Ocular Development, Peripheral Refraction and Custom Optical Design: the New Wave in Optometry and Visual Science Research

The scientific knowledge on the development of the human eye has evolved dramatically during the last decades from the embryologic, physiological and functional viewpoint, from the ocular surface to the neural pathway and visual cortex. However, one the most enigmatic aspects is still the reason why a given eye could become myopic during the ocular development and even more important, what is behind myopia progression towards pathological levels? Nowadays, this is a public health concern, as more than 25% of the population in developed countries[1] and perhaps as much as 70% in some Asian regions suffer myopia.[2] Beyond being a common refractive error, myopia can be a serious compromise to the visual function as it is associated with several retinal abnormalities, glaucoma, and early cataract.

During the last decade several developments in the field of Optometry have provided strong evidence that several environmental, genetic and parental history of myopia are factors potentially involved in the determination of the refractive status of the eye.[3,4] More recently, several studies have proposed that the pattern of peripheral refraction could be also potentially involved in the progression of refractive error. This assumption comes from separate evidences reported in different studies. First, it has been demonstrated that myopic patients have comparatively less myopia in the peripheral retina,[5] compared to the central refraction used with clinical purposes, leading to a potential peripheral hyperopia when axial refraction is compensated with eyeglasses or spherical contact lenses. This fact correlated well with the known fact that myopic eyes have a less oblate or prolate posterior retinal shape compared with the oblate shape which is predominant among emmetropic and hyperopic eyes[6,7] This could be related to the different patterns of growth in the axial and equatorial dimensions of those eyes.[7] Second, some optical treatments that invert the profile of peripheral refraction in myopic eyes from relative peripheral hyperopia to more myopic peripheral refraction[8] due to changes induced in the corneal surface by orthokeratology or corneal refractive therapy have been pointed as the cause for the lower ocular growth either in separate report of cases[9] or in a controlled trial in Hong Kong.[10] Third, to confirm the hypothesis that peripheral refraction could interfere on the ocular growth pattern of myopic eyes, studies conducted by Smith and colleagues showed in animal models that the visual experience in the peripheral retina could interfere with this process.[11] Furthermore, recent clinical studies have also showed that the peripheral refractive profile along the horizontal meridian could also play a role on the onset and progression of myopia in children with eyes having less myopic or hyperopic peripheral refractive patterns.[12]

Although the molecular basis of the mechanisms behind slow-down of myopia progression with the aforementioned approaches are relatively unknown, the previously cited scientific contributions have led to a number of recent patents of optical devices to compensate refractive errors differently in the foveal and peripheral region of the retina in order to provide sharp central vision and at the same time warrant that the peripheral images form over or in front of the retina to neutralize or invert the hyperopic shift potentially involved on myopia progression. These devices usually involve the application of contact lenses,[13-15] but solutions for applications in spectacle lenses are also being developed. Some of these devices also incorporate the concept of image quality control through aberration control or introduction of certain desired aberration patterns, which will be the next step towards the more complex understanding of the impact of peripheral retinal imagery on the development of the human visual system.[16,17]

All the previous concepts have a reflection in the contents of the current issue of Journal of Optometry where several articles lead with different aspects of visual development, axial and peripheral refractive patterns in myopic eyes and optical modelization of the human eye. Although not directly related with the emmetropization mechanism, the article from Leat et al.[18] presents a relevant summary of information regarding the timeframe of visual development in terms of visual acuity and contrast sensitivity function. The work of Bakaraju et al. have shown that the peripheral refractive patterns could be different for different models of myopic eyes which with no doubt is an interesting contribution in the development of future devices for myopia progression control;[17] while the paper from Bao et al. reports on the aberration patterns of myopic and emmetropic eyes.[19] Last, but not least, the extensive discussion of literature available and innovative contributions on the optical modelization of the human eye brought to the Journal of Optometry by Navarro et al., provides better tools for the development of new optical treatments to change the optical properties of the human eye in a customized fashion.[20]

The readers will also enjoy the papers from Lleó-Perez et al.[21] and Mustafa et al.[22] regarding some of the pathological implications that are also common to highly myopic patients as glaucoma and vitreoretinal surgery, respectively.

Is our compromise at the Journal of Optometry to continue providing insights on the latest scientific findings within the Optometry and Visual Science research fields and related areas.

Hope our readers enjoy the articles enclosed in this issue.

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