

The canary in the coalmine

A series of chance events and his own family background have shaped the career of Professor Minas Coroneo, a pioneer of research into UV and the eye, as Anna Sulley discovers in an interview.

Minas Coroneo was adjusting his tie in the mirror when he noticed an unusual effect. A beam of light falling on his eye from a window to his side was focused on the nasal limbus.

Coroneo had been studying optics for his ophthalmology exam and this simple observation started him thinking about how the effect came about. In fact this was just one of a series of events and circumstances that would lead to the discovery known as the Coroneo Effect.

As a teenager, Coroneo worked in the family business, a cinema in a small, country town in Australia, and learnt how

to operate 35mm projectors. It was this background that led to an interest in optics and the decision to pursue a career in ophthalmology.

The implications of his discovery were not immediately clear. 'I thought it had to do with sclerotic scatter but it probably didn't. And then I started seeing patients with pterygium' (Figure 1). The connection between peripheral light focusing and this debilitating condition was made.

KEY POINTS SUMMARY

- The ophthalmohelioses are diseases of the eye in which sunlight is implicated - their effects range from cosmetic to life-threatening
- Light striking the temporal limbus is focused at the nasal limbus at 20X the intensity of incident light, known as the Peripheral Light Focusing (PLF) or Coroneo effect
- Although usually nasal, about 10% of pterygia occur temporally, often where the nasal bridge is flat, so that side light can be focused on the temporal limbus
- Exposure to high levels of UV carries an increased risk of pterygium; as many as 90 per cent of professional surfers develop pterygium
- Pterygium is associated with a two-fold increased risk of dry eye symptoms
- PLF is also implicated in cortical cataract which is usually inferior nasal
- Sunglass designs can allow as much as 45% of ambient UV to reach the eye
- Wearing a hat affords extra protection but a hat alone is not effective
- UV-blocking contact lenses may offer additional ocular protection, especially in at-risk groups and where other protective measures are impractical. These lenses shield the limbus but do not protect exposed conjunctiva or lids
- Peak UV eye exposure occurs in the morning and afternoon, not at midday
- Ocular UV fluorescence photography, used in dermatology to reveal skin damage, demonstrates preclinical ocular surface evidence of solar damage
- This technique can be used to detect early evidence of UV damage and communicate the protection message to people particularly at risk
- Mediterranean and certain traditional diets may offer some protection against age-related macular degeneration in those exposed to high levels of UV
- A balance is needed between enough UV exposure to synthesise sufficient Vitamin D and stay healthy while protecting against skin cancer
- Recommend UV-blocking contact lenses for additional eye protection, especially for those at risk

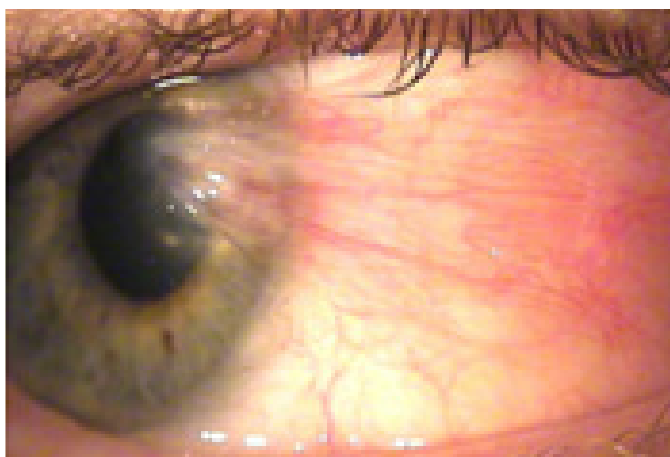


Figure 1:
Pterygium (from *A Handbook of CL Management* published by THE VISION CARE INSTITUTE®)

From observation to science

Coroneo demonstrated the effect to his mentor, the New Zealand-born ophthalmologist Fred Hollows, who recognised the potential immediately and presented the finding at various meetings. But the initial response from the ophthalmology establishment was sceptical. 'It took eight or nine years to get the work published,' Coroneo explains.

Another chance encounter, with Arthur Ho – who had studied optometry with Coroneo's brother – led them to collaborate on a paper on ray tracing aspects of peripheral light focusing (Figure 2). 'What that did was put some science to it. It wasn't just a clinical observation.'

In fact although Coroneo is credited with the discovery, others had already described related phenomena. Helmholtz

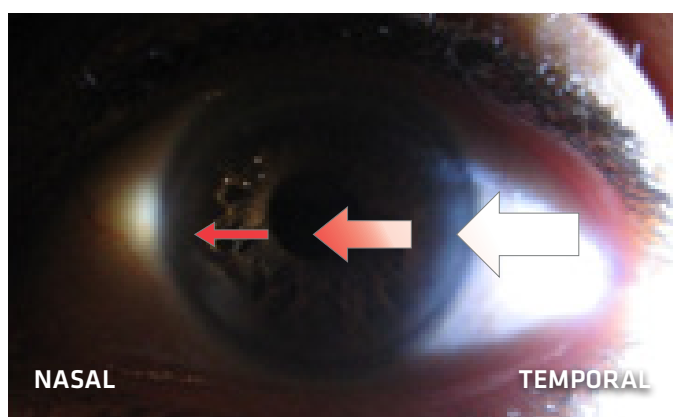


Figure 2:
Peripheral light focussing effect (with kind permission of Professor Minas Coroneo)

used a similar principle in his studies of accommodation and a light focusing effect had been identified in keratoconic eyes but not in normal patients. Other researchers had failed to recognise that limbal focusing was one of a series of foci induced by the optics of the anterior eye.

Coroneo's thesis was accepted by the University of New South Wales (UNSW) and he continued his studies in Germany, working on cell physiology.

In 1991 he returned to Australia and opened a successful private practice in Sydney. Two years later Hollows died and Coroneo was appointed as his successor, chairing the UNSW ophthalmology department at the age of 40. The post entailed not only running a busy department but going into the outback, as Hollows had done, carrying out surgery in isolated towns and among Aboriginal communities.

Over the past 20 years, Coroneo has continued his studies of ophthalmohelioses, the term used for diseases of the eye in which sunlight is implicated which range from the cosmetic to the life threatening. His many publications describe the effects of UV exposure on corneal stem cells, corneal nerves, the crystalline lens and other ocular tissues. 'I have been fortunate to work with excellent collaborators' Coroneo adds.

Worldwide hazard

Australia proved the ideal location for conducting his research. Back in the 1950s, Kerkenezov was the first to recognise the link between pterygium and skin cancer, in the population of northern New South Wales, noting that pterygia developed about a decade before the skin condition. Today, Australia is known as 'the melanoma capital of the world' with one of the highest incidence and mortality rates.

But Coroneo points out that UV exposure is not only a concern in countries such as Australia and levels can be hard to predict. UV is a year-round hazard to eyes and advice for eye protection differs from that for skin protection.

'You can't always predict just by looking at the location what sort of dosage you'll get. Most people in western societies now travel. Many of them have fair skins and they can get a certain amount of skin damage and probably eye damage as well.'

Research also shows that the maximum exposure to the eye is around 9am in the morning and mid-afternoon. 'The thing to do is to know where you're going and take adequate protection measures – wear sunglasses and a hat.'

Eye protection has been a major research interest for Coroneo. His studies have shown that peripheral light focusing is greatly attenuated by UV-blocking contact lenses shielding the limbus. These lenses can offer additional protection to sunglasses, especially in at-risk groups and where other protective measures are impractical.

The importance of improved sunglass designs with side protection has also been recognised as a result of his work and will soon be covered by a new ISO standard.

Revealing technique

Most recently, Coroneo has developed imaging techniques using UV fluorescence photography, previously applied in dermatology, to demonstrate evidence of preclinical ocular surface solar damage.

His initial interest in the technique came from studying oculo-plastics. 'Looking at the cosmesis literature I came across fluorescence photographs showing sun damage to the face. It was another of those Eureka moments - why don't we do this for the eye? We looked at the specifications for skin cameras and applied them directly to a macro camera for the eye. It's a very simple concept and it worked first go.'

The system consists of a digital single-lens reflex camera, macro lens and a specially adapted electronic flash fitted with UV-transmission filters (Figure 3). It demonstrates that UV-related ocular changes start early in life. A study of school age children in Australia found that nearly one in three (29 per cent) of those aged 9-11 years, and more than eight in 10 (81 per cent) of 12-15 year olds, showed fluorescent spots at the limbus in otherwise normal eyes (Figure 4).



Figure 3:
Professor Coroneo using his UV Fluorescence camera

Studies carried out on the remote Norfolk Island in the Pacific show an increase in conjunctival fluorescence associated with the presence of pterygium, which affects as many as one in 10 islanders.

Although developed as a research tool, the technique may also have clinical applications. Johnson & Johnson Vision Care are using the system at meetings around Europe to demonstrate to practitioners the pre-clinical signs of ocular UV damage.

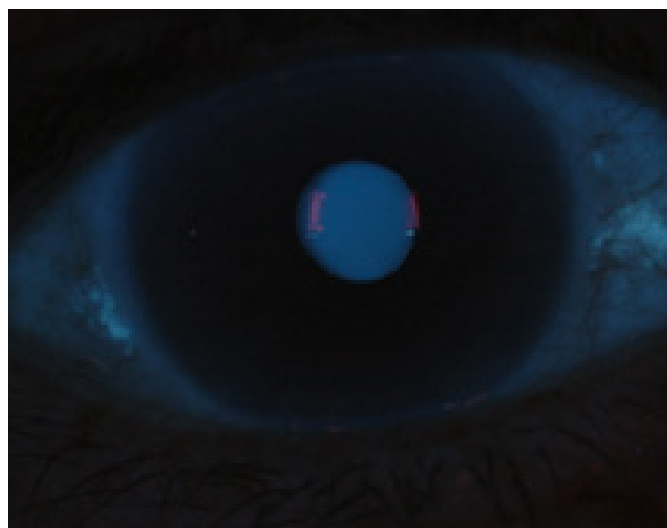


Figure 4:
Conjunctival fluorescence

New approaches are needed to modify attitudes to sun protection, says Coroneo, and UV fluorescence photography shows promise for communicating the message.

'A picture's worth a thousand words so if patients have early signs of pterygium or pinguecula you can photograph it and show them. I also use a pen torch to demonstrate where light is focused, the fact that it comes from the periphery, and that standard sunglasses are not much use. That's a very powerful tool.'

Health benefits

Eye protection in childhood has recently been in the news since studies suggest spending more time out of doors may protect children against myopic progression. Coroneo says he is as yet 'unsure about the myopia story' but argues that there are other, general health benefits to an outdoor lifestyle.

'I think it would be reasonable for people to get outside - it's a healthy thing to do, if for no other reason than their sanity. There are mood effects as well. Getting outside is also good in terms of getting a dosage of Vitamin D.'

If children are to spend more time outdoors, what advice should practitioners give to parents about protecting the eyes? 'Under high exposure I would think a minimum of wrap-round sunglasses and a hat. And if they're already ametropic a reasonable strategy would be to use a UV-blocking contact lens.'

While young people need to be vigilant about sun exposure since some UV-related conditions are determined by early-life exposures, Coroneo argues that patients of all ages need advice on UV protection.

Longer life expectancy increases susceptibility to age-related eye diseases in which UV radiation plays a part and those whose habitat, work or lifestyle exposes them to high levels of UV are particularly at risk.

Posterior pointers

The role of UV in the pathogenesis of posterior eye disease is less clear than for anterior conditions but Coroneo highlights a recent study in France that may help our understanding. Researchers found a higher incidence of maculopathy and drusen, as well as pterygium, pinguecula and cortical cataract, in mountain guides exposed to high levels of UV when compared to those who spent most of their time in valleys.

'Since macular degeneration is a really big problem in western societies, anything we can do to lessen it is a good strategy,' argues Coroneo. You really don't want to be elderly and without good sight. It plays a big role in people's quality of life. There are all sorts of reasons why you should try to protect the organs of vision and make them last as long as they possibly can.'

Coroneo's family background again provided a stimulus for another area of interest: a possible role for diet in protection against UV-related diseases. It has been suggested that the low rates of melanoma found in Mediterranean countries, despite high levels of solar radiation, could be partly due to diet.

In 2000, Coroneo returned to the Greek island of Kythera, where his family originated. He found that although life expectancy among islanders was high, the incidence of age-related macular degeneration (AMD) was very low, at only 5 per cent compared to 40 per cent in Australia. A diet rich in freshly grown produce and olive oil seemed to offer some protection against AMD in this population, which was also exposed to high UV levels.

'To feed cities you need foods with a long shelf-life. The consequence is that food has become less nutritious and full of things that are not good for you. The price we've paid is the prevalence of obesity and other, degenerative conditions. Macular degeneration may be one of them,' he argues.

Like his other research interests, Coroneo's work on diet and ocular health has led to a practical spin-off. With his wife Hellene, he has written 'Feast your Eyes: the Eye Health Cook Book' (www.feastyoureyes.com.au) with recipes for healthy eating and a review of eye diseases in which diet can play a role.

Protecting eye and patient

Looking at his career as a whole, Coroneo says UV 'accidentally became a big part of it'. 'If I'm remembered for anything at all, it's for those early experiments. It wasn't just limbal focusing - no-one had described the lens pathway or the stem cell concept.

'If you understand basic mechanisms then you can do something about them. If this hadn't been described, we'd still be wearing conventional sunglasses and not talking about UV-blocking contact lenses. In my lifetime, I think we've moved forward a little.'

The association between UV and a range of anterior eye conditions is now accepted. 'The evidence is really quite strong. In many ways it parallels the [UV and] skin cancer research. I see children with pterygium in their teens and many are going on to get skin cancer 20 years later.'

'Ophthalmology ought to be leading this debate. We can image tissues better than almost anywhere else in the body. You can see single cells with confocal microscopy and technologies such as OCT mean we're in a good position to understand a lot about disease processes as they affect the eye.

'Early evidence of ocular UV damage makes the eye the perfect place to study these mechanisms. We have the opportunity to protect the eye and the whole patient too.'

Getting the message across

Based on our current understanding, what advice should practitioners be giving to patients about protecting the eyes against UV? 'I learnt a lot from medicine by being a patient myself. The question you should ask yourself is, "With our present level of knowledge, what would you do for yourself and your family?"' says Coroneo.

'I don't see a downside to having a UV blocker if you're going to be using a contact lens. Until we know more, it's at least a reasonable strategy to have a blocker in there.' There were also some patients exposed to high levels of UV but not requiring vision correction who could benefit, he adds.

But there was still work to be done to get the message about the risks of UV exposure across, despite mounting evidence of the effects on the eye. 'The eye should come before the skin. We're in a position where we can say to society, "look, here are studies that show you get changes earlier in the eye than anywhere else in the body, take some notice of it".

For Coroneo, the message is simple: 'It's the canary in the coalmine,' he says.



Figure 5:
Professor Minas Coroneo

Further reading

- Coroneo M. Ultraviolet radiation and the anterior eye. *Eye & Contact Lens* 2011; 37:4 214-224.
- Kwok LS, Daszynski DC, Kuznetsov VA, et al. Peripheral light focusing as a potential mechanism for phakic dysphotopsia and lens phototoxicity. *Ophthalmic Physiol Opt* 2004; 24:119-129.
- Fonn D. A special issue on ultraviolet radiation and its effects on the eye. *Eye & Contact Lens* 2011;37:4 167-272.

About the Authors

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Acknowledgement

This interview was first published in a supplement to *OPTICIAN UV & The Eye* July 2012.