Are Blue-Cut Lenses Safe for Children? Potential Effects on Eye Length and Refractive Disorders

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ABSTRACT

Blue-blocking lenses, including both spectacles and intraocular lenses, are designed to selectively reduce the intensity of short-wavelength visible light and UV radiation using a chromophore. Unlike standard spectacle lenses, which only offer varying degrees of UV protection, blue-blocking lenses provide additional benefits such as enhancing visual performance, reducing eye fatigue from digital screens, protecting the retina from phototoxicity, and minimizing disruption of the circadian rhythm caused by blue light-emitting devices used in the evening. Research has shown that the length of the eye tends to increase over time, especially during the first 10 months of life, indicating the importance of this period in eye development. The Purkinje shift is a phenomenon where the eye becomes more sensitive to blue light in the dark, and it is a normal physiological process. However, there is concern that prolonged use of blue-cut lenses in children may affect the development of eye length and contribute to an increase in refractive eye disorders.

Keywords

Blue Light; Eye; Refractive Errors; Myopia; Ocular Axial Length

Introduction

Today, there is a growing concern regarding the potential negative health impacts of excessive exposure to short-wavelength visible light. Our laboratories have focused on the adverse health effects of blue light over the past years, especially on the association between screen time and adverse health effects such as breast cancer [1-3]. While standard spectacle lenses only offer varying degrees of protection against UV, blue-blocking lenses, including spectacles and intraocular lenses, are designed to selectively reduce the intensity of short-wavelength visible light and UV radiation by using a chromophore. These lenses are intended to provide a range of benefits, such as enhancing visual performance, reducing eye fatigue when using digital screens (such as mobile phones and tablets), protecting the retina from phototoxicity, and minimizing disruption of the circadian rhythm associated with the use of blue light-emitting devices in the evening [4]. Some studies have indicated that over one-third of individuals using a clear lens with a blue-filtering coating (BT lens) have reported

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Received: 14 April 20233
Accepted: 2 May 2023

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better anti-glare performance and improved vision for digital screens [5]. Moreover, some reports suggest that blue light filtering lenses may be helpful in mitigating computer vision syndrome, which is a collection of symptoms associated with prolonged exposure to digital screens, such as eyestrain, headaches, blurred vision, and dry eyes [6]. However, some researchers believe that there is currently insufficient evidence to support the efficacy of blue-blocking filters as a clinical treatment for digital eye strain [7].

At a broader level, the clinical efficacy of mitigating these disorders was often theoretical or based on laboratory or animal experiments [8, 9]. Additionally, blue-blocking lenses may reduce color contrast sensitivity, particularly at low light intensities [10]. However, some reports have found no difference in the long-term contrast perception of adults who use blue-light blocking lenses [11].

Defining the theory

Bach et al. conducted a study on data obtained from 330 eyes of 165 subjects, which showed an increase in ocular axial length over time. The most significant rise in ocular axial length occurs during the first 10 months of life. The Purkinje shift is a phenomenon in which a dark-adapted eye becomes more sensitive to the blue region of visible light, with retinal rods taking over from cones [12]. Although the Purkinje shift is typically associated with luminance thresholds during dark adaptation, we believe that continuous use of blue-cut lenses in children may lead to disorders in ocular axial length development (Figure 1).

Our theory can explain the rationale for the increased rate of refractive disorders, particularly the overall rise of myopia in children over the past few years. While factors such as lower time spent outdoors, increased screen time, and more time doing close-up tasks indoors, especially during the COVID-19 pandemic, can contribute to this increase [13], blue-cut lenses may also play a role. The rapid rise in childhood myopia seems to be linked to a significant number of degenerative changes in the retina, choroid, and

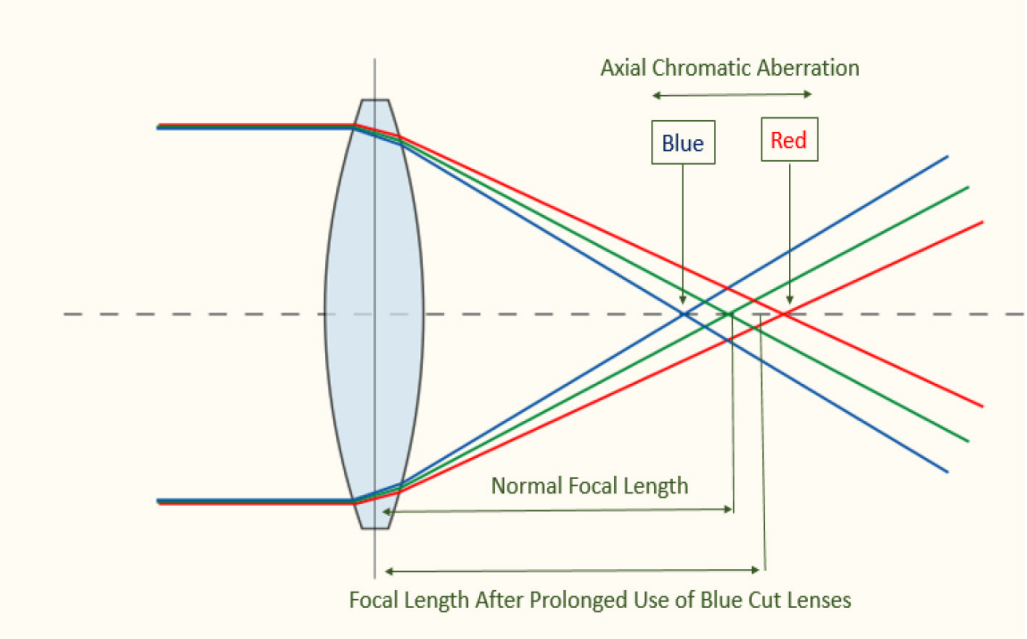

Figure 1: Children who continuosly use blue cut lenses may be at risk of disorders in ocular axial length development due to Purkinje rod - cone shift.

sclera. Further studies are necessary to assess the impact of blue-cut lenses on ocular axial length development in children and adolescents and their potential adverse effects.

Conclusion

In summary, studies have shown that ocular axial length tends to increase over time, with the most significant growth observed during the first 10 months of life, indicating the critical role of this period in ocular development. The Purkinje shift is a phenomenon where a dark-adapted eye becomes more sensitive to the blue region of visible light, with retinal rods taking over from cones. Typically, the Purkinje shift is associated with luminance thresholds during dark adaptation, which is a normal physiological process. However, considering this, there is a concern that continuous use of blue-cut lenses in children may potentially impact ocular axial length development and contribute to the occurrence of frequent disorders.

Authors' Contribution

M. Ostovari and SMJ. Mortazavi conceived the idea. The draft was prepared by SAR. Mortazavi and SMJ. Mortazavi. All the authors read, revised, and approved the final version of the manuscript.

Conflict of Interest

SMJ. Mortazavi, as the Editorial Board Member, was not involved in the peer-review and decision-making processes for this manuscript.

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