



# How exposed are you? UV and your practice

Karen Walsh reviews new research material and provides a framework for better education of patients

Previously published work described in 'UV radiation and the eye' provided an overview of the ocular effects of UV radiation and the challenges of providing adequate protection.<sup>1</sup> This article reviews new research in this important area that looks specifically at the benefits of UV-radiation protection, and will aim to help practitioners better educate patients in the importance of UV protection in practice.

## What is UV?

Ultraviolet (UV) radiation sits adjacent to the blue end of the visible portion of the electromagnetic spectrum. It is categorised according to wavelength, and from the natural source of the sun, we are exposed to both UVA (400-315nm) and UVB (315-280nm) radiation on earth.<sup>2</sup>

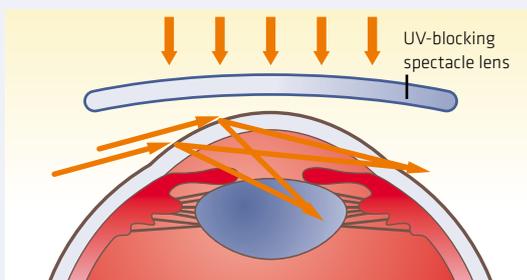
## What can it do to ocular tissues?

The effect of UV exposure on the skin is well understood by the public with 85 percent knowing about the risk of skin melanoma.<sup>3</sup> However, the level of understanding when it comes to the eye is extremely low, with only 7 percent of people associating UV with eye problems.<sup>3</sup>

Ocular tissues readily absorb UV radiation, with the cornea primarily absorbing radiation below 300nm (UVB) and the lens mainly absorbing wavelengths below 370nm (UVA).<sup>4</sup> At the point radiation is absorbed, its energy is transferred to the tissue<sup>5</sup> and has the potential to do damage. The type of damage is dependent on the wavelength.

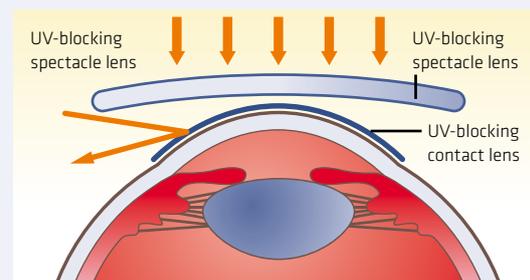
**Figure 1: Peripheral light focusing effect**

Sunglasses only

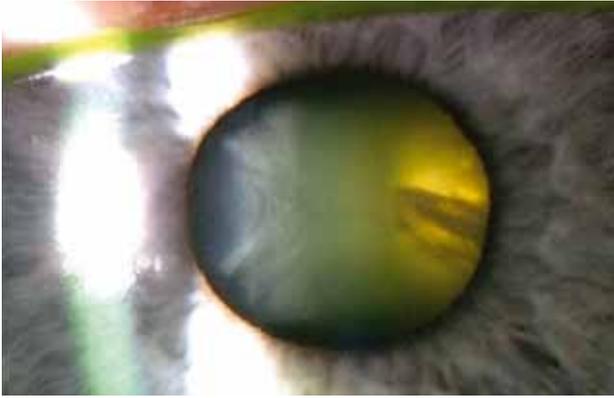


Exposure to UV from peripheral sources is still possible even when wearing UV-blocking spectacle lenses.

Sunglasses plus UV-blocking contact lenses



The use of a UV-blocking contact lens provides additional protection.



**Figure 2: Cortical cataract**

The literature provides plenty of evidence that the eyes are at risk of damage by both acute and chronic UV exposure. There is strong epidemiological evidence to support an association between chronic UV exposure and the formation of pterygium.<sup>6</sup> A high prevalence of pingueculae has been found in populations that live in both sunny and snow-covered environments.<sup>7</sup> Photokeratitis is the cornea's acute response to UV radiation.<sup>8</sup> The anterior chamber contains the antioxidant ascorbic acid which can protect against UV-induced DNA damage by scavenging free radicals,<sup>9</sup> and it has been shown that levels of ascorbate are significantly depleted following UV exposure.<sup>10</sup> The link between UV and cataract formation is well established<sup>11</sup> and although only a small proportion of UV reaches the adult retina, studies have shown a significant link between the incidence of early macula degeneration and extended exposure to summer sun.<sup>12</sup>

## What is the likelihood of exposure?

The effects of ocular exposure to UV are cumulative over our lifetime. Children are particularly vulnerable to UV damage; few wear eye protection outdoors and their larger pupils and clearer crystalline lenses mean that significantly more UV reaches the retina. Recent studies have calculated an individual gets 23, 46 and 74% of their lifetime UV dose by ages of 18, 40 and 59 respectively.<sup>13</sup> The importance of patient education from a young age and throughout adulthood is paramount.

Exposure to UV radiation occurs not only through direct exposure to sunlight, but also through indirect sources such as radiation reflected off surfaces (such

as snow and water, and even sand and concrete, although to a lesser extent) and scattered sources such as high cloud cover, where up to 90 percent of radiation can still pass through.<sup>14</sup>

It is difficult to predict when eyes are most at risk as the greatest exposure to ocular tissue has been shown to occur at unlikely times, both in terms of the time of day and the months of the year.<sup>15</sup> This makes patient education on the need for all-year round protection very important.

## The challenges of protection

The peripheral light focusing effect needs careful consideration when choosing ocular UV protection. The cornea acts as a side-on lens, focusing and intensifying UV incident on the temporal cornea onto the opposite side of the eye at the nasal limbus and lens cortex (Figure 1).<sup>16</sup> This process has been linked to the development of both nasal pterygia and nasal cortical cataract (Figure 2).<sup>17,18</sup>

It has been shown that non-wraparound sunglasses or UV-blocking spectacle lenses provide limited protection from peripherally focused UV radiation.<sup>19</sup>

## UV-blocking CLs

Well fitting soft contact lenses cover the entire cornea and limbus. The addition of Class I or Class II UV-blocking to lenses has been shown to be effective at protecting the eye against all angles of incidence, including from the peripheral light focusing effect.<sup>20</sup> Indeed the authors concluded by raising the possibility that the risk of eye diseases such as pterygia and early cortical cataract may be reduced by the wearing of UV-blocking contact lenses.

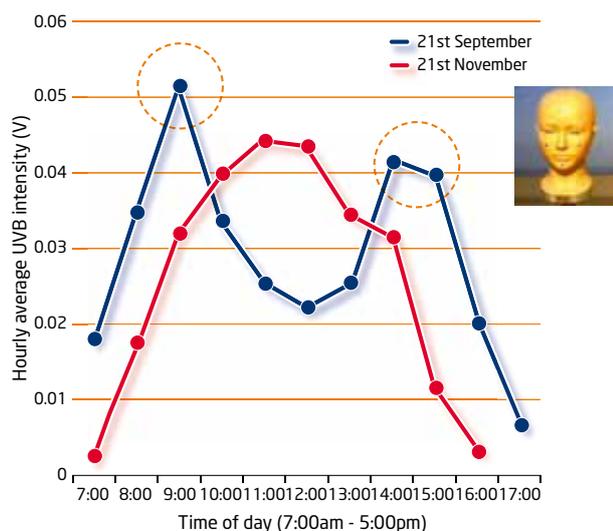
Not all UV-blocking lenses provide the same level of protection. There are a few brands contact lenses available with Class II UV-blocking properties, and Acuvue brand lenses have either Class I or II blocking properties across the entire range.

## Research update

### Dangers of UV exposure

A recent study conducted in Japan, and presented at the American Academy of Optometry meeting in 2009, measured UV exposure to both the top of the

**Figure 3: Average UVB intensity from sunrise to sunset (after Sasaki20)**



head and the eye using a mannequin head fitted with UVB sensors.<sup>20</sup> It concluded that UVB exposure to the eye follows very different patterns than to that of the head and skin, particularly for some parts of the day and the year (Figure 3). While top of the head exposure was proportional to solar altitude, with the peak occurring around noon, it was found that anatomical features, such as the brow ridge, provided ocular protection from the high midday sun. Instead, the eye is most vulnerable during times of the day and seasons of the year when the sun is lower in the sky, at an angle of around 40 degrees.

Another study from the same group to be presented at the BCLA conference in May looked at the effect of latitude on UV exposure.<sup>21</sup> Again using a mannequin, this time fitted with both UVA and UVB sensors, data for UV intensity related to solar angle were collected in both Okinawa, southern Japan and the more northerly latitude of Reykjavik, Iceland. It was found that even though the ambient UV was highest in Japan, ocular UV exposure was significantly higher in Reykjavik due to the persistent lower angle of the sun in the sky throughout the day. The notable conclusion was that people living in northern latitudes are more likely to receive more total radiation to their eyes due to the increased time the sun spends below the solar angles of about 40 degrees. It is worth noting that the latitude of London (51.3N) is much closer to that of Reykjavik (64.1N) than of Okinawa (26.2N). This again highlights the need for patient education on the importance of year-round protection from ocular exposure to UV radiation.

### Efficiency of UV-blocking contact lenses

The spectral transmittance of UV-blocking contact lenses was recently published where measurements were taken outdoors in Houston, Texas.<sup>22</sup> Of the three UV-blocking silicone hydrogel lenses tested, galyfilcon A (Acuvue Advance) and senofilcon A (ACUVUE® OASYS®) were the most effective UV blockers. These Class I UV blockers had a 50 percent transmittance cut off around 380nm. Enfilcon A (Avaira) was found to let more UVA through with a lower cut off around 370nm. All three were found to effectively reduce UV radiation to safe levels, ranging from 90 to 98 percent, compared to 13 percent for a non-blocking silicone hydrogel lens lotrafilcon B (Air Optix).

The study also aimed to model the ocular protection factor (PF) afforded by each lens. The authors feel it would be useful to develop a standard system, such as that seen with skin care products, which could easily classify the UV-blocking properties of lenses in order to increase public and professional awareness. The PF calculations were found to work well, although they did not always compare precisely with measured data due to factors such as the nature of the incident solar spectrum and the sensor spectral response.

**Table 1: Top tips to communicate**

#### Patient education

- UV damage is cumulative and can lead to eye disease
- Protection is important from infancy onwards
- UV protection for eyes is as important as sunscreen for skin
- UV protection is a full-time job, with exposure from direct exposure to sunlight in addition to indirect sources (via reflection and scatter)

#### Ocular UV protection

- For patients wearing contact lenses, recommend those with high levels (Class I or II) UV protection to reduce ocular exposure to UV radiation implicated in most sun-related disease
- Recommend contact lenses that offer UV protection in settings where wearing glasses or sunglasses is not possible
- Recommend spectacle lenses with UV-blocking protection as standard
- Recommend good quality, fully wraparound sunglasses
- The addition of a brimmed hat can further protect the eyes

A study published this year investigated whether UV-induced damage to the anterior segment can be prevented by using Class I UV-blocking contact lenses.<sup>23</sup> Matrixmetalloproteinases (MMPs) can be induced within the cornea by UV exposure and are associated with many pathologic inflammatory cascades. It has already been stated that ascorbic acid in the anterior chamber protects against UV-induced damage to the lens.<sup>9</sup> Levels of MMPs, anterior chamber ascorbic acid and the impact in crystalline lens epithelial cells though DNA fragmentation following exposure to UV were measured in a rabbit model with and without the presence of a UV-blocking contact lens. The study concluded that senofilcon A (Acuvue Oasys) Class I UV-blocking contact lenses are capable of protecting the cornea, aqueous humour and crystalline lens of rabbits from UV-induced pathologic changes.

### Practice discussions

The current level of awareness of ocular UV exposure is low, although once educated, patients are very motivated to take the necessary steps to better protect their eyes.<sup>24</sup> The American Academy of Optometry released a statement in 1997 that it was evident how UV radiation effects were insidious and harmful to any part of the eye that absorbed it. They stated that it was prudent to include protection from UV in all types of eyewear, including prescription and non-prescription spectacles, safety spectacles, contact lenses and sunglasses. Accordingly, discussion of UV protection with patients should become standard practice, especially with those participating in work and leisure activities exposing them to UV radiation, to allow them to make fully informed decisions. *Table 1* highlights some tips to use when communicating with patients about the range of ocular pathologies associated with UV radiation and the benefits of protecting the eyes against the long-term effects of exposure.

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