measurements. Percept psychophys 18: 441–446.
8. Oshika T, Tokunaga T, Samejima T, Miyata K, Kawana K, et al. (2012) Visual functions and acute ingestion of alcohol. Ophthalmic Physiol Opt 16: 460–466.
9. Anera RG, Castro JJ, Jimenez JR, Villa C (2001) Effects of alcohol on performance on a distraction task during simulated driving. Clin Exp Med 33: 617–625.
10. Jimenez JR, Ortiz C, erez-Ocon FP, Jim enez R (2012) The effects of ingested alcohol on accommodative, fusional, and dark vergence. Percept psychophys 39: 25–31.
11. Fan R, He T, Qiu Y, Xu SY, Li YY, et al. (2013) Oral alcohol administration disturbs tear film and ocular surface. Ophthalmology 119: 965–971.
12. Oshika T, Tokunaga T, Samejima T, Miyata K, Kawana K, et al. (2012) Accuracy and usefulness of a breath alcohol analyzer. Ann Emerg Med 13: 516–520.