

## LIGHT, UV RADIATION, MYOPIA PROGRESSION AND CONTACT LENSES

### ABSTRACT

Myopia is a very common refractive condition that has reached epidemic levels the last decades in most modern countries, especially in Asia. This increase has been attributed to hereditary and also environmental factors, the latter mainly being accommodation stress due to increasing near vision tasks in everyday life. However, the vital role of natural light in arresting myopia progression has been also documented. Other theories have been developed, like the one concerning peripheral hyperopic defocus and new refractive devices have been designed to cope with the increase in myopia in infants and adults. Somehow, combining research results gives us a new perspective of what might be the key to the problem and a new old player that everybody seems to be afraid of speaking its name (UV) comes literally to light.

**Key words** myopia, contact lenses, UV radiation

### INTRODUCTION

Myopia is a very common refractive condition. In some parts of East Asia, myopia has reached epidemic proportions and its prevalence can even exceed 80% in some highly educated groups. Moreover, there is growing evidence that the prevalence of myopia, including high myopia, is increasing rapidly in the United States and other non-Asian countries.<sup>1,2,3,4,5,6</sup> This rapid rise in myopia prevalence has been frequently suggested that it is significantly affected by changing environmental factors.<sup>7</sup>

### DISCUSSION

Myopia is associated with ocular complications that can lead to permanent and significant vision loss. Thus, myopic eyes have an increased risk of cataract, glaucoma, chorioretinal degenerations, and retinal detachments.<sup>8,9,10,11</sup> As a result, myopia is considered to be a leading cause of permanent visual impairment.

Through the last decades there have been many theories and attempts to arrest myopia progression in teens and adults, from hard PMMA flat-fitted contact lenses to atropine use but most of them were rendered rather ineffective and some with only temporary results, except for atropine of course, which has given impressive results but is related with many side-effects for long term use and thus can't be recommended.

In 2008 there was a very interesting hypothesis that was put forward by Prepas<sup>12</sup> which did not attract a lot of attention. Prepas suggested that "close focusing in the absence of UV light may provoke axial myopia". During the last decade there have been studies that have also exhibited that greater exposure to natural light and involvement in outdoors activities slows down significantly myopia progression.<sup>13,14,15</sup> With regard to contact lenses, orthokeratology has shown some promising results lately<sup>16,17,18</sup> as well as fitting youngsters with soft bifocal, center distance design, contact lenses.<sup>19</sup> Lately, following the theory of peripheral defocus and myopia, introduced mainly by Earl Smith III<sup>20,21</sup>, there have been specially designed ophthalmic lenses and contact lenses that correct peripheral hyperopic defocus and are being tested with mixed results so far.<sup>22,23,24,25</sup>

Myopia increases have been associated in the past mainly with accommodation.<sup>26</sup> Myopia progression and especially axial elongation also seems to be interconnected to a mechanism we call emmetropization in which refractive development and eye growth are mainly driven

At this point and in the light of all the above, we would like to present the main points of a theory that supports that indeed UV radiation may play a very vital and important role in myopia progression.

1. Emmetropization is a natural "defensive-protective" mechanism that fights defocus with the eye growing from a very young age and remains always active
2. Modern way of living puts far more stress on our accommodation from a very young age continuing for many years in our lives. Stress in accommodation might give fluctuating vision and defocus. The eye responds rather quickly by growing....it's the only defensive mechanism it has....
3. UV light interfering with vitamin D formation<sup>29</sup> and dopamine plays a vital role in the hardening of the sclera. Thus, quite soon, the eyeball is, normally, hard enough so that it can't respond to any "pseudo-emmetropization" effect. However, if such a hardening does not exist the eye is more capable of growing, thus showing increased axial myopia. Ashby and Schaeffel<sup>30</sup> have also supported that the retardation of myopia development by light is partially mediated by dopamine, as the injection of a dopamine antagonist abolished, in their study, the protective effect of light, at least in the case of deprivation myopia.
4. Through the last five decades in many ways we have filtered UV light in order to protect our eyes from the - actually - aging effects of the UV radiation. We have plastic ophthalmic lenses that filter more UV light, car windscreens that block UV, window panes, we use sunglasses a lot more, we produce UV filtering contact lenses and we live indoors maybe a little more, thus being exposed to UV probably much less. Also, our nutrition has changed and there are possibilities that even this may contribute to eyes more prone to axial elongation and myopia.<sup>31,32,33,34,35</sup>
5. All the above may be valid most prominently for the Caucasian genre, as the Asian populations particularly in the Far East seem to have extra morphological contributing factors to myopia increase.
6. Through the years it is possible that an inherited predisposition to myopia and axial elongation may be created
7. Orthokeratology (OK) may seem effective in reducing the development of myopia but this may be due to the fact that OK patients do not wear a refractive device before their eyes during the day and maybe they are more exposed to light in general and also UV.
8. Atropine is very effective in the retardation of myopia, first because it neutralizes accommodation and secondly because of the mydriasis it causes and the bigger exposure to light (and UV radiation as well...).

A very recent study by Sherwin et al.<sup>36</sup> found a very clear protective association between Ultraviolet Autofluorescence (UVAF), a rather dependable biomarker of outdoor light exposure, and myopia (the higher the UVAF, the less myopic the people, even in a multivariable model that adjusted for age, sex, smoking, cataract, height and weight.)

## CONCLUSION

The question that finally emerges is whether, during the last decades, we have managed to protect our eyes from a number of negative effects of UV radiation (pterygia, early cataracts, macular degeneration, pinguecula, etc...), but, on the other hand, we have created many more myopic people, who may suffer cataracts, vitreous or retinal detachment, due to myopia. And can we really support that UV light is far more dangerous today, universally, than it has been 40-50 years ago, due to a certain reduction of the protective ozone layer of our planet? The answer to this question may change drastically the way we use protective eyewear especially in younger ages and our attitude towards natural light. Furthermore, it may provide stimuli for inventing different ways of providing the eye with the benefits of natural light without being exposed much to it (e.g. cross-linking the sclera with UV, producing vitamin D releasing contact lenses or lenses soaked in solution with Vitamin D, etc.).

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