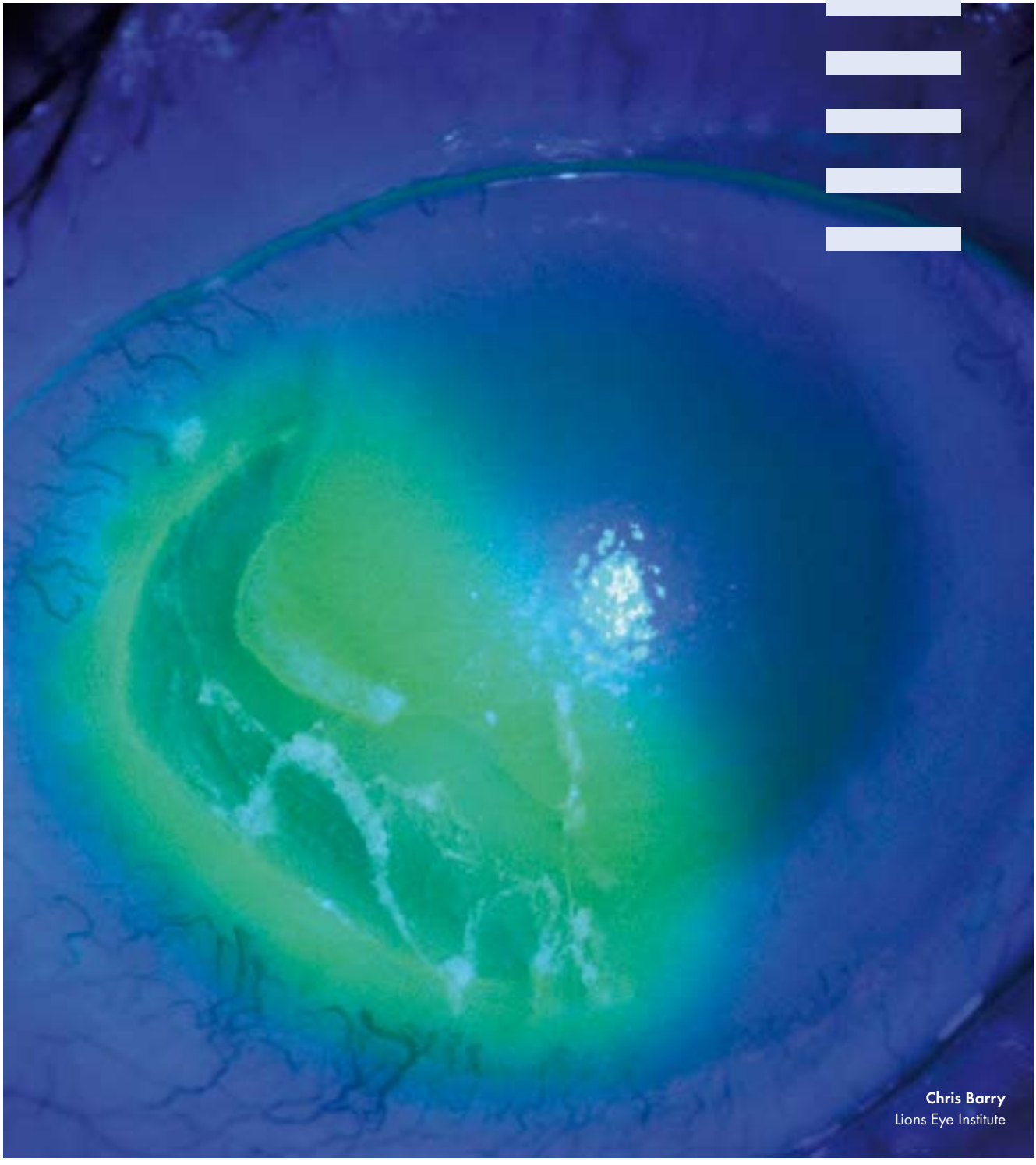
OPTOMETRY pharma
SUPPLEMENT TO AUSTRALIAN OPTOMETRY MARCH 2009

Special issue
DRY EYE



Chris Barry
Lions Eye Institute

- NSAIDs
- Biocompatibility
- Punctal plugs
- Ocular drug delivery challenges
- Combat hyperosmotic stress
- Vernal keratoconjunctivitis
- Antimicrobial contact lenses

FORESIGHT

[the ability to see into the future and be alert to the signs ahead]

Never has it been more vital to test for age-related macular degeneration (AMD).

AMD is now the leading cause of blindness in Australia.[1,6] Lucentis offers real hope to those diagnosed with wet AMD.[2,3,5]

Already helping thousands maintain independent lives, Lucentis is proven to help patients gain and sustain vision.[2,3,4] Some patients treated report improvement as early as 7 days after treatment.[2]

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Improving vision. Restoring hope.[2,3,5]

PBS Dispensed Price: $1975.93. Please refer to the Product Information before prescribing. Product Information is available from Novartis Pharmaceuticals Australia Pty Limited or visit www.novartis.com.au. For further information please contact Medical Information & Communication on 1800 671 203. **Indication:** Treatment of neovascular (wet) age-related macular degeneration (AMD). 0.5 mg or 0.3 mg is recommended to be administered by intravitreal injection once a month. **Dosage and administration:** Recommended dose is 0.5 mg (0.05 mL) or 0.3 mg (0.03 mL) given monthly. Interval between doses should not be shorter than 1 month. Treatment might be reduced to one injection every 3 months after the first three injections but, compared to continued monthly doses, dosing every 3 months may lead to an approximate 5-letter (1-line) loss of visual acuity benefit, on average, over the following 9 months. Patients should be evaluated regularly. Must be administered by a qualified ophthalmologist using aseptic techniques. Broad-spectrum topical microbicide and anaesthetic should be administered prior to injection. Patient should self-administer antimicrobial drops four times daily for 3 days before and after each injection. Not recommended in children and adolescents. **Contraindications:** Hypersensitivity to product components, active or suspected ocular or periocular infections, active intraocular inflammation. **Precautions:** Intravitreal injections have been associated with endophthalmitis, intraocular inflammation, rhegmatogenous retinal detachment, retinal tear and iatrogenic traumatic cataract. Proper aseptic injection techniques must be used. Monitor patients during the week following injection to permit early treatment if an infection occurs. Intraocular pressure and perfusion of the optic nerve head must be monitored and managed appropriately. Safety and efficacy of administration to both eyes concurrently have not been studied. There is a *potential* risk of arterial thromboembolic events following intravitreal use of VEGF inhibitors. *A numerically higher stroke rate was observed in patients treated with ranibizumab 0.5mg compared to ranibizumab 0.3mg or control, however, the differences were not statistically significant. Patients with known risk factors for stroke, including history of prior stroke or transient ischaemic attack, should be carefully evaluated by their physicians as to whether Lucentis treatment is appropriate and the benefit outweighs the potential risk.* As with all therapeutic proteins, there is a potential for immunogenicity with Lucentis. No formal interaction studies have been performed. Should not be used during pregnancy unless clearly needed; use of effective contraception recommended for women of childbearing potential; breastfeeding not recommended. Patients who experience temporary visual disturbances following treatment must not drive or use machines until these subside. **Side effects:** Very common: Conjunctival haemorrhage, eye pain, vitreous floaters, retinal haemorrhage, *intraocular pressure increased*, vitreous detachment, intraocular inflammation, eye irritation, cataract, foreign body sensation in eyes, lacrimation increased, visual disturbance, blepharitis, subretinal fibrosis, ocular hyperaemia, visual acuity blurred/decreased, dry eye, vitritis, eye pruritis, *nasopharyngitis*, headache, *arthralgia*. Common: Ocular discomfort, eyelid oedema, *eyelid pain*, conjunctival hyperaemia, posterior capsule opacification, punctate keratitis, corneal abrasion, anterior chamber flare, *injection site haemorrhage*, eye haemorrhage, retinal exudates, injection site reactions, conjunctivitis, *conjunctivitis allergic, eye discharge, photopsia*, photophobia, maculopathy, detachment of the retinal pigment epithelium retinal degeneration, retinal disorder, retinal detachment, retinal tear, *retinal pigment epithelium tear*, vitreous haemorrhage, vitreous disorder, uveitis, iritis, iridocyclitis, *cataract subcapsular, influenza, anaemia, anxiety, stroke, cough, nausea, allergic reactions (rash, urticaria, pruritis, erythema).* Uncommon: Keratopathy, *iris adhesions, corneal deposits*, dellen, corneal striae, *injection site pain, injection site irritation, abnormal sensation in eye, hyphema*, cataract nuclear, angle closure glaucoma, endophthalmitis, eyelid irritation, blindness, corneal oedema, hypopyon. Rare but serious adverse reactions related to intravitreal injections include endophthalmitis, rhegmatogenous retinal detachment, retinal tear and iatrogenic traumatic cataract. **Please note changes to Product Information in italics.* **1.** Bressler NM. J Am Board Fam Pract 2002;15:142-152. **2.** Rosenfeld PJ, et al. N Engl J Med. 2006;355:1419-1431. **3.** Brown DM, et al. N Engl J Med. 2006;355:1432-1444. **4.** LUCENTIS Approved Product Information. **5.** Chang TS, et al. Arch Ophthalmol. 2007;125:1460-1469. **6.** Attebo K, et al. Ophthalmol. 1996, 103: 357-364. Novartis Pharmaceuticals Australia Pty Limited, ABN 18 004 244 160. 54 Waterloo Road, North Ryde NSW 2113. ® Novartis Pharmaceuticals Australia Pty Limited. NVO_LUC65_11/2008. Bluedesk LUC3C.

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PBS Information: Authority required. Refer to PBS schedule for full Authority Required Information.

Special issue
DRY EYE

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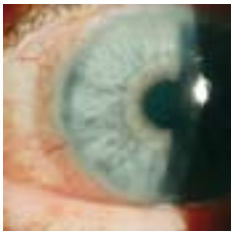
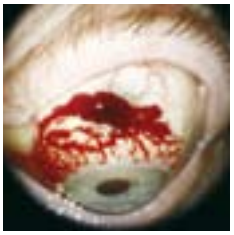
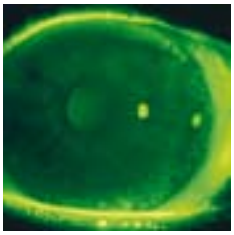

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COVER
Melting of the cornea in a case of advanced rheumatoid arthritis

Photography
Chris Barry
Lions Eye Institute

Optometry Pharma is distributed in Australia and New Zealand. All references to pharmaceutical preparations in *Optometry Pharma* are applicable within Australia.

Antiglaucoma preparations

Final hurdle overcome

Systems are in place for the much anticipated inclusion of antiglaucoma drugs on the PBS for optometrists from 1 March 2009.

The National Health Act has been amended and the Department of Health and Ageing has made the necessary administrative arrangements for the inclusion of 21 new items, representing 13 antiglaucoma preparations on the PBS for optometrists (refer to table on page 39).

The announcement made by the department follows the meeting of the Expert Advisory Panel on Optometric Prescribing held in Canberra on 22 December 2008.

Authorised optometrists will be required to prescribe antiglaucoma medications under shared-care arrangements promoting quality use of medicine that were jointly developed by the association, the Royal Australian and New Zealand College of Ophthalmologists and the Department of Health and Ageing. These will be available on the PBS website at www.pbs.gov.au.

These changes have a significant impact on both the profession and patients. Optometrists are now formally recognised as playing a major role in the therapeutic management of patients with glaucoma.

Restrictions on the use of these preparations are to be advised.

Almost the entire list of approved glaucoma drugs has been accepted. A notable omission from the list is apraclonidine which is available on PBS only under limited circumstances.

For further information on the obligations when prescribing under the PBS visit www.optometrists.asn.au/information/resources/pbs. ■

No longer

Latest developments in steroids and NSAIDs in the treatment and management of dry eye

Dry eye is a common condition affecting many of our patients. For years practitioners were using a hit and miss approach in the treatment of this condition, a methodology that was clearly unsubstantiated and inappropriate. The 2007 Dry Eye Work Shop report (DEWS),[1] an encyclopaedic review of dry eye, has improved our understanding of this condition.

The DEWS report has set new standards for everything relating to dry eye, including methods to evaluate and diagnose, and the various management strategies connected with this condition. This article looks at specific findings from the DEWS report, particularly regarding the role of non-steroidal anti-inflammatory drugs (NSAIDs) and steroids in the management of patients suffering dry eye.

The core mechanisms of dry eye are driven by tear hyperosmolarity and tear film instability.[2,3] Tear hyperosmolarity (too many salts in the tear film) causes damage to the surface epithelium by activating a cascade of inflammatory events at the ocular surface and a release of inflammatory mediators into the tears. Epithelial damage involves cell death by apoptosis, a generalised loss of goblet cells and disturbance of mucin expression leading to tear film instability. Tear film instability can also be initiated, without prior occurrence of tear hyperosmolarity, by several aetiologies including ocular allergy, topical preservative use and contact lens wear (Figure 1).

The major causes of tear hyperosmolarity are reduced aqueous tear flow resulting from lacrimal failure and/or increased evaporation from the tear film.

Increased evaporative loss may be caused clinically, in particular, by meibomian gland dysfunction (MGD),[4,5,6] which leads to an unstable tear film lipid layer. The quality of lid oil is modified by the action of esterases and lipases released by normal lid commensals, of which the numbers increase in blepharitis. Reduced aqueous tear flow is due to impaired delivery of lacrimal fluid into the conjunctival sac. It is unclear whether this is a feature of normal ageing, but it may be induced by certain systemic drugs such as antihistamines and anti-muscarinic agents. The most common cause is inflammatory lacrimal damage, which is seen in autoimmune disorders such as Sjögren's syndrome. Inflammation causes both tissue destruction and a potentially reversible neuro-secretory block.

Tear film insufficiency and/or tear film instability if left untreated will ultimately assist in the formation of an inflammatory tear film.[7] The understanding of the role of inflammation in dry eye condition has lead to the development of treatment strategies aimed at targeting these inflammatory processes. In most patients the use of artificial tear supplements early on in their condition will go a long way to slow their progression into the 'red zone'.

hit and miss

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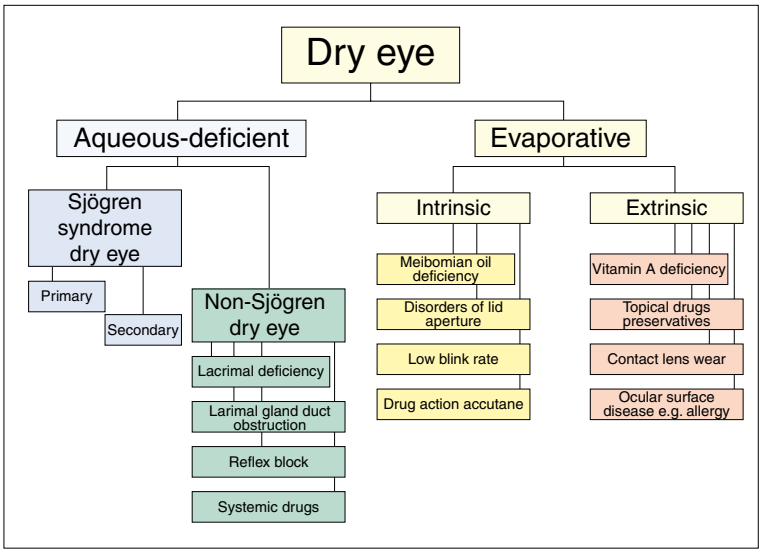

Figure 1. Reproduced from the DEWS report

The problem is that we often see these patients in the grade 3 and 4 severity of their condition, so treating them must require a shutting down of the ocular surface inflammatory cascades. Such treatments have included topical corticosteroids, NSAIDs, topical immunosuppressants (Cyclosporine A), autologous serum and tetracycline derivative agents. Before exploring these treatment strategies, it is important to gain a better insight into some of the clinical pearls that can assist us in the diagnosis.

Diagnostic clinical pearls

Clinical examination techniques for dry eye are:

Ocular Protection Index (OPI)

- The OPI is a ratio of the tear film break-up time (TFBUT) over the inter blink interval (IBI) measured in seconds (OPI = TFBUT/IBI).
- It is unfavourable if the OPI is less than one. This indicates that the patient's tear film is breaking up prior to the inter blink interval.
- The OPI must be measured prior, during and after a treatment strategy is implemented. The treatments are adjusted until an OPI equal to or greater than one is achieved.

Injection

- Grade injection severity, locality (ciliary vs conjunctival), appearance and whether it is uni- or bi-lateral. A red eye is an inflamed eye and a sign that immediate intervention is required.

Questionnaire

- This is essential for comparing of pre- and post-treatment strategies.

Ocular surface staining

- This is where you discard the NaFl strips and obtain some Lissamine Green strips (Optical Manufacturers). The golden rule here is that focal conjunctival cellular drop-out occurs way before corneal epithelial compromise. Lissamine green will determine conjunctival staining far more easily and much earlier than NaFl.

Schirmer's

- Always use an anaesthetic as we are determining basal tear secretion rather than reflex tearing, and place in lower temporal conjunctival sac. Record secretion rates after five minutes.

Tear film function studies

- The Ocusense Tear Lab is essential for any practising dry eye consultant. It determines tear film osmolarity and is also capable of looking at the levels of a number of tear film immunoglobins. This will be available shortly in Australia from Designs For Vision.

Continued page 5

Unlike most lubricant eye drops, SYSTANE® restructures the tear film for sustained comfort and healing protection.[1,2,3]

Thanks to its unique mechanism of action, SYSTANE® Lubricant Eye Drops starts as a drop then soothes and protects the ocular surface as a gel – beyond the transient tear bulking effect on the tear film.

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No longer hit and miss

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Treatments

Steroids

Nothing beats a steroid when we are required to suppress all aspects of the inflammatory cascade. As inflammation plays a significant role in many eyes that present with clinically determined tear film dysfunction, the challenge is to know which patient would benefit from anti-inflammatory therapy and which will not. Generally, greater signs and symptoms equate to a greater success of topical anti-inflammation therapy. Concurrent use of artificial tears is always implemented in all dry eye patients. My treatment combination of choice is guttae unit dose Systane qid along with guttae fluorometholone (Flucon) qid. I prefer Flucon in dry eye patients because of the inclusion of Hypromellose. My patients report feeling more comfortable using Flucon than other topical mild steroids. This is most likely to be due to the lubricating quality of the Hypromellose cellulose ether vehicle carrying the active steroidal ingredient.

If the patient finds the steroid trial significantly beneficial, two choices are then available:

1. either we continue the Flucon bid for one month then taper to once-daily for one or two months (keep with the unit dose Systane qid) or
2. continue the Flucon bid for one month along with topical Restasis (Cyclosporine) bid (also keeping with Systane).

Cyclosporine (Restasis)

Restasis (cyclosporine ophthalmic emulsion) 0.05% contains a topical immunomodulator with an anti-inflammatory effect. It is available in Australia through the SAS (Special Access Scheme) and has been approved for clinical use by the TGA and the US Food and Drug Administration for moderate to severe dry eye.

I access this drug via close collaboration with a corneal specialist with whom mutual patients are managed so I am privileged to witness first-hand the benefits of this drug in patients. Topical cyclosporine may slow or halt the progression of dry eye but it usually takes Restasis at least one month to render a meaningful effect. Front loading with the Flucon quantitatively diminishes the expression of inflammation and seems to potentiate the therapeutic effect of the Restasis.

Clinically speaking, the combination of Restasis/Systane[8] for dry eye patients, especially ones suffering both symptoms of ocular discomfort and signs of ocular surface staining, is a magic bullet in our therapeutic armamentarium. Bear in mind that steroids reign supreme in the treatment of inflammation and neither Restasis nor any NSAIDs comes close to matching their anti-inflammatory action, but the unwanted side-effects of steroids must always be considered in any treatment strategy.

The larger issue is: how long do we need to keep our patients on these anti-inflammatory therapies in the setting of dry eye? The answer to this has not yet been definitively established. Once the patient has achieved good control of their signs and symptoms, it should be relatively \easy to maintain the patient without anti-inflammatory interventions.

NSAIDs

NSAIDs are on the verge of becoming the ophthalmic equivalent of aspirin. Just as medical science continues to find new uses for aspirin, eye care physicians and practitioners are reporting excellent results using NSAIDs in a variety of new ways. Let us first understand the pharmacology of NSAIDs prior to looking at their role on a dysfunctional ocular surface.

First of all, they have no direct anti-inflammatory properties. They simply inhibit an enzyme along the synthetic pathway to the production of prostaglandins (PG), which are powerful mediators of inflammation. It is known as the arachidonic acid cascade. As shown in Figure 2, the origin substrate is membrane phospholipids released from cell membranes as a generic response to multiple causes of cellular micro trauma. Corticosteroids inhibit the conversion of these phospholipids to arachidonic acid by inhibiting the catalytic enzyme phospholipase early in this synthetic cascade. Once arachidonic acid (AA) is formed, two different enzymes convert it ultimately to either prostaglandin formation or leukotriene formation. Cyclo-oxygenase converts AA to prostaglandins, and lipoxygenase converts AA to leukotrienes.

The key point is that while NSAIDs inhibit the enzymatic activity of cyclo-oxygenase, they have no effect on lipoxygenase, thereby allowing the production of leukotrienes (white blood cells) to go unchecked. NSAIDs' role in dry eye management revolves around the improvement of symptoms of ocular discomfort in patients with Sjö-

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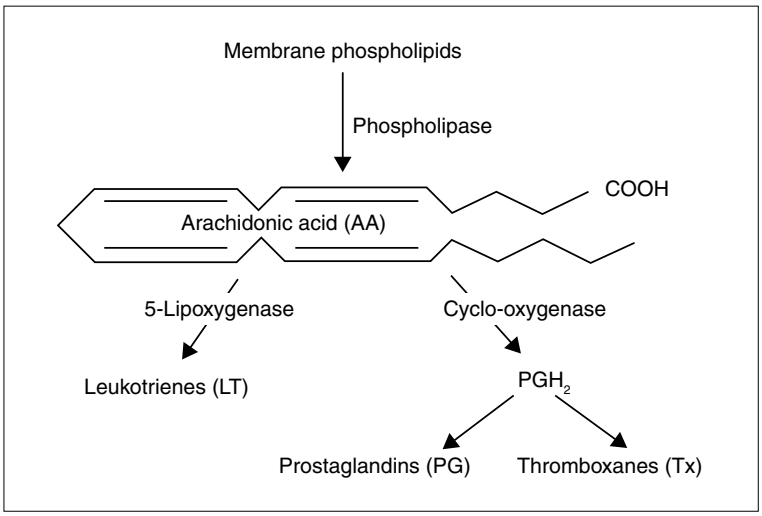

Figure 2. Pharmacology of non-steroidal anti-inflammatory drugs (NSAIDs)

No longer hit and miss

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gren's syndrome. NSAIDs have an influence on corneal sensitivity helping to maintain a normal epithelial ultrastructure and healing in patients with epithelial compromise.[9]

The NSAIDs we commonly deal with in Australia are guttae Voltaren (my preferred) and guttae Acular. Although reports of corneal melting have been noted in the literature regarding the use of topical NSAIDs, I do not believe this to be an issue at the primary care level. Studies have noted the inconsistent and variable dose-toxicity relationships suggest that coexistent factors other than simple drug toxicity are implicated, if not causative, in NSAID-associated corneal melting.[10] These cases demonstrate the importance of making a clinical diagnosis before treatment and of following the clinical course of patients carefully during treatment.

Other common ophthalmic conditions for which topical NSAIDs can play a beneficial role are:

- corneal abrasions
- post foreign body removal
- post penetrating keratoplasty or any surface disruptive laser procedure
- a key to CME prevention
- allergic conjunctivitis, especially in controlling the itch sensation
- some cases of photophobia
- treating and/or preventing inflamed pterygia and pingueculae.

There have been tremendous advances in the treatment of dry eye and ocular surface disease in the past two decades. There has also been a proportionate increase in knowledge regarding the pathophysiology of dry eye.

This has led to a paradigm shift in dry eye management from simply lubricating and hydrating the ocular surface with artificial tears to strategies that stimulate natural production of tear constituents, maintain ocular surface epithelial health and barrier function and inhibit the inflammatory factors that adversely impact the ability of ocular surface epithelia to produce tears.

Preliminary experience using these new therapeutic approaches suggests that quality of life can be improved for many patients with dry eye and that initiating these strategies early in the course of the condition may prevent potentially blinding complications. Optometrists should be taking a more active role with better quantitative techniques in the determination of dry eye diagnosis and management.

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Signs and symptoms inconsistent

The onset of dry eye symptoms after initial treatment may be a positive step to recovery in long-term dry eye patients. This can be explained by potential discrepancies between clinical signs and subjective symptoms.

A report published in *Primary Care Optometry News*[1] warns optometrists not to abandon treatment prematurely.

Because ocular surface damage can lead to desensitisation over time, patients in the later stages of dry eye may exhibit severe staining and shorter tear film break-up time values without complaining of standard dry eye symptoms. This is common in patients who have had chronic dry eye stemming from systemic disease or hormonal changes.

Successful treatment for sign-only dry eye patients will restore health to the ocular surface, including neural sensation, which may result in a temporary manifestation of symptoms. A determination of ocular surface desiccation, as observed via fluorescein staining, is important when evaluating a patient's dry eye.

Conversely, due to intermittent ocular surface exposure, patients in the earlier stages of dry eye may complain of dry eye symptoms without exhibiting substantial clinical signs. According to the report, these patients are usually younger and present with more epithelial neural sensitivity. They include contact lens wearers, smokers or possibly misdiagnosed ocular allergy sufferers.

The report cites clinical findings from a study conducted by Casavant and colleagues, that states that 63 per cent of dry eye patients experienced worsening of signs and symptoms under a controlled adverse environment, while 19 per cent had symptomatic responses only and the other 18 per cent saw only changes in clinical signs.

It is important for dry eye therapies to control both signs and symptoms of dry eye. An artificial tear must not simply bulk up the aqueous layer of the tear film, but must provide an opportunity for the ocular surface to self-repair. A tear substitute capable of approximating the glycocalyx could give the epithelium the chance to rebuild the microvilli that help generate and hold the natural glycocalyx.

A therapy that hinders the dry eye cycle by allowing the eye's natural defences to work is valuable for any type of dry eye patient.

1. Stephen M Cohen. Dry eye signs and symptoms often inconsistent. *Primary Care Optometry News*; Online 1 Nov 2008.

Choosing the right solution to avoid SICS and ocular hypersensitivity with silicone hydrogels may depend on patient-specific characteristics

No easy road to biocompatibility

Narelle Hine
DipAppSc (Optom) MSc
DCLP FAAO

Fifty per cent of our new contact lens patients and 52 per cent of our refitted patients are fitted with silicone hydrogels, according to recent surveys (CLIC 2008). The greatly improved physiological performance by these first and second generation lens materials in terms of no detectable hypoxia even during closed eye wear, less hyperaemia, less dehydration and greater comfort makes silicone hydrogels a logical clinical choice for all two-week and monthly disposable wearers where available.

The improved biocompatibility is expected to translate into happier, healthier lens wearers returning for after-care.

Why then did an estimated 20 per cent of newly dispensed silicone hydrogel wearers return to my practice within two to four weeks, complaining of discomfort, dryness, redness and reduced wearing time?

Biomicroscopy confirmed allergic inflammation of the conjunctiva, limbus and sometimes central cornea with fluorescein punctuate staining typical of solution induced corneal staining (SICS) as described by Carnt and colleagues.[1] Some patients also presented with heavy front surface lens deposits of mucin and lipo-proteins resulting in contact lens induced papillary conjunctivitis (CLPC). A few patients who showed ocular surface staining or injury were asymptomatic, which emphasises the need for diligent patient after-care, especially within the first month of dispensing. Patients with SICS reportedly have three times the risk of developing corneal infiltrates.[1,2]

Consistent with type I and type IV allergic responses, the ocular hypersensitivity resolved rapidly after several days of discontinuation of contact lens wear and returned within hours if the eye was exposed to a new lens previously soaked in the specific multi-purpose solution (MPS).

Were the minority of patients showing hypersensitivity response sensitive to the material or to the MPS, or to the combined interaction of the two?

One of my cases (GM), a -2.00 D myope, had successfully worn Proclear multifocal lenses in combination with Complete disinfecting solution. After complaints of mild dryness, I refitted him with PureVision (Balafilcon) multifocal lenses and he continued with his customary Complete solution. After one week, his wearing time had been reduced to four hours due to dryness and poor vision accompanied by increased mucous secretion and redness (Figure 1). There were mild tarsal plate changes, corneal SPK and conjunctival staining (Figure 2).

New PureVision lenses were dispensed with a change to Optifree Express MPS based on Polyquad. The symptoms did not return, indicating that patient GM was not sensitive to the lens polymer itself. Some months later, GM swapped to Aquify MPS and again the filmy vision and sticky eye feeling returned after one week.

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Figure 1. Cytotoxic allergic conjunctivitis

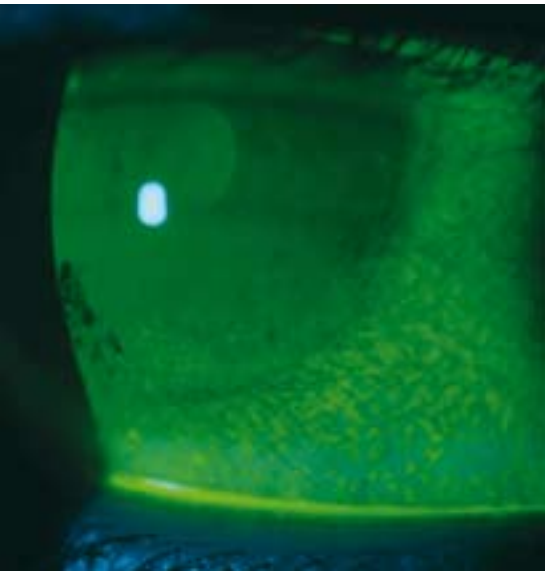

Figure 2. SICS solution induced corneal and limbal staining

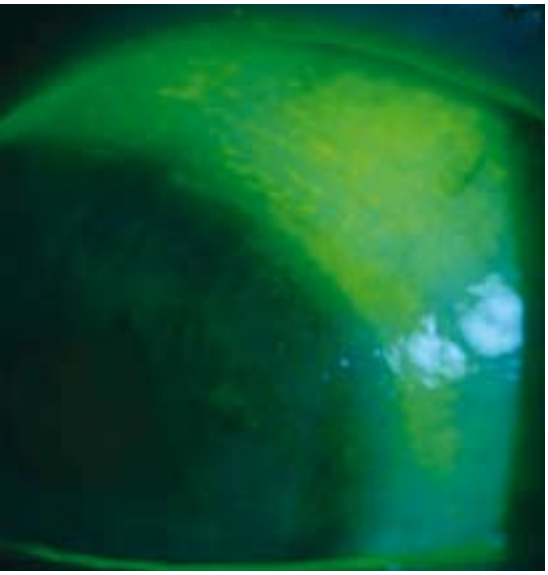

Figure 3. Cytotoxic limbal stain with Acuvue Oasys wearing eye

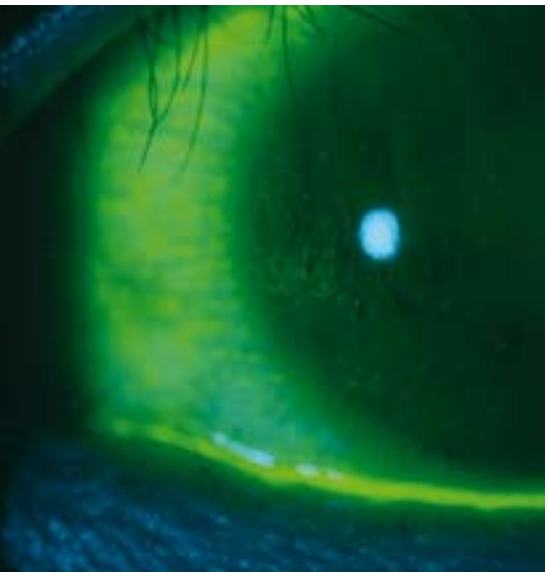

Figure 4. Cytotoxic stain in Acuvue Advance wearing eyetoxic staining

No easy road to biocompatibility

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This suggests that the Complete chemical formulation somehow interacted with the PureVision (Balafilcon) lens to cause ocular surface inflammation, increased lens deposition and reduce wetability in a way that did not occur with the Proclear lens matrix/surface for this patient. The adverse response indicates an incompatibility of Balafilcon material with Complete MPS for this patient.

The same biocide base polyhexamethylene biguanide (PHMB) is found in both Aquify and Complete, which may account for the similar result when used by this patient with the Balafilcon lens. PHMB, in the form of ReNu disinfecting solution, has been previously implicated in the disruption of epithelium: it was associated with a high proportion of SCIS when used in combination with PureVision[3,4] and Focus N&D.[5]

Variation in severity of SICS will occur with different silicone hydrogel polymers with the same patient using the same MPS. This was demonstrated by patient MH. Using Aquify MPS for one week, the eye wearing Acuvue Oasys (Figure 3) showed mild redness, significant limbal and corneal staining compared to the lesser response in the eye wearing Acuvue Advance (Figure 4). Repeating the lens trial with new lenses and replacing Aquify with hydrogen peroxide AOSept resulted in no staining for either eye. This suggests that neutralised hydrogen peroxide disinfected lenses release negligible residual biocide, therefore avoiding an inflammatory toxicity response such as SICS.

The cytotoxic response of SICS has been ascribed to the ability of silicone hydrogel lenses to absorb and concentrate disinfectant/lubricant solution biocides into the lens matrix and to subsequently release these concentrations onto the ocular surface on insertion.[2,4]

The rate and concentration of biocide release varies according to molecular size of biocides and compounds, ionic charge and structure of the lens polymer. For example, PHMB biocide found in Complete, ReNu and Aquify is a relatively small molecule and has a strong poly-cationic (+) charge allowing more active absorption by the lens matrix as well as enhanced binding to anionic sites on the eye surface and lens lipid deposits compared to the larger, less cationic Polyquad used in Optifree.[6]

Interest is also growing in the cytotoxic effect of buffers used in solutions, such as sodium borate buffer of ReNu, for example, versus the lesser reactive sodium phosphate buffer such as Aquify and Complete.

The Table (right) reports the results of the IER Matrix Study to investigate the incidence of SICS during three months of wearing various commonly prescribed lens/solution combinations by 40 patients.[1] Clearly the risk of SICS was least for all four silicone hydrogel lens materials studied when hydrogen peroxide was the assigned disinfectant. The table shows that some specific polymer/MPS combinations caused less risk of SICS than others. For example, while Aquify outperformed Optifree Express or Optifree Replenish with Acuvue Oasys and O_2Optix lenses, it was least compatible with PureVision (Balafilcon) whereas Optifree MPS was more compatible with PureVision than Aquify.

The risk profile in the Table shows that the interaction of a given silicone hydrogel material with components of a specific MPS solution will not trigger an ocular hypersensitivity response in all wearers.

Recently in my practice several patients successfully using Optifree Express with their silicone hydrogel lenses (O_2Optix and Acuvue Oasys) suddenly developed intolerance to lens wear within weeks of swapping to the new Optifree Replenish solution, yet the majority of users continued successfully. This demonstrates the crucial role played by patient-specific characteristics that may include tear clearance rates and sensitivity of the immune system. Drier-eyed patients

are likely to be more susceptible to SICS when using an MPS with silicone hydrogels because they lack the tear volume to rapidly dilute and remove compounds eluted by the lens matrix on eye. They may be safer using a lower risk hydrogen peroxide system of disinfection (Table) to enjoy the benefits of silicone hydrogels.

Combined use of some MPS and preserved lubricants with lenses will also create cocktails that may result in unexpected SICS and discomfort. To realise the potential benefits of silicone hydrogels we must be familiar with the active ingredients of solutions such as biocides and buffers, and aware of their known interactions and contraindications for use in combination with a given silicone hydrogel material.

2. Choose the reputable MPS we bought on bulk purchase offer.
3. Choose the same solution the patient previously used with their lenses.
4. Choose the solution with least risk of SICS for the chosen design using the results of the IER Matrix Study.
5. Choose only hydrogen peroxide disinfection for silicone hydrogels.

Research suggests that strategies 4 and 5 are the most likely to avoid SICS and ocular hypersensitivity with silicone hydrogels. For patients presenting with ocular hypersensitivity response, the evidence suggests that the faster road to success with silicone hydrogels is to first explore the option of issuing fresh lenses and changing the MPS before refitting the lens design.

The IER Matrix Study: Corneal staining				
Solution-induced corneal staining per month with the combination*				
Lens/solution	**Clear Care**	**AQuify**	**Opti-Free Express**	**Opti-Free RepleniSH**
Acuvue Advance	0.0%	0.9%	0.0%	0.0% (2W)
Acuvue Oasys	0.9% (2W)	2.6% (2W)	6.2%	7.1% (2W)
O_2Optix	0.5%	3.2%	5.9%	6.7%
PureVision	0.9%	23.2%	11.3%	14.2%
Night & Day	1.7%	0.9%	7.2%	6.7%

lower quartile inner two quartiles upper quartile

* percentage of patients per month showing lens care related staining in the first three months of lens wear
2W = two-weekly replacement

Incidence of SICS after one month: silicone hydrogel material versus care solution. Reproduced with permission Institute of Eye Research.

Choosing disinfectants and lubricants from the same product range, which share the same biocides and buffers or adhering to preservative free products where possible would help ensure more biocompatible outcomes.

Success with silicone hydrogels is not assured by simply dispensing a well-fitted design and issuing an MPS for disinfection, as was the case with earlier non-silicone lens materials.

On which basis should optometrists select the care system to minimise risk of adverse response?

1. Choose any one of the top four MPS because they are all similar in efficacy.

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Upgrade lenses to alleviate symptoms

Refitting hydrogel contact lens wearers with silicone hydrogel lenses may eliminate the component of dry eye that is lens induced.

A study, published in *Optometry and Vision Science*,[1] is unique as it offers projection of a real-world estimate of how much of the symptom burden in contact lens wearers can be alleviated with a change of contact lens material.

Comparing before and after symptoms reported with refitting silicone hydrogel contact lenses to the cross-section of symptoms previously reported between non-wearers and contact lens wearers gives a reasonable estimate of the expected improvements in symptoms as a result from a change in lens material.

Contact lens wearers were approximately twice as likely to report high frequency of dryness compared to an age- and gender-matched group who did not wear contact lenses. Approximately half of the subjects who reported 'high frequency' of dryness during the day or end-of-day reported a reduction in frequency symptoms when changing to a silicone hydrogel lens.

The findings may be limited by their reliance on subjective reports. The dry eye patient is the only observer of their own symptoms and the clinician cannot directly measure or verify such sensations. Independent variables associated with contact lens wear means it's impossible to design a generic contact lens validation study for any one questionnaire. Lens material, lens design, lens care system and wearing schedule may interact with each other and have large bearing on the specific descriptors and study findings.

Based on data from non-wearers, elimination of all ocular dryness symptoms by wearing silicone hydrogel lens is not a reasonabe goal or expectation.

1. *Optom Vic Sci* 2008; 85: 778-784

Dr Gunter Wong
MOptom PhD

Office environments tough on dry eye

Your advice can help patients relieve the symptoms of dry eye in the workplace

Eye irritations such as dry eye are common in office environments. The cause of eye irritations is multifactorial. Symptoms include stinging, scratchy, burning, dry, sore, gritty and itchy eyes. Control of office environment, workstation design and appropriate treatment plan helps relieve these symptoms.

Several factors are associated with dry eye in office environments.

Low relative humidity

Sustained low relative humidity causes impairment of precorneal tear film, resulting in an increase of tear evaporation rate. It has been shown that a 20 per cent decrease of relative humidity will increase the rate of tear film evaporation by 100 per cent, and relative humidity greater than 40 per cent helps stabilise tear film and reduce irritation caused by desiccation.[1,2] However, relative humidity larger than 60 per cent should be avoided because of the higher risk of dust mite proliferation.[3]

High room temperature

It has been suggested that a one degree Celsius decrease in room temperature is associated with a 19 per cent decrease of reported eye symptoms.[4] Elevated room temperature will disrupt stability of the lipid layer of tear film.[5] A room temperature between 20 and 22 degrees may reduce eye irritation symptoms by avoiding excessive tear film evaporation.[6]

Indoor air velocity

High horizontal or downward air velocity along the head region increases evaporation of water from the eye, causing dry eye symptoms.[7]

VDU work

Blinking is essential in coating and redistribution of the tear film at each blink. Computer users are more likely to be suffering from dry eye symptoms because of changes in blinking pattern during VDU work. Studies show that blink frequency can be reduced by a factor of two to three times during VDU work[2] and is dependent on the type of computer tasks.[8,9] Blink frequency during an active computer task with demands on vision and hand-eye co-ordination is 69 per cent lower than during a passive task like watching a film on a VDU.[8,9] Squinting at a computer screen may further reduce blink frequency by half.[10]

Squinting can provide two benefits: it improves visual acuity and decreases retinal illumination from glare sources. However, the more people squint, the less they blink. A reduction of blink frequency will result in tear film thinning and allows formation of dry spots on the cornea, causing an increase of dry eye symptoms.

Contact lens wear

Forty-three per cent of soft contact lenses wearers have dry eye symptoms.[11] Higher tear evaporation with contact lens wear is a major factor contributing to contact lens induced dry eye. It has been found that tear film evaporation at normal relative humidity (40 per cent) with contact lenses is similar to the evaporation at low relative humidity (30 per cent) without contact lenses.[12] This means contact lens wear can be equated to putting someone in a low humidity environment, when in fact the environmental humidity is normal.

Make-up

There is a significant association between the use of eye make-up and a thin lipid layer of the tear film. It has been proposed that oils in the eye make-up may be able to displace the phospholipids and influence the formation of lipid layer on the cornea.[13]

Reduce symptoms in office

To reduce irritations and dry eye symptoms in office environments, the following preventive measures and intervention can be considered.

Workstation

Maintenance of relative humidity is important. A relative humidity level above 40 per cent helps maintain tear film stability.

Lowering room temperature may reduce tear film evaporation. The optimal room temperature is between 20 and 22° C.

Avoid ventilation directed at your eyes. Adjust the position of the monitor. Downward gaze may minimize loss of water from the tear film. It has been found that lowering the gaze angle by 25 degrees decreases the exposed area by seven per cent during an active task.[9]

Change font and font size of characters displaced on the monitor to avoid squinting. Among the different fonts, Verdana and Arial have been shown to be the most legible while Times New Roman and Franklin are the least legible.[14]

Remove any bright light glare on the computer screen by moving the screen, lowering the light level or using an anti-reflection screen. Make sure that the computer monitor screen is not in front of a bright background (for example, a bright window). Glare source will induce squinting, which is strongly associated with a reduction of blink frequency.

Alternate between work with a high and low degree of visual and cognitive demands. A computer task with high visual demands will reduce blink frequency more significantly.

Small breaks every one to two minutes and exercise of complete blinks help restore normal tear film stability.

Ophthalmic intervention

Lubricating eye drops may be used in treatment of dry eye symptoms from different causes. New eye drops containing lubricating agents such as PEG-400 (blink Intensive Tears, AMO) are well proven to relieve dry eye symptoms.[15] Preservatives found in artificial tears may be harmful to corneal epithelium and can cause irritations.[16,17] A preservative-free eye-drop or an eye-drop with preservatives that will decompose into natural tear ingredients when instilled on the eyes is recommended. An example of decomposable preservatives is stabilised oxychloro complex, SOC, (for example, OcuPure, AMO). When exposed to light, SOC will be converted into sodium ions, chloride ions and water. It has been shown that SOC produces fewer observable effects on the morphology of rabbit corneal epithelial cells compared to other products tested.[17]

The use of high water content lens materials has been found to be strongly related to dry eye in lens wear.[18] The odds of developing dry eye for high water content contact lens materials is two to three times greater than that associated with nonionic, low water content. Lens surface characteristic may also have an impact. The non-ionic high water content lens materials in general are more associated with dry eye than the ionic high water content lens materials.[18] Refitting patients with silicone hydrogel lenses may be helpful.[19]

Manage near point stress to prevent squinting (for example, near spectacles).

Other intervention

Because dry eye symptoms are associated with a reduction of blink frequency during intensive VDU work that requires a high level of mental alertness, it has been proposed that specific 'relaxation' exercises such as yoga can relieve visual discomfort during the use of computer by restoring blink frequency towards normal.[20] ■

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PUNCTAL PLUGS
Remedy for the right

With care and minimal training, optometrists can treat certain types of dry eye with punctal plugs. It is considered a simple and safe technique if you understand the risks involved. 'It is simple plumbing,' says Penguin optometrist Daryl Guest. 'All you are doing is making the current tear film more bio-available.'

Suitable candidate

Punctal and intracanalicular occlusions are appropriate only for certain patients with aqueous abnormalities so making a correct diagnosis is integral to success. The procedure is most appropriate for treating lacrimal dry eye when the patient has a severe deficiency in tear volume produced by the glands of the conjunctiva.

'I look for patients with moderate to severe dry eye but without significant ocular surface disease,' says Guest. 'Often they have tried a range of treatments that have been ineffective or effective only for short periods.'

Guest says that there is not one definitive test to evaluate dry eye. He uses a range of techniques in qualitative and quantitative assessments of the tear film that investigate tear river and tear break-up time, staining patterns, meibomian gland secretions and the extent to which the bulbar conjunctiva is injected. He estimates that although only five per cent of his dry eye patients fit the profile, the impact he has on the quality of life for those he treats is significant.

If the puncta is inappropriately plugged in mild cases of dry eye, Guest says the patient will experience epiphora, which is an overflow of tears onto the cheeks. This is a result of inadequate drainage during periods when the tear film flow is normal.

Gary Oshry

patient

Epiphora is usually determined during the initial trial period.

Patients with meibomian gland dysfunction who experience periodic periods of mild to moderate dry eye caused by air-conditioning, windy conditions or medication often can be treated simply with a tear supplement, he says.

Trial period

Guest's patients undertake two stages of trials using temporary collagen plugs to see whether plugging the puncta will alleviate the symptoms of dry eye, after which the patients either progress to permanent plugs or are referred for further treatment.

'In the first trial I do not tell the patient how long the collagen plugs will last,' says Guest. 'I ask patients to apply the drops and write in a diary how they feel at the end of each day. After a fortnight they came in for a review and we discuss the results.

> **Plugging does not replace therapy; it is an adjunct to therapy.**

'During the first week, patients will notice a significant enhancement in the effectiveness of their tear supplement drops. The collagen plugs dissolve after seven days and the dry eye symptoms will return but the patient doesn't know why. The collagen plugs dissolve at different rates for different patients so it may be that one eye feels better for longer periods than the other.'

After the first trial Guest explains to the patient what has occurred and then repeats the process. Some optometrists choose to insert the collagen plug in one eye only and compare the results but Guest believes that if patients really want the plugs, the psychological effects of knowing will cloud their perception.

'It does require a commitment from the patient but those who request plugging are looking for a solution,' says Guest. 'Many have seen several practitioners, tried drops and nutritional supplements but the daily annoyance of dry eye persists.'

Patients can use punctal plugs in conjunction with contact lenses, according to Guest. Considering the high drop-out rate of contact lens wear caused by dry eye, this is an important finding. Guest has had more success using punctal plugs with silicone hydrogel lenses than with hydrogel lenses.

Risks and side-effects

The risks associated with punctal plugs are minimal. Guest says his biggest concern is that plugging the puncta restricts movement of tears or drops, such as Restasis, though the lacrimal sac. For this reason Guest does not plug the upper puncta so at least 20 per cent of tear flow is still possible. If infection occurs, the plugs can be removed and the system flushed with antibiotics. Patients should he warned that dacriocysistitis is also a major potential complication.

It is common for the punctal plugs to fall out, especially with silicone plugs. Guest says this occurs in 20 to 30 per cent of cases and replacements can be costly for the patient, as they are about $150 to $200 a pair. The thermo plugs are less likely to dislodge but if infection occurs they are more difficult to flush through the system.

To prevent plugs falling out, Guest uses a punctal gauging system sizing tool to accurately match the plug to the size of the puncta, although with the intracanaculor inclusion the thermo plugs fit in the canacular so sizing is less critical.

After-care

'Patients are still required to use drops,' says Guest. 'Plugging does not replace therapy; it is an adjunct to therapy. Instead of the drops lasting 20 minutes, they may now last one and a half to two hours.

'Managing patient expectations is important,' says Guest. 'Patients want the magic bullet but with dry eye this doesn't exist.' ■

At a glance

Types of plugs

- **Collagen intracanicular**
  Dissolvable punctal/canalicular collagen inserts can be used to evaluate the benefits of permanent punctal occlusion. The collagen inserts are effective for three to five days and dissolve in about seven to 10 days.
- **Extended duration**
  Effective 60 to 180 days. Made of E-Caprolactone-L-Lactide copolymer (PCL), these are ideal for treatment of post lasik induced dry eye, seasonal dry eye and retention of ocular medication.
- **Silicone**
  Most silicone punctal plugs are umbrella-shaped and the top part of the punctal plug rests on the eyelid surface.
- **Thermo**
  Used as a permanent punctal occlusion, these one size fits all plugs expand in the canaliculus after insertion to block tear drainage.

Contraindications

- allergy to bovine collagen (temporary plugs)
- allergy to silicone
- infective conjunctivitis
- dacryocystitis
- inflammation of the eyelid
- epiphora

Fees

Guest bulk bills consultations and charges a nominal fee of about $30 for the collagen plugs, which covers the trial and incidentals. The silicone punctal plugs will cost the patient between $150 and $200 a pair. Health fund rebates are determined on a case by case basis.

Guest says he has written many letters to health funds but because they do not have an item for punctal plugs when prescribed by optometrists, payment is at the fund's discretion.

Tear film osmolality

Further research on osmolality is needed to help us understand ocular discomfort and dryness sensation during contact lens wear

Ulrike Stahl
DipAO (Germany)

Complaints about dryness and ocular discomfort by contact lens wearers are common and have prompted numerous research studies. Up to 75 per cent of contact lens wearers complain about bothersome symptoms such as dryness or discomfort, often leading to a reduction in wear time or cessation of lens wear.[1-3]

In an attempt to understand contact lens related dryness and discomfort symptoms, discussion has focused on whether dryness experienced during lens wear is similar to that of keratoconjunctivitis sicca and should be regarded in the same way.

In 2007, the Dry Eye Workshop[4] classified contact lenses as one cause of dry eye, triggering alterations to tear film and ocular surface characteristics. Typical changes observed in dry eye patients and contact lens wearers include a decreased tear film break-up time or thinned lipid layer, possibly causing excessive tear film evaporation.

Tear film osmolality is a unique tool to assess the balance of tear film dynamics driven by tear production, drainage, absorption and evaporation.[5] Osmolality is the number of dissolved particles in one kilogram of solvent,[6] and the osmolality of tears is mainly determined by electrolytes such as sodium, potassium, magnesium and chlorides, with its main contributor being sodium chloride.[7]

> **Tear film osmolality is considered one of the core mechanisms causing ocular surface inflammation and has been recommended as a main diagnostic factor in dry eye disease.**

Confusion has arisen with the interchangeable use of the terms osmolarity and osmolality. Although tear osmolality (moles per kilogram of solute) is the preferred term due to its temperature independence, and it is also slightly higher (five per cent) than tear osmolarity (moles per litre of solution), for clinical purposes both measures can be treated as equivalent.[8]

An increase in tear osmolality, an expression of increased salt concentration, can often be seen in dry eye and has been suggested as a cause of ocular discomfort,[4,9] corneal and conjunctival changes[10] and the release of proinflammatory mediators.[11,12] Currently, tear film osmolality is considered one of the core mechanisms causing ocular surface inflammation and has been recommended as a main diagnostic factor in dry eye disease.[13] Research in tear osmolality in contact lens wear has shown increased osmolality in daily and extended wear of both soft and hard contact lenses.[14-16]

Recent studies have demonstrated elevated tear osmolality in lens wearers who complain of discomfort, and an association between dry eye status during lens wear and the level of tear osmolality.[17,18] Contact lenses have the potential to lower corneal sensitivity, ultimately leading to decreased tear production,[19] and can disrupt the highly organised tear film leading to increased tear thinning times and consequently higher evaporation.[18] Therefore, the main reasons for increased tear osmolality in contact lens wear seem similar to those in dry eye. The impact of the osmolality of the lens itself on ocular discomfort is unclear and is under investigation at the Vision CRC and Institute for Eye Research at the UNSW.

During normal conditions, contact lenses are covered by a thin tear film but when the tear film on the contact lens surface breaks up, the lens surface can be exposed to air, resulting in evaporation and possibly increased lens osmolality.

A study[20] involving 15 subjects each wearing nine different contact lens materials showed a significant association between the osmolality of the worn lenses and ocular comfort after six hours of wear. Increased contact lens osmolality was associated with

decreased comfort. In general, symptomatic lens wearers had a higher contact lens osmolality than asymptomatic lens wearers.

An increase in tear osmolality could also be observed during lens wear, and ranged between 318.1 and 326.4 mmol/kg. Although these values were above the suggested cut-off value for dry eye (316 mmol/kg)[21] and symptomatic lens wearers had higher osmolality values, this study failed to show a clear association between tear osmolality and comfort.

Increased contact lens osmolality was also associated with greater lens-induced indentation of the conjunctiva. Particularly within the silicone hydrogel lens group, material characteristics such as water content were associated with contact lens osmolality, leading to the hypothesis that a wearer may benefit from a different contact lens material.

Ocular discomfort during contact lens wear seems to be caused by a multitude of factors, including increases in tear film and contact lens osmolality. Current investigations are underway to assess the efficacy of hypo-osmotic drops and of increasing tear volume using punctal plugs to decrease contact lens osmolality and consequently enhance ocular comfort during contact lens wear.

A better understanding of this phenomenon and how comfort can be modified may ultimately assist practitioners in advising and fitting their patients.

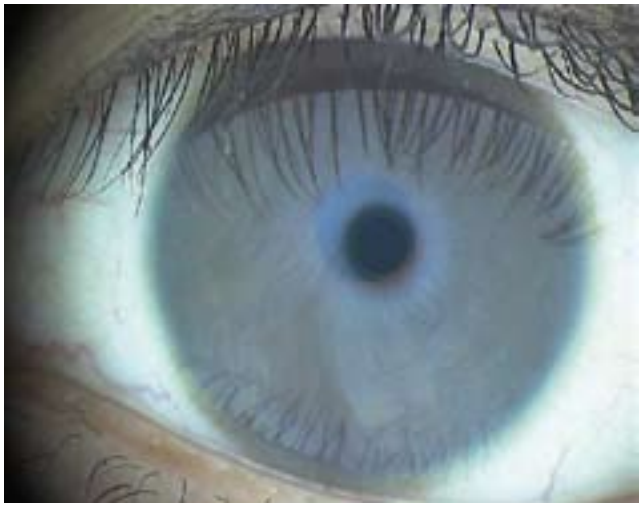

Figure 1. Complete and stable tear film across contact lens surface

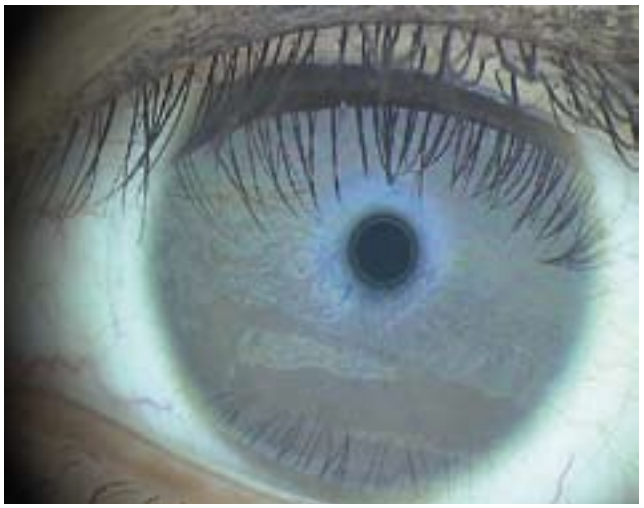

Figure 2. Tear film break-up over contact lens surface partly due to incomplete blinking

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Ocular drug delivery

Successful treatment of eye disease requires effective concentration of drug to the eye for sufficient periods of time. Treatment of ocular surface infection, inflammation and dry eye requires effective drug delivery to the eyelids, conjunctiva or cornea. In contrast, treatment of uveitis, glaucoma or retinitis involves therapeutic drug levels at sites deep within the globe.

Imprecise and inconsistent delivery can reduce significantly the effectiveness of ocular drugs and lead to contamination and injury. The key to successful treatment is finding the right balance.

Although many systems have been developed specifically for drug delivery to the eye, most of them suffer from lack of precision, and those associated with intraocular drug delivery can lead to unacceptable toxicity. This article reviews the most clinically useful drug delivery systems along with the benefits and downfalls of each.

Topical administration

The most common route of administration of ophthalmic drugs is via topical application due to its convenience, simplicity and non-invasiveness. Patients can also administer the medication themselves. Although topical drops are much more convenient and simple, they wash away easily and therefore less than five per cent of the applied drug reaches the anterior segment of the eye, with an even smaller fraction reaching the posterior segment of the eye.[1] The most commonly used topical ophthalmic drug delivery systems include solutions and suspensions, gels, ointments, contact lenses and insertions.

Solutions and aqueous suspensions are the pharmaceutical forms most widely used to administer drugs that must be active on the eye surface or in the eye after passage through the cornea or conjunctiva.[1,2] Ophthalmic suspensions are sterile preparations of drug with low water solubility dispersed in a liquid vehicle. Suspensions are different from solutions as they must be resuspended by shaking to provide an accurate dosage of drug.

The advantages of these drug delivery systems include ease of administration by patients, minimal blurring of vision for the patient, immediate activity due to the drug being in the dissolved state, and fewer potential complications than other delivery methods.

Disadvantages of topically applied solutions and suspensions include short ocular contact time, imprecise and inconsistent delivery of drug, frequent contamination and the possibility of ocular injury with the dropper tip. In addition, poor ocular bio-availability can occur due to rapid and efficient drainage by the nasolacrimal apparatus, non-corneal absorption, and the relative impermeability of the cornea to both hydrophilic and hydrophobic molecules.[2]

To help minimise these disadvantages and promote more potent ocular drug absorption, a proper instillation technique is critical. The patient's head should be inclined backward so that the optical axis is nearly vertical. With the lower lid retracted and the upper lid stabilised, the patient should be instructed to look up toward their forehead to move the cornea away from the instillation site, which will minimise the blink reflex.

The solution or suspension is instilled into the cul-de-sac that is formed with the lower lid retraction. The dropper tip should be kept at least two centimetres from the globe and lashes to avoid contact contamination.

After the drop is instilled, the patient should be advised to close their lids gently while avoiding lid squeezing. Pressure should be applied with the fingertips over the puncta and canaliculi to minimise nasolacrimal drainage. Nasolacrimal occlusion should be maintained for two to three minutes.

Studies have shown that simple eyelid closure alone significantly retards medication drainage and thereby minimises potential side-effects associated with systemic drug absorption.[2,3] When nasolacrimal occlusion is used in conjunction with eyelid closure, intraocular drug absorption may be enhanced.

Ocular ointments and gels prolong the corneal contact time of many drugs administered by topical ocular route, thereby prolonging the duration of action and enhancing ocular bio-availability of drugs.[4]

To properly instil an ointment, patients are instructed to elevate the gaze with the lower lid retracted and instil the ointment into the inferior conjunctival sac. When applied to the inferior conjunctival sac, ophthalmic ointments melt quickly and the excess spreads out onto the lid margins, lashes and skin of the lids.

Contact dermatitis often results and is one of the most common complications associated with ointment use. Immediate removal of excess ointment not in contact with the globe will help relieve this problem. Blurred vision is another common adverse effect from ophthalmic ointments and gels. Therefore, patients should be instructed to wait for a minimum of five minutes after instillation before driving or performing other visually demanding activities.

Although it was once thought that ointments were not eliminated through the nasolacrimal drainage system, this has since been disproved. Ointments travel through the nasolacrimal drainage system, although at a much slower pace than solutions or suspensions. This promotes slower systemic absorption, which explains why systemic drug toxicity is much less common with topical ointments compared to solutions.

Contact lenses can absorb water-soluble drugs when soaked in medicated solutions. These drug-saturated contact lenses then release the medication for longer periods. Currently, disposable soft contact lenses are used for drug delivery and appear to be of greatest clinical value in the treatment of

challenges

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dry eye syndrome, bullous keratopathy and corneal conditions requiring protection.

The traditional ophthalmic systems like aqueous solutions, suspensions and ointments are associated with pulse entry type drug release behaviour in the eye, which is characterised by transient overdose, relatively short periods of acceptable dosing, followed by prolonged periods of under-dosing that leads to decrease in bio-availability.[2]

Ocular insertions overcome this disadvantage by providing more controlled, sustained and continuous drug delivery by maintaining an effective drug concentration in the target tissues while at the same time minimising the number of applications.

Developed for treating dry eye syndrome, Lacrisert (hydroxypropyl cellulose ophthalmic insertion, Aton Pharma, Inc.) is an artificial tear insertion that is inserted into the inferior conjunctival fornix. After placement into the conjunctival sac, its hypertonicity causes it to absorb basal tear production and fluid from the capillaries of the conjunctiva and it consequently swells, becoming a gelatinous mass. In most patients, the duration of action is about 24 hours with once-daily application enough to relieve the dry eye symptoms.[2]

Lacrisert is useful for patients with moderate to severe dry eye syndrome for whom conventional therapy has failed. Common side-effects of Lacrisert include blurring of vision four to six hours after insertion, along with local discomfort or foreign body sensation.

Periocular, intracameral and intravitreal injection

When higher concentrations of drugs—particularly corticosteroids, antibiotics and antivirals—are required in the eye than can be delivered by topical administration, local injections into the periocular tissues, anterior chamber and vitreous can be considered. Localised pain along with bleeding and bruising at the injection site are common side-effects of periocular injections.[5,6] Conjunctival haemorrhage, endophthalmitis, retinal detachment and traumatic cataracts are the most common or concerning side-effects of intravitreal injections.[5,6]

Successful treatment of ocular disease requires effective concentration of drug at the eye for specific periods of time. Drug bioavailability is critical and is often hampered by quick drainage by the nasolacrimal apparatus, non-corneal absorption and the relative impermeability of the cornea to hydrophobic and hydrophilic molecules.

Steps must be taken to make certain that proper amounts of drug remain for effective treatment, while making sure that excessive doses of drug do not cause toxicity to the ocular tissues. This fine balance continues to create a great challenge for clinicians in the treatment of ocular disease.

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Success rate 70% with plugs

The application of punctal plug treatment in dry eye patients with short tear break-up time (TBUT) completely resolves symptoms of dry eye in 70 per cent of cases.

A study[1] has tested punctal plug occlusion when treating short TBUT dry eye in patients with visual symptoms such as visual blur, inability to perform visual tasks for long periods and eye fatigue.

Patients selected for this study had normal Schirmer test scores, minimal vital staining but persistent visual and dry eye symptoms despite treatment with non-preserved artificial tears drops for one month.

Results show that 70.4 per cent of eyes had satisfactory outcomes with punctal plug treatment and had complete resolution of visual symptoms and discomfort. Of the remaining 29.6 per cent of eyes, 75 per cent of patients had epiphora.

Although epiphora may interfere with vision quality, no significant relationship could be found between epiphora and tear function such as Schirmer test value, tear clearance, ocular surface vital staining scores and tear stability. Consequently, there is no definitive indication of when punctal plug occlusion should not be carried out on patients with short TBUT dry eye.

The study also concluded that functional visual acuity after punctal plug insertion improved significantly.

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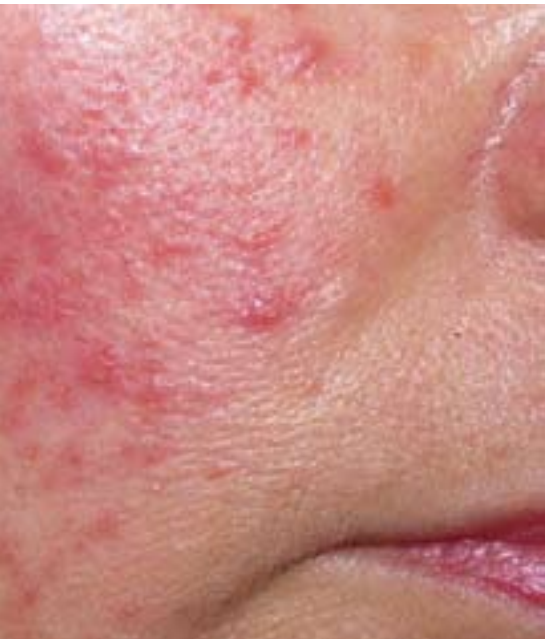
Rosacea not just skin deep

Ocular complications such as dry eye and contact lens intolerance may relate to skin type so it is important to look at the big picture

Annette was a fair-skinned 33-year-old contact lens wearer reporting blurred vision with spectacles but relatively trouble-free contact lens wear. She wore fortnightly third generation silicone hydrogel contact lenses on a daily basis and replaced monthly, and used hydrogen peroxide disinfection. Since becoming pregnant, she had been wearing spectacles more often.

Annette used a Symbicort inhaler for asthma and had previously taken the contraceptive pill.

Spectacle correction of R -4.25/-1.00x80, L -4.25/-0.25x85 gave acuities of 6/6= and 6/6, respectively.



The contact lens fit and power appeared appropriate and vision with the spherical contacts was 6/6=, 6/6=.

Both corneas showed a small amount of scattered punctate fluorescein staining and the left contact lens had some subtle small non-specific deposits.

She used tear supplements intermittently.

She was advised that marginal dry eye with some tear film instability and use of tear supplements possibly caused the filmy appearance of her vision with spectacles. Only part-time contact lens wear was recommended at this stage.

After five months, Annette reported that her left eye was producing mucus and she felt as if there was a foreign body under the upper lid. Both corneas showed scattered punctate staining with several larger areas of stain in the right eye. Upper tarsal conjunctivae showed mild to moderate papillae. No foreign body was found.

Hot compresses and lid hygiene bid, cessation of contact lens wear and increased use of unpreserved lubricants were instituted.

Annette did not attend the review appointment. When contacted by phone, she said she felt more comfortable after the consultation so did not avoid contact lens wear. She thought the lid eversion may have dislodged the foreign body and felt tired and uncomfortable when wearing spectacles.

She made an appointment to return so her corneas could be checked but did not appear until four months later when she needed a resupply of lenses. After further questioning, Annette remembered an episode of contact lens intolerance some years before. She had also suffered scalp psoriasis.

There was a rosacea type flush on both cheeks. Superficial punctate keratitis was present on both inferior corneas with significant upper tarsal papillae. A short course of fluorometholone qid with hot compresses and lid scrubs was instituted along with a break from lens wear.

At this stage there has been little progress in resolution of Annette's condition. The next step is likely to be aggressive treatment of what appears to be rosacea.

The case illustrates some general points regarding dry eye/blepharitis/contact lens intolerance. These problems may often relate to skin type and general health so it is important to look at the big picture.

There is no magic bullet; these conditions are often chronic, recurrent and obstinate. Our treatment of Annette was episodic rather than disciplined. In our defence, she had a history of broken appointments and not returning phone calls, but we all have non-complying contact lens patients and need strategies to safeguard their eye health.

What is rosacea?

Rosacea is a common facial rash most often affecting fair-skinned people with blue eyes and Celtic origin between the ages of 30 and 60 years. It is commonly persistent or recurrent and more frequent in females.

The distribution is often a butterfly pattern across the nose and cheeks. The severity of the rash varies from subtle reddening to pustular lesions on nose, forehead and cheeks, and on rare occasions can result in rhynophyma, an enlarged irregularly

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shaped nose with prominent pores and fibrous thickening.

The term 'acne rosacea' is a misnomer. Rosacea differs from acne in that the lesions are dome-shaped rather than pointed, with no blackheads, whiteheads or deep cysts.

Other markers of rosacea include telangectatic vessels, dry and flaking skin, and sensitivities to make-up, sunscreens, face creams, face oils and topical steroids. It may be aggravated by sun exposure, alcohol and spicy foods.

Causes of rosacea

The cause of rosacea is unknown, similar to blepharitis, which is associated with a minority of rosacea cases.

Theories regarding causes of overactive facial blood vessels cover many factors including genetic, environmental, vascular and inflammatory origins. Hair follicle mites are found in greater numbers in rosacea papules.

Ocular rosacea

In a minority of rosacea sufferers there is ocular involvement, including blepharitis, hordeolum formation, keratitis and, rarely, corneal perforation. The most common ocular effects are posterior blepharitis and inferior punctuate keratopathy.

Patients with these signs often exhibit thick yellow discharge from the meibomian glands with plugs in the gland openings. They will report red, irritated sore eyes with scratchy foreign body sensations and possibly photophobia. They may also be aware of the thick discharge on lids and lashes.

Treatment

If symptoms are low grade they may be treated locally. Hot compresses, gentle massage and lid scrubs twice daily can be used for the posterior blepharitis, with a course of fluorometholone drops if there are signs of keratitis. Omega-3 supplements are also widely used to increase tear production, stabilise the tear layer and help reduce lid inflammation. Various, unpreserved lubricants for tear film instability may also be beneficial. These measures may suffice to reduce mild ocular disease associated with rosacea.

Systemic treatment will be necessary in most cases where significant blepharitis and keratitis exist or in cases where a patient has not responded to previous treatment options. Tetracycline-type antibiotics reduce inflammation in rosacea. The most common treatment is Doxycycline taken daily for six to 12 weeks, depending on severity, with 100 mg for the first half of the course tapered to 50 mg for the second half.

It is important to warn patients to take these drugs with food to avoid possibly serious gastric and oesophageal irritation.

The antibiotics reduce inflammation and restore the function of meibomian glands rather than cure the rosacea. Sometimes further courses of antibiotics are needed for recurrences. Antibiotics such as metronidazole are prescribed for resistant cases. Other treatments include metronidazole cream or gel, and where antibiotics are not effective or are not well tolerated, oral isotretinoin, in low dose long term.

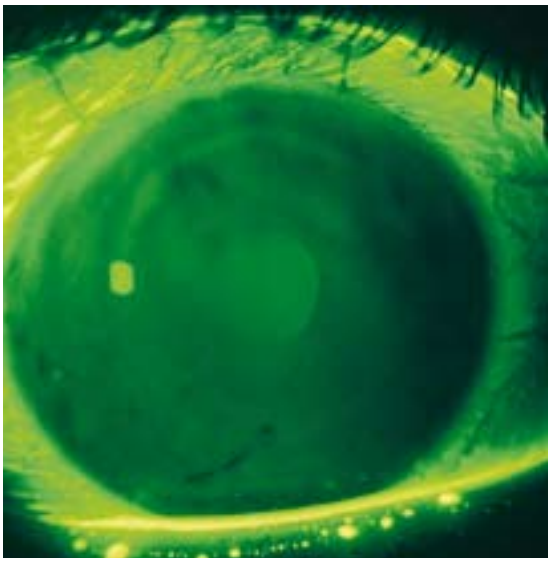
Isotretinoin is off-label when used for long-term treatment of rosacea, unlike when used for the treatment of cystic acne, so there will be a significant cost to the patient.

Some treatments to reduce facial flushing include use of the alpha2 receptor agonist clonidine to reduce vascular dilatation.

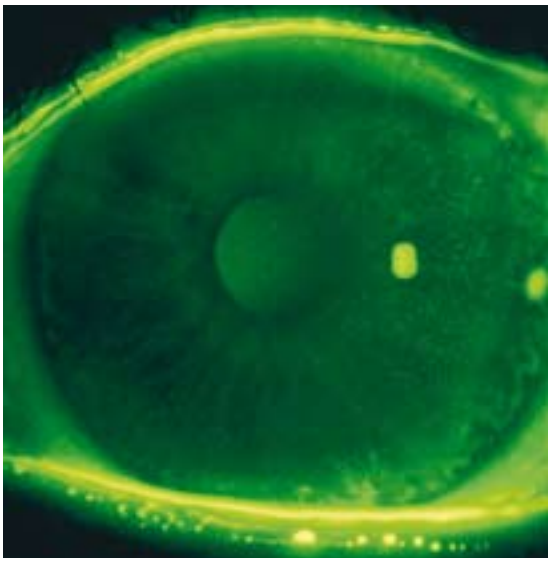
Persistent telangectasia can be reduced by vascular laser or intense pulsed light treatment and other cosmetic procedures.

Final thought

Any one of contact lens intolerance, dry eye, tear film instability, punctuate epithelial staining and meibomian gland dysfunction may be part of a bigger picture, especially in the rosacea demographic. It may prove insightful to look at the whole patient, their skin type and facial appearance, and ask about history of skin problems like facial rashes.



Mild papules



Moderate papules

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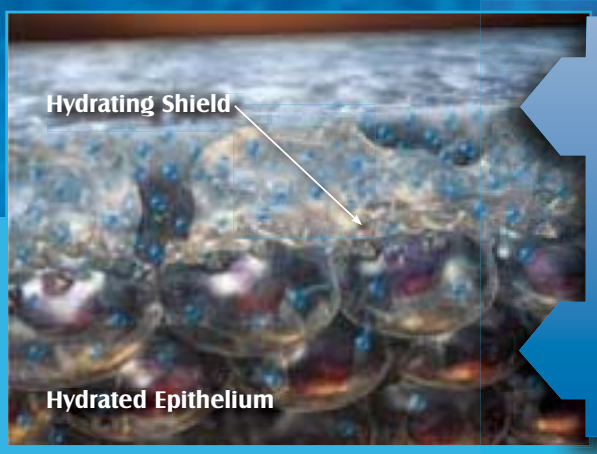

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Combat hyperosmotic stress

Boosting the cornea's natural protective mechanism can help curb the inflammatory process that causes chronic dry eye

The clinical condition of dry eye may result from a variety of factors ranging from a consequence of the normal ageing process to autoimmune disease, various eyelid conditions, and as a side-effect of many systemic medications.[1]

One of the most well-documented characteristics of dry eye is the fact that the tear film becomes hypertonic relative to its normal state and to the optimum osmolarity of the ocular surface cells.[2] Extensive research has demonstrated that a hyperosmolar tear film triggers a number of cellular responses, leading to activation of an inflammatory process that can produce a chronic dry eye condition.[3]

This type of hyperosmolar stress response is commonly experienced by many cell types in micro-organisms, plants and animals when exposed to changes in osmolarity of either the external or internal environment. As a defence mechanism, many types of cells increase synthesis and uptake of small non-electrolyte osmolytes, which allow the intracellular fluid to increase osmotic strength without uptake of additional electrolytes such as sodium.[4,5] Through uptake of these osmolytes, also called compatible solutes, cells are able to balance their internal and external osmotic strength without compromising cellular function.[6]

Recent research has demonstrated that corneal cells in tissue culture can be protected from hyperosmolar stress by the addition of one or more of these compatible solutes to the culture medium. In particular, corneal cells have been shown to be able to take up specific amino acids such as glycine betaine and carnitine, and specific polyols such as glycerin, erythritol and xylitol. When present these compatible solutes reduce the activation of MAP kinase signal molecules when the cells are exposed to a hyperosmotic medium.[7,8]

A dry eye treatment, Optive eye drops (Allergan), has taken advantage of this natural protective mechanism with inclusion of the compatible solutes glycerin, l-carnitine and erythritol in an isotonic formula without added sodium chloride. L-carnitine has been reported to be deficient in dry eye patients,[9] and clinical testing has demonstrated that Optive reduces the signs and symptoms of dry eye and produces long-lasting protection from dry eye symptoms.[10,11]

Prior treatments for hyperosmotic stress involved reducing the osmotic strength of the tear film by adding water using a hypotonic artificial tear. This strategy is limited due to rapid reversal of the tear film to its pre-dose hypertonic condition.[12]

Optive eye-drops are isotonic yet contain far less sodium than most tears. Instead of delivering excess water, they provide compatible solutes that are internalised and held by cells, protecting them from subsequent osmotic stress. Thus Optive provides an advanced treatment option suitable for dry eye patients.

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Omega-3 can correct the inadequacies in our diet but a specifically formulated supplement may be required to treat evaporative dry eye. **GARY OSHRY** investigates

Try a natural therapy

Water in a cup will evaporate in one week but if you add olive oil, the same volume of water with an oily film can stand for almost one year, claims Sydney optometrist Allan Ared. He says the function of oil contained in nutritional supplements will similarly inhibit evaporation in patients presenting with the evaporative form of dry eye and increase the time the tear film remains intact on the ocular surface.

Nutritional supplements formulated specifically for ocular health include omega-3s with flaxseed oil, fish oil and vitamin E. Thera Tears technical consultant Graham Lehman says that only a specialised formula will address both meibomian gland dysfunction and the underlying causes of dry eye by decreasing inflammation, stimulating aqueous tear production and augmenting the tear film oil layer.

Omega-3s are essential fatty acids that cannot be produced naturally by the body so their inclusion in the diet is essential for good health. Those experiencing the evaporative form of dry eye who indulge in salmon, tuna, herring, mackerel and other cold water fish will reap the benefits of omega-3.

Nutritional supplements can be beneficial for the majority of us who find it difficult to adhere to balanced diets. In an open-label clinical trial Boerner and associates[1] treated 116 patients with omega-3 supplements and found that 98 per cent of dry eye patients reported an improvement in their symptoms.

On pharmacy shelves you will find myriad types of omega-3 supplements but according to Ared these will treat only some of the symptoms. 'When dealing with lid disease or evaporative eye disease, omega-3s do not assist with the production of meibomian, so fish oil alone will not treat meibomian gland dysfunction,' he says. 'Omega-3 is important only for its anti-inflammatory properties.'

The inclusion of flaxseed, rich in the omega-3 fatty acid a-linolenic acid (ALA), is crucial in the production of clear, thin, transparent and consistent meibomian oil. Blackmores research director Chris Oliver says that to have an anti-inflammatory effect, ALA needs to be converted into other longer chain omega-3 fatty acids, eicosapentaenoic acid (EPA) or docosahexaenoic acid (DHA).

'The problem is the conversion of ALA to EPA and DHA is only about 10 to 20 per cent in women and less in males,' says Oliver. 'In addition, the enzymes that convert ALA to EPA and DHA are also used by the omega-6 fatty acids. Western diets that are typically high in omega-6 fatty acids may offset the effects of omega-3.'

Omega-6 is found in beef, dairy and vegetable shortening and cooking oils. It increases serum and promotes heart disease, stroke and other degenerative diseases. When omega-6 breaks down via the arachidonic acid cascade, it produces prostaglandins, which are pro-inflammatory in our body.

Using the women's health database at the Harvard School of Public Health, investigators examined the dietary intake of essential fatty acids in 32,470 female health professionals. They found that the higher the dietary ratio of omega-3 to omega-6 essential fatty acids, the lower the likelihood of dry eye, and the higher the dietary omega-3 intake, the lower the likelihood of dry eye.[2]

While the recommended ratio of omega-3 to omega-6 consumption is about one-to-two, the existing ratio is estimated at one-to-10.[3] Omega-3 supplements, which tackle the same receptorcites as some of these longer chain omega-6s, are important to fine tune that balance.

As with all medications and supplements, practitioners need to consider the benefits against potential risks. Recently, several studies have been published that seem to indicate that taking flaxseed, which contains alpha linolenic acid, may cause prostate cancer. Studies show prostate cancer patients had high blood levels of alpha linolenic acid.[4]

Ared says nutritional supplements are most effective when used in conjunction with oral tetracyclines, because you need to immediately shut down the inflammatory process for the production of these oils to take effect. If these glands are clogged up with inflammatory cydercites, it takes a lot longer for nutritional supplements to be effective. 'Recent studies have shown that low dose doxycline is as effective as higher doses for meibomian gland dysfunction.[5] In our practice we are seeing excellent results with initial dosing of 25 mg bid for one month, then 25 mg once per day for a longer period,' he says. 'It depends on the stage of the condition at which the patient presents.'

There are many options for treating dry eye and Lehman encourages the use of natural therapy if the practitioner feels that it may be affective. 'Think before you grab your prescription pad,' he says.

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Airborne antidote

Many people with a dry eye complaint have a lipid layer deficiency leading to excess tear evaporation. Ocular lubricants are effective viscosity enhancers that reduce the frictional interaction between the lid and ocular surface by increasing the contact time of moisture on the eye. Ocular lubrications may not be effective if the liquid applied by using eye-drops is either drained via the tear channels or evaporates too quickly.

GARY OSHRY explores whether an ocular spray can be more effective than lubricants when treating evaporative dry eye

'Tears Again spray takes a different approach by working directly on the lipid layer,' says Simon Allen, general manager of Bio Revive. 'By stabilising the lipid layer, it controls the evaporation and addresses the underling cause of most dry eye complaints.'

A key difference between the two treatments is the inclusion of phospholipids in the Tears Again spray, which cannot be emulated in an ocular lubrication. These solid substances that stabilise the polar layer can be transferred into a liquid form for application as eye-drops only by using detergents or organic solvents, which are toxic and can destroy the natural lipid layer of the tear film and further injure the irritated eye.

Allen says this problem is overcome in a spray application by transferring the phospholipids into a liposomal form. Liposomes are microscopic balls of oil with an aqueous core that can be sprayed on a closed eyelid.

Complications may also occur with dry eye patients using ocular lubrications irregularly or for an extended period who need to use a preservative-based product to prolong the shelf-life and prevent contamination. There are situations when this is not feasible.

Institute of Eye Research executive director of research and development, Eric Papas, says that if the lubricant needs to be used repeatedly over several days, the risk of introducing a microbial contaminant is much greater with preservatives. 'It is preferable to not put preservatives into the eye unless it is essential because the chemicals used in the preservatives are known to be irritants,' says Papas.

'Tears Again has an ethanol-based preservative that preserves the substance in the bottle for up to three years,' says Allen. 'As you spray, the ethanol evaporates so it does not come in contact with the eye. It is equivalent to a preservative-free eye-drop designed to be used by chronic dry eye sufferers.' ■

Detrimental effects of preservatives

Improving the tolerability of medications with preservative-free formulations should become one of the key objectives of glaucoma therapy, according to a review article published in *Acta Ophthalmologica*.[1]

Antiglaucoma medications are often associated with ocular adverse reactions such as dry eye and tearing, burning and stinging sensations. Studies have indicated that these adverse effects are caused by benzalkonium chloride (BAK), a preservative commonly contained in glaucoma drops. Symptoms are dose-dependent, so increasing the number of preserved eye-drops will exacerbate the BAK-induced manifestations.

When treating patients with chronic glaucoma, medical treatment is predominantly used as first-line therapy. If effective, these patients will often undergo long-term administration of topical antiglaucoma agents. Long-term use of preservatives leads to corneal damage, the side-effects of which can have a significant impact on quality of life.

Studies have proven that the signs of damage to the conjunctiva, cornea and eyelids significantly decrease when patients switch from preserved to preservative-free medication, or when the number of eye-drops containing BAK is decreased.

It may be that the glaucoma patient is already susceptible to dry eye. An impaired tear film may interfere with topical treatments in a high proportion of patients and reduce the resistance of the cornea and conjunctiva to the presence of toxic or irritant compounds.

The review also indicates that the cumulative use of polytherapy over time is likely to increase the incidence of adverse events. Because of the progressive nature of the glaucoma, a majority of patients receive multiple therapies concomitantly.

Bimatoprost and travoprost, both of which contain BAK, include a warning that Benzalkonium chloride may cause eye irritation, and close monitoring is required with frequent or prolonged use of Lumigan/Travatan in dry eye patients or in conditions in which the cornea is compromised. The same warning has been issued

1. Baudouin C. Detrimental effect of preservatives in eyedrops: implications for the treatment of glaucoma. *Acta Ophthalmol* 2008; 86: 7: 716-726. ■

Briefs

Lubricants and contact lenses

The beneficial effects of drops instillation on comfort with contact lens wear could be psychological or mediated simply by the presence of the additional moisture in the eye.

A study[1] has compared the lubricating efficacy of two commercially available in-eye drops to a saline solution when used in association with low DK hydrogel and silicone hydrogel contact lenses.

Unpreserved saline alone when used as an in-eye drop can improve the subjective comfort of low DK hydrogel wearers, yet none of the lubricants tested in the study demonstrated additional benefit that might be expected from the application of more complex formulations. One of the lubricants tested was approved for use with contact lenses but the other was not.

Rewetting or comfort drops are frequently prescribed to relieve discomfort among soft contact lens wearers by preventing dehydration of the lens and ocular surface. In the past there has been little controlled evaluation of their efficacy. The wide variety of 'active ingredients' contained in various lubricants makes the task of evaluating a broad view of in-eye drop performance difficult.

The researchers also found that although instillation of a lubricant, including saline, immediately post-lens insertion improves comfort temporarily, repeat instillation does not translate into a significant improvement in longer-term comfort.

An increase in viscosity will presumably increase the residence time of the product on the eye and prolong the interaction with the lens surface. The study suggests that an increase in residence time does not appear to influence comfort. The benefits of increased lubricant viscosity may be more evident in non-contact lens wearing dry eye situations.

1. *Optom Vis Sci* 2008; 85: 773-777

Anti-inflammatory lowers AMD risk

Anti-inflammatory medication can reduce the risk of developing age-related macular degeneration (AMD).

A study[1] was conducted involving 614 male patients over the age of 50 years who had visited the Birmingham Veterans' Administration Medical Center in Alabama, USA. The researchers found that patients who had filled a prescription for anti-inflammatory drugs had an 85 per cent reduced risk of being diagnosed with AMD.

Eighteen individual drugs with anti-inflammatory properties were involved in the study, including medications for arthritis, cardiovascular disease and diabetes.

1. *Optom Vis Sci* 2008; 85: 947-950

PBS revises Systane listing

Following the introduction of a reclosable vial for Systane Lubricant Eye Drops Preservative-Free, the PBS Authority listing has been modified from 3+5 repeats to 2+5 repeats as of 1 December 2008.

The reclosable vial means that each vial of Systane lubricant eye drops doesn't have to be discarded after each dose is administered but can now be reclosed and used for up to 12 hours after opening.

A reclosable vial reduces wastage by allowing a patent to use the full 0.8mL intermittently within 12 hours of opening, and improves value to those patients who need frequent dosing throughout the day.

Whilst these Systane vials are only PBS reimbursed for severe dry eye (see below), it is also used outside the PBS in patients with less severe forms of dry eye where the cornea is compromised.

The PBS Authority listing is only for severe dry eye syndrome in a patient who is sensitive to preservatives in multi-dose drops.

FDA reviews ganciclovir antiviral

Sirion Therapeutics Inc, a privately-held ophthalmic-focused biopharmaceutical company, has announced that its New Drug Application for ganciclovir ophthalmic gel 0.15% has been accepted for review by the US Food and Drug Administration (FDA).

Sirion Therapeutics is seeking approval for ganciclovir as a treatment for herpetic keratitis, an ocular disease caused by the herpes simplex virus.

CEO of Sirion Therapeutics, Barry Butler, said that herpes simplex keratitis remained one of the leading causes of corneal blindness and corneal transplants in the United States. If approved by the FDA, ganciclovir ophthalmic gel would become the first topical ophthalmic antiviral treatment launched in the USA in almost three decades. This product would provide a significant new option for physicians in the treatment of patients with herpetic keratitis,' he said.

To assess the efficacy and safety of ganciclovir, four randomised, multicentre trials compared ganciclovir gel 0.15% with acyclovir ointment 3%, both of which are used as first-line therapies outside the USA to treat herpetic keratitis.

According to the company, the studies found that ganciclovir is as effective as acyclovir and that the tolerability of ganciclovir was superior to acyclovir, particularly with regard to blurring and stinging or burning sensations after instillation. As ganciclovir is formulated as an aqueous gel, it allows for prolonged contact time with the corneal surface.

Fluoroquinolone

A novel fluoroquinolone, besifloxacin, has been found to effectively treat bacterial conjunctivitis.

In a study[1] funded by Bausch & Lomb, either besifloxacin or vehicle was randomly administered to participants, with clinical resolution and eradication of baseline bacterial infection then observed and compared.Clinical resolution and bacterial eradication were significantly higher in participants treated with besifloxacin compared to those administered vehicle.

Clinical resolution using besifloxacin was comparable to that of other ophthalmic fluoroquinolones previously studied.

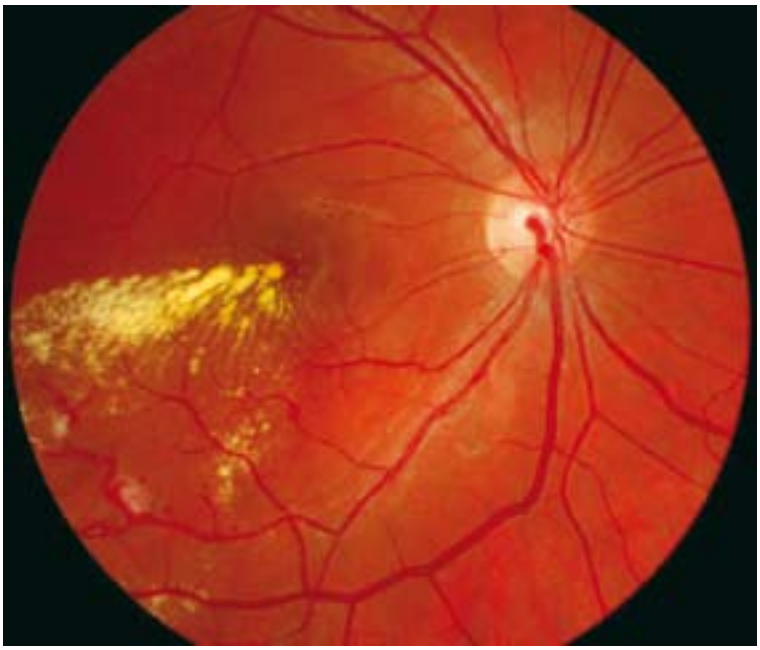
1. *Optometry* 2008; 79: 332-333.

What's your diagnosis?

Clinical quiz

JB, a 20-year-old male, presented with a blur like a shadow in the superior part of his central vision in his RE. His general health was unremarkable. Immediate family ocular history was also unremarkable: primary open angle glaucoma (POAG) paternal grandfather at 93 years, age-related macular degeneration (AMD) paternal grandmother at 85 years. Distance vision of R 6/6=, L 6/4.8 was unable to be improved.

Answer page 32



Use all the tools

Fernando Lamas
BAppScOptom BSc

We are all guilty of occasionally giving dry eye problems a very big broad stroke, particularly on a busy day. Dry eye should be treated with a systematic approach, just like any other therapeutically oriented condition.

Finding out the patient history is good place to start, particularly whether the symptoms are worse in the morning or the afternoon. Some dry eye symptoms experienced in the afternoon can indicate poor tear structure or poor tear production.

If the examination indicates that the meibomian glands may be dysfunctional, there will be a characteristic lipid layer over the tear film and lipid beading at the orifices of the meibomian glands. In my anecdotal experience, this seems to be a common cause of dry, stinging eyes accompanied with blurred, variable vision.

I prefer to treat these patients initially with regular lubricants and hot compresses. Depending on the severity of the problem, I usually commence the patient on one drop of Thera Tears four times a day for the first two weeks in conjunction with hot compresses twice a day. At review two weeks later, if improvements are being made, I reduce the dosage of artificial tears to three times a day in combination with hot compresses bid and review in another month.

After two to four weeks if no progress is made with Thera Tears drops and hot compresses alone, I may consider commencing the patient on nutrition supplements which have omega-3. I generally prescribe three tablets a day for one month and review again in two weeks. No progress will be noticeable at this stage but I still like to see the patient to offer encouragement.

It can take six to eight weeks before any improvement is noticeable, after which I reduce the dosage to two tablets a day. I have had great success with these tablets.

Treating dry eye can be complicated but with a systematic approach accompanied with appropriate questioning, you should be able to offer relief to many of your dry eye patients. ■

Cyclosporin helps dry eye, too

A review[1] of clinical trials involving topical cyclosporin seems to demonstrate that cyclosporin minimises the signs and symptoms of dry eye and is not associated with any significant systemic or ocular adverse reaction.

This article reviews the clinical trials and safety profile of the ophthalmic preparation cyclosporin and its use in the treatment of dry eye. Inflammation is a frequent and often frustrating component in dry eye condition.

Cyclosporin has long been used systemically to decrease the effects of inflammation. It acts primarily by blocking the action of T cells, decreasing the release of inflammation causing cytokines and preventing the apoptosis of goblet cells–for which the goblet cells are thankful.

Dry eye is a common and yet complex condition. Artificial tears are the mainstay of therapy but controlling the inflammation response can be vital in patients who do not get by on lubricant drops alone.

1. *Expert Opin Pharmacother* 2008; 9: 17: 3121-3128. ■

Lymphangietasia haem

Case report

Abnormal communication between lymphatic and blood vessels may be due to faulty valves

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A 69-year-old Caucasian woman presented to our practice with interesting and relatively rare anterior eye pathology.

At initial presentation (Figures 1 and 2) the patient had been aware that her left eye had been red for five days, although she had experienced no pain or other symptoms. Ophthalmoscopy was NAD. At first glance it could easily have been mistaken for a common subconjunctival haemorrhage.

On closer inspection, this was not the case. It was lymphangietasia haemorrhagica conjunctivae, which is an uncommon condition in which the conjunctival lymph vessels fill with blood–first described by Leber in 1880[1]–and is considered to be largely benign. It occurs as a result of abnormal communication between conjunctival lymphatics and conjunctival blood vessels,[2] possibly due to a failure of the valvular mechanisms. The lymph vessels are reportedly arranged in three layers and it appears the larger, tortuous vessels of the middle layer have venous communication and are therefore more likely to be affected.[3]

Aetiology and related conditions

Related conditions are generally considered to be unknown, although one case report describes an episode in which lymphangietasia haemorrhagica conjunctivae was evident the day after phacoemulsification surgery. It was thought that a rise in periocular or orbital pressure during surgery resulted in venous engorgement and allowed a backflow of blood to enter the lymphatic system from the venous vessels by overcoming the valvular mechanisms.

The first report in English literature in 1969 describes a patient with lymphangietasia haemorrhagica conjunctivae who had previously suffered from iridocyclitis yet the patient had had no recent episodes and any link between the conditions was unknown.[4]

A summary of a few previous cases and associated ocular conditions is given by Awdry.[4] (Table right)

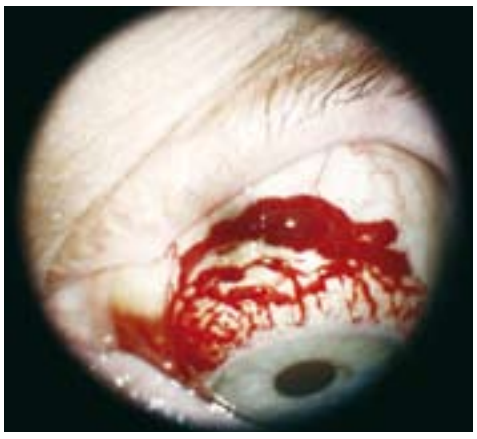

Figure 1. Initial presentation

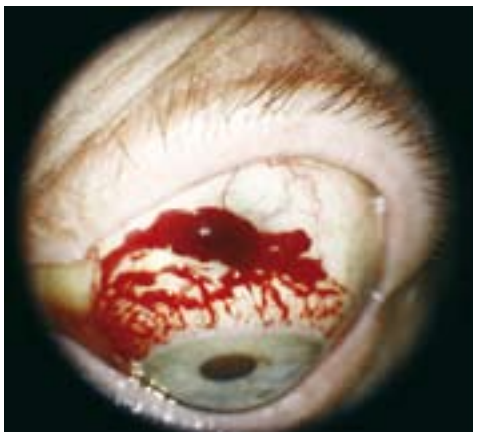

Figure 2. Initial presentation

orrhagica conjunctivae

Differential diagnosis

- most commonly confused with subconjuntival haemorrhage
- allergic conjunctivitis, due to redness and chemosis
- conjunctival lymphangioma.[2]

Treatment

- spontaneously resolves in most cases, with reports ranging from several days to two or three weeks, although many patients suffer recurrent episodes
- surgical removal of the abnormal communication
- argon laser photocoagulation treatment is possible if attacks become frequent or cause discomfort[1]
- coagulation diathermy.[4]

In this case the patient was monitored until spontaneous resolution occurred about 19 days after initial presentation (Figure 4).

Author	Date	Patient		Eye (L/R)	Previous/existing pathology
		Sex	Age (years)		
Leber	1880	F	28	R	none known
Zimerman	1899	F	14	L	chronic conjunctivitis
Bartók	1917	M	27	L	angioma of eyelid
Contino	1935	F	50	R	trachoma
Heydenreich	1956	M	50	R	none known
Conrads & Kühnhardt	1957	F	18	L	corneal foreign body
Stepanik	1958	F	12	L	parotid lymphangioma
Leffertstra	1962	F	53	L	marginal keratitis
		M	60	not stated	recurrent marginal keratitis

Previous reports of cases of lymphangietasia haemorrhagica

Reproduced from P Awdry. *British Journal of Opthalmology* 1969; 53: 274-278 with permission from BMJ Publishing Group Ltd

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3. A case of lymphangiectasia haemorrhagica conjunctivae following phacoemulsification. Letter to the editor. *Acta Ophthalmol Scand* 2004; 82: 5: 627-628.
4. Awdry. Leber's lymphangietasia haemorrhagica conjunctivae. *Br J Ophthalmol* 1969; 53: 4: 274.

The authors practise at McLennan Deece Optometrists in Grafton and Maclean, NSW. The images were taken with a Canon CR-Dgi non-mydriatic retinal camera. ■

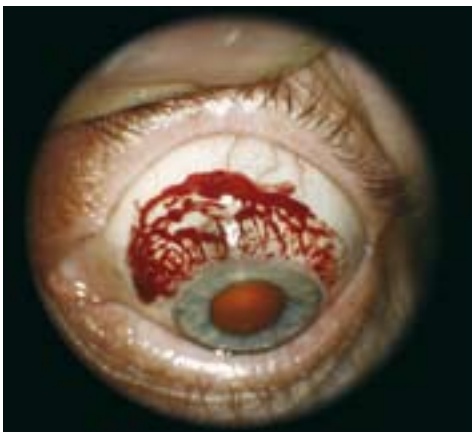

Figure 3. Eight days after initial presentation

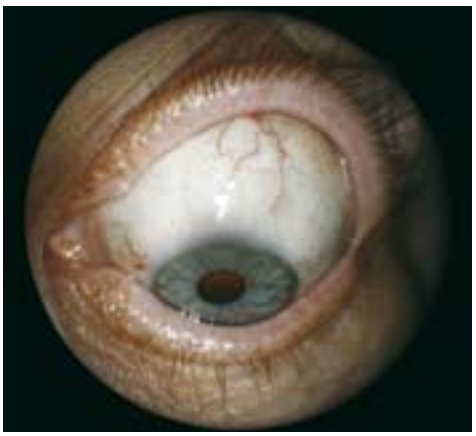

Figure 4. Resolution 19 days after initial presentation

Abstracts

Andrew Hogan
BScOptom

When is a pemphigoid not a pemphigoid?

Using too much topical decongestant eyedrops can cause a patient to look like they have ocular pemphigoid.

The authors of this report discuss a 45-year-old man who used phenylephrine hourly for years. Not surprisingly, he presented with extreme eye redness, fornix shortening and scarring of the puncta. He also had neovascularisation of the conjunctiva. His symptoms essentially resolved after ceasing use, which was good for him but sales of phenylephrine drops never recovered.

Ocular pemphigoid is a systemic autoimmune disorder with ocular and non-ocular manifestations, including bullous lesions of the skin and mucous membranes. These can result in scarring of the skin and conjunctiva, which can be very unpleasant—like an Adam Sandler movie but without the laughs.

Tappeiner C, Sarra GM, Abegg M. Abuse of vasoconstrictive eyedrops mimicking an ocular pemphigoid. *Eur J Ophthalmol* 2009; 19: 1: 129-132.

Things go better with timolol

When considering combination therapy on a glaucoma patient who is not responding to prostaglandin monotherapy alone, it appears that bimatoprost and latanoprost are both more effective when used with timolol.

In this study, 82 patients were randomised to either bimatoprost/timolol fixed combination or latanoprost/timolol fixed combination. The primary aim was to compare the mean daily IOP reduction with the combination therapy to that achieved with monotherapy, without the timolol. Not surprisingly, both combination treatments were more effective than monotherapy alone. The bimatoprost/timolol combination showed better relative IOP reduction, with 72 per cent of this group showing a reduction of greater than 15 per cent, compared with 40 per cent of the latanoprost/timolol group.

Combination therapy is a key part of glaucoma management but perhaps not all combinations are created equally.

Centofanti M, Oddone F, Vetrugno M, Manni G, Fogagnolo P, Tanga L, Ferreri P, Rossetti L. Efficacy of the fixed combinations of bimatoprost or latanoprost plus timolol in patients uncontrolled with prostaglandin monotherapy: A multicenter, randomized, investigator-masked, clinical study. *Eur J Ophthalmol* 2009; 19: 1: 66-71.

Prostoglandins can give you red eyes

An analysis of 13 random clinical trials has suggested that the use of latanoprost is less likely to cause conjunctival hyperaemia when compared to the other prostaglandin analogues, travoprost and bimatoprost.

This meta-analysis looked at studies with a combined total of 2,222 patients. No mention of whether Richie Benaud was excited by this number. The outcome measure was the appearance of conjunctival hyperaemia. Five of the studies compared lataonoprost with travoprost, seven compared latanoprost with bimatoprost, and two compared latanoprost with both the other drugs. The combined results showed that latanoprost produced a lower occurrence of conjunctival redness than the other drugs.

Glaucoma patients often complain of ocular redness and irritation; and optometrists, regardless of whether they are authorised to treat glaucoma, are still required to manage the condition. Red eyes can be enough to convince a patient to cease using their medication so studies such as this are vital to our understanding of patient compliance.

Honrubia F, Garcia-Sánchez J, Polo V, Martinez-de-la-Casa JM, Soto J. Conjunctival hyperemia with the use of latanoprost versus other prostaglandin analogues in patients with ocular hypertension or glaucoma: a meta-analysis of randomized clinical trials. *Br J Ophthalmol* 2008; Nov 19 [Epub].

Twice a day is enough for this antibiotic

Topical treatment with 1.5% azithromycin used only twice daily for three days appears to eradicate most pathogens associated with bacterial conjunctivitis and is as effective as tobramycin used more frequently for one week.

In this study, 1,043 subjects received either azithromycin twice daily for two days, or tobramycin every two hours for two days, then four times daily for another five days. Conjunctival swabbing was performed at days zero, three and nine. Based on the swabs, the authors concluded that azithromycin was equivalent to tobramycin and eliminated most bacteria associated with conjunctivitis.

The short course of treatment associated with azithromycin has an impact on patient compliance, as does the lower dose frequency. Whether azithromycin can dethrone choramphenicol as the king of all eye-drops remains to be seen.

Denis F, Chaumeil C, Goldschmidt P, Delval L, Pouliquen P, Cochereau I, Chainier D, De Barbeyrac B. Microbiological efficacy of 3-day treatment with azithromycin 1.5% eye-drops for purulent bacterial conjunctivitis. *Eur J Ophthalmol* 2008; 18: 6: 858-868.

Side-effects: expect the unexpected

The use of the drug topiramate (Topamax) can result in the acute onset of myopia and angle-closure glaucoma in an extremely short time.

This case report is about a 23-year-old woman who developed extremely blurred vision only seven days after commencing therapy with topiramate. Visual acuity was worse than 6/120 in both eyes, and intraocular pressure was R 33 mmHg and L 32 mmHg. She had conjunctival chemosis, corneal oedema and—surprise!—closed angles. Her refraction had shifted to -7.50 dioptres in both eyes. When topiramate was discontinued and anti-glaucoma drops were used, her condition resolved completely.

Topiramate is an anticonvulsant drug generally used to treat epilepsy. It has also been used as an antidepressant. These days, it is frequently used for prevention of migraines. It has numerous off-label uses, including the treatment of bulimia, OCD, alcoholism, smoking cessation, and as a treatment for obesity to reduce binge eating.

A single medication with a wide spectrum of uses can be responsible for a host of ocular conditions and if a patient has a 7.50 dioptre myopic shift in one week, they probably don't just need glasses.

Boonyaleephan S. Bilateral acute onset myopia and angle closure glaucoma after oral topiramate: a case report. *J Med Assoc Thai* 2008; 91: 12: 1904-1907.

Is there a future for medical treatment of cataract?

An alternative to the surgical treatment of cataract is attracting researchers

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Age-related cataract is a growing issue with the ageing of the population and is a common condition optometrists deal with on a daily basis. Currently, the only viable management plan for cataract is surgical, by phacoemulsification and intraocular lens implantation. While successful, the cost can be prohibitive for many and surgical access through the public hospital system is increasingly difficult.

Some research is now emerging on the possibility of medical or therapeutic management techniques for cataract. An article published in *Clinical and Experimental Ophthalmology* deals with this question through a review of literature on the subject.[1] Cataract is a leading cause of blindness and vision impairment, even in developed countries like Australia. In poorer populations of the world its effects are devastating. The financial burden of cataract surgery is very high and surgery is not without its risks; pseudophakic patients have a four-fold cumulative risk of retinal detachment for up to 20 years after surgery.

The rate of posterior capsular opacification requiring Yttrium-aluminium-garnett (YAG) laser capsulotomy remains around 10 per cent, and endophthalmitis, although thankfully rare, can occur in as many as one in 1,000 cases, depending on the surgical technique.[2] A safe, accessible, cost-effective alternative would be ideal and would have a positive impact on eye health management on a global scale.[2-4]

The crystalline lens has a natural defence system involving Vitamin E, Vitamin C and gluthathione, which protects against free radical oxidation. The concentration of these antioxidant chemicals decreases with age and minimal biochemical turnover in the lens leave it more vulnerable to other modifications and insults like absorption of UV radiation.[5]

There is little doubt age-related cataract represents the cumulative effect of a variety of cataractogenic stressors that accelerate natural protein degradation coupled with a reduced efficiency of the lens's protective mechanisms.[1] Medical treatment of cataract must focus on either augmentation and support of these natural defence systems, or combat of extrinsic and intrinsic cataractogenic factors.

The first obvious question is the validity of multivitamin supplementation to support the declining levels of Vitamin E and C in the ageing crystalline lens. Vitamin E acts to protect against lipid peroxidase (LPO), which denatures lens membrane lipids. Vitamin C, or ascorbate, is held in much higher concentration in the aqueous humour and lens than anywhere else in the human body. It prevents aggregation of crystallin molecules as well as acting as a free-radical scavenger.

Animal studies in vitro and in vivo have shown promise; in humans, reduced intake of Vitamins C and E supplements has been shown to correlate with increased incidence of cataract in patients from 40 years of age.[5,6] A small positive treatment effect was also obtained by the Roche European American Cataract Trial with a similar concentration of micronutrients.[7]

The well-known Age-Related Eye Disease Study (AREDS) found no significant effect of antioxidant intake on the development or progression of age-related cataract.[8] The variability in quality, bioavailability and synergistic activity with other micronutrients within different multivitamin supplements is well known,[9] though more investigation into this emergent area of nutritional medicine is needed.

Extrinsic cataract risk factors are significantly related to lifestyle such as dietary intake of antioxidants, UV exposure and smoking; general health issues like diabetes and side-effects of therapeutic drugs like steroids. Some of these are modifiable, such as those related to dehydration and malnutrition in developing countries, and many still remain unknown.

Future research into medical therapies for cataract must answer the complex question of managing these risk factors in combination with an understanding of the many different pathways by which cataract develops. The prospect of a therapeutic eye-drop to resolve such a far-reaching and significant problem as cataract is very exciting.

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Eosinophils in conjunctival scrapings can confirm the diagnosis of VKC

Vernal keratoconjunctivitis

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Case report

GJ, an 11-year-old boy, first presented to our practice in November 2007 with a five-day history of severe ocular discomfort in both eyes. Other ocular signs and symptoms included intense itching with an associated burning and foreign body sensation, moderately red eyes, excessive lacrimation, mild photophobia, a thick 'ropy' mucous discharge and a slight bilateral ptosis.

The patient had not experienced any problems with his eyes in the past. He had never worn any form of refractive correction and there was no significant familial ocular history. GJ had suffered from mild forms of asthma and eczema for the previous three years and was allergic to dust mites and cat fur.

Slitlamp examination revealed in both eyes five to 10 large 'cobblestone' papillae on the upper palpebral conjunctiva (Figure right), generalised bulbar conjunctival hyperaemia, prominent mucous strands in the inferior fornix, superior superficial punctate keratitis and a reduced tear break-up time of about five seconds. A slight bilateral ptosis was also noted.

All other ocular findings were normal. Unaided vision was R and L 6/4.8 and there was negligible refractive error.

GJ was diagnosed as having bilateral vernal keratoconjunctivitis (VKC). This condition is nearly always bilateral, although the two eyes may vary in severity. It occurs more commonly in males than females, with an onset typically between eight and 14 years of age. VKC is more common in areas that are hot and dry, and is a seasonal condition, usually diagnosed during Spring and Summer.

Symptoms include:

- itching
- intermittent redness
- lacrimation
- foreign body or burning sensation
- photophobia
- blurring of vision (in severe cases).

Clinical signs include:

- large cobblestone papillae on the upper tarsal conjunctiva
- mild conjunctival hyperaemia
- superficial punctate epithelial erosions, more pronounced superiorly
- slight ptosis (if eyelids are very inflamed)
- Tranta's dots (at the limbus)
- limbal plaques
- shield ulcers (in severe cases).

The following topical medications were prescribed:

- Flarex (fluorometholone acetate 0.1%) eye-drops qid ou
- Patanol (olopatadine HCl 0.1%) eye-drops bid ou
- Systane artificial tears (minims) qid ou.

On review two weeks later, the patient's symptoms and clinical signs had decreased significantly. The patient was advised to continue using Patanol and Systane at the same frequency but to reduce Flarex to twice a day in both eyes.

At the next review appointment one month later, the patient's symptoms had subsided. Use of Flarex was ceased and GJ was prescribed FML (fluorometholone 0.1%) eye-drops to be used once daily as a maintenance therapy, as well as continuing with the Patanol eye-drops twice daily in both eyes. The artificial tears were now to be used on an as-needed basis.

Two months later the patient, who was still asymptomatic, was advised to cease using the FML but was kept on the Patanol as a prophylactic measure until April, at which time this drug was ceased due to the onset of cooler weather and the end of the allergy season. The next review appointment was scheduled for early September, at which time consideration would be given to resuming the use of the Patanol eye-drops due to the patient's ocular history and the onset of the allergy season.

Throughout the therapeutic treatment period the patient's intraocular pressures were monitored on a regular basis and they remained constant within normal limits, ranging from 11 to 13 mmHg. Slitlamp examination also revealed no changes to the patient's ocular lenses during this time.

VKC is a seasonally recurrent, bilateral external ocular inflammation that occurs more frequently in warm, dry countries. The condition is more common in males and the majority of patients are between five and 20 years of age. It is rarely seen in patients over 30 years; these patients often have a family history of the condition as well as a personal atopic history.

VKC has a remitting and exacerbating history with a self-limiting nature usually

within five to 10 years after the initial episode. The prognosis for eventual recovery is good and, when it occurs, is almost always complete. Unfortunately, in a significant proportion of patients, it evolves into atopic keratoconjunctivitis (AKC) as they become adults.[1]

VKC may affect the palpebral or the bulbar conjunctiva or both. The palpebral changes are generally more manifest than the limbal, although the majority of cases tend to have involvement of both. The palpebral form affects the upper tarsal conjunctiva, causing a papillary hypertrophy that often has a cobblestone appearance. Ptosis can result due to the thickening of the lid. The limbal or bulbar form is characterised by a hyperaemic, oedematous and thickened conjunctiva, with the upper margin of the cornea most affected. Corneal involvement, usually in the form of a superior superficial punctate keratitis, is more common in the limbal type.

In more advanced forms of VKC, discrete white superficial spots–Tranta's dots–which are composed predominantly of eosinophils may be observed, most commonly at the superior limbus.[2] In very severe cases, superficial shield ulcers may result from rubbing of the cornea from the roughened superficial conjunctiva.

The differential diagnosis of VKC includes seasonal allergic conjunctivitis (SAC), perennial allergic conjunctivitis (PAC), AKC and contact lens associated papillary conjunctivitis (CLPC). AKC is closest in appearance to VKC although the former rarely occurs in childhood and most often involves the inferior palpebral conjunctiva, compared with VKC which usually involves the superior palpebral conjunctiva. Corneal changes are rarely seen in SAC and PAC, while in CLPC the ocular surface allergic condition is associated with contact lens wear.[3]

VKC has an immunological basis primarily of the Type 1 (atopic) category. The ocular inflammation is an IgE cell-mediated response, causing mast cell degranulation and subsequent histamine release.[1] There is some evidence that a Type 4 (delayed hypersensitivity) mechanism may also be involved. The diagnosis of VKC can be confirmed by the presence of eosinophils in conjunctival scrapings as there is no other ocular disease in which so many of these cells are seen.[2]

Treatment options

In theory, the best therapy is the elimination of the antigen but this is often impractical and desensitisation appears to have little effect.[2] Patients with allergies to pollens should be counselled to avoid outdoor activities on high pollen-count days.[1] Cold compresses and ocular lubricants may provide some short-term relief of symptoms. Artificial tears help to normalise the tear film, dilute the level of antigens reaching the ocular surface and enhance the efficacy of other antigens. Moving to a cooler climate may be accompanied by relief of symptoms.

Topical anti-histamines, such as antazoline 0.5% (Albalon-A, Antistine-Privine) or pheniramine 0.3% (Naphcon-A), and non-steroidal anti-inflammatory drugs (NSAIDs), such as ketorolac tromethamine 0.5% (Acular) and diclofenac sodium 0.1% (Voltaren), can be used to control the itching and redness associated with acute attacks. Most topical anti-histamines also contain sympathomimetic decongestants–Livostin (levocabastine 0.05%) is an exception–which helps to reduce oedema and redness through vasoconstriction.

Practitioners should be aware that ophthalmic decongestants can cause rebound dilation while topical ophthalmic anti-histamines can, paradoxically, cause allergic reactions and ocular irritation.

Anti-histamines and NSAIDs are only partially effective in the treatment of VKC as they both inhibit only one particular mediator of this allergic condition. Mast cell stabilisers are better drugs for long-term preventative and maintenance therapy of VKC because they target the cause of the immune reaction, rather than just treating the symptoms, by inhibiting the degranulation of mast cells.

As the mast cell contents stay within the system for approximately two weeks, mast cell stabilisers are of limited benefit for relief of acute symptoms as they have no anti-histaminic or anti-inflammatory properties. Mast cell stabilisers have not been shown to be associated with any serious adverse reactions. Lodoxamide 0.1% (Lomide) has been shown to be far more effective than cromolyn sodium 2% (Opticrom or Crolom) in the treatment of VKC.

Newer drugs incorporate anti-histamines with a mast cell stabiliser. These drugs are preferred because not only do they target the cause of the immune response, they also provide instant symptomatic relief. Both ketotifen 0.025% (Zaditen) and olopatadine 0.1% (Patanol) are histamine H-1 antagonists with some mast cell stabilising properties.

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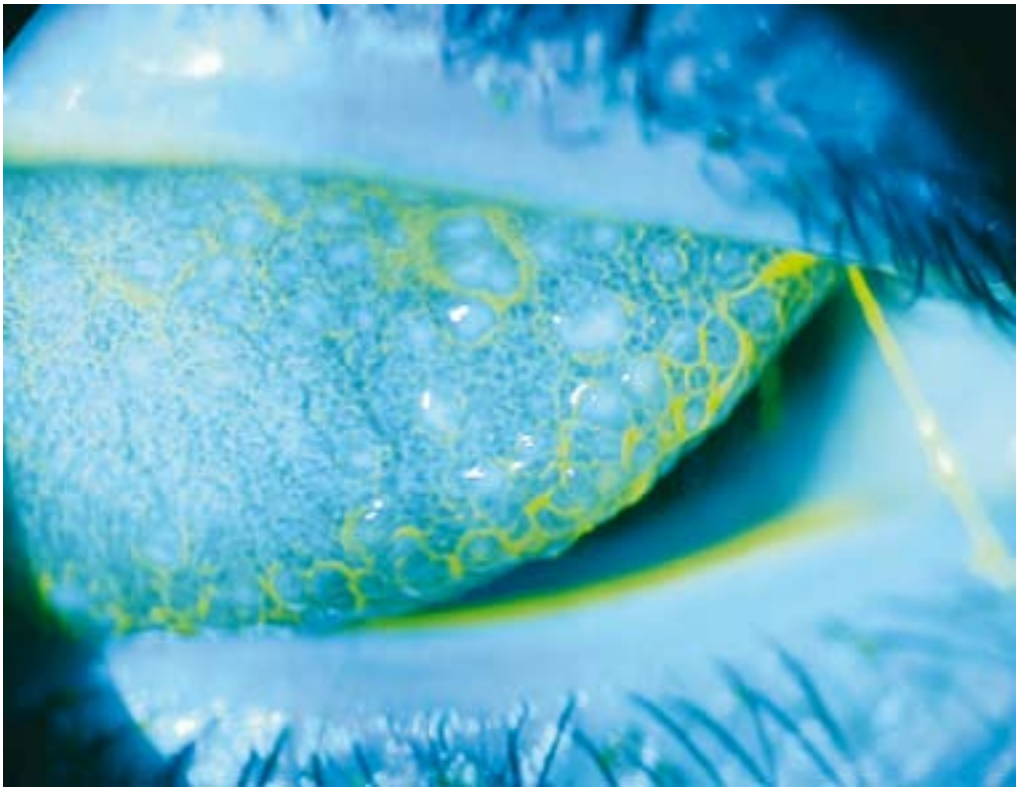

Large 'cobblestone' papillae on patient's upper left palpebral conjunctiva

Vernal kerato-conjunctivitis

From page 31

Unlike lodoxamide and sodium cromoglycate, these drugs have an immediate effect due to their anti-histamine action and are usually the preferred option for the initial treatment and ongoing management of VKC.

If the condition can be isolated to allergy season, therapy with these drugs may be initiated prior to the commencement of the allergy season. If the condition is very severe, year-round use may be required.

All forms of VKC respond very well to topical steroids; a short course of a topical steroid such as Flarex will usually break the inflammatory cycle. Less potent steroids such as FML may be used as maintenance therapy to help keep the VKC under control.[1] In more severe cases of VKC where shield ulcers may result, aggressive therapy with more potent steroids, such as dexamethasone 0.1% (Maxidex) and prednisolone acetate 1% (Prednefrin Forte), may be required as shield ulcers can be visually threatening.

In these cases, therapy should be combined with a broad-spectrum prophylactic antibiotic. In addition, a topical cycloplegic such as homatropine 2% may be prescribed to alleviate pain. Care needs to be taken if steroids are used on a long-term basis because of potential complications such as cataract and glaucoma.

Topical cyclosporine A, an immunosuppressive agent, has been shown when used twice a day to decrease the papillary hypertrophy in those cases of VKC that have failed to respond to other therapeutic treatment.[1,3] This drug is not currently available in Australia as a proprietary medication but may be formulated by pharmacy in a hospital environment under ophthalmologic instruction. In the USA it is distributed under the proprietary name of Restasis.

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Clinical quiz

From page 25

Answer

Fundus examination with dilated pupil revealed cluster of abnormal retinal arterioles with some aneurysmal dilation consistent with telangiectasia of the retina and significant foveal hard exudates. A retinal specialist confirmed diagnosis of Coats disease. This retinal vascular abnormality usually develops in males during the first two decades of life; more severe cases occur in the first decade. Coats disease is rarely bilateral with no link to family history.[1]

Conservative treatment was given at that stage due to the excellent visual acuity (VA). Consideration was given to using laser photocoagulation of the ischaemic retina but given the good VA, this was deferred.

Prognosis is uncertain; possible complications include continued leakage, exudative detachment of the retina, vitreous haemorrhage, and ischaemia/neovascularisation.

There are reports of some groups starting trials using anti-VEGF (vascular endothelial growth factor) drugs.[2] Blocking the VEGF protein is beneficial in a number of eye diseases such as retinopathy of prematurity or wet AMD. Anti-VEGF drugs such as Avastin, Lucentis or Macugen help to block the growth of new blood vessels and may prevent the progression of the disease.

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BScOptom MBA PGCertOcTher

1. The Wills Eye Manual, 5th ed. USA: Lippincott Williams & Wilkins. 2008; 167-168
2. www.coatsdisease.org

Glaucoma patients report better vision and comfort with BAK-free medications

Two American optometrists have highlighted potentially damaging ocular effects of the preservative benzalkonium chloride (BAK), particularly for glaucoma patients.

In an article published in *Primary Care Optometry News* on 1 December 2008, Michael Chaglasian and Ronald Carr said that BAK, which is present in the majority of ophthalmic preparations, could contribute to the development of ocular surface disease.

They claimed the preservative could also decrease epithelial cell integrity, increase the number of inflammatory cells in the conjunctiva and adversely affect tear film break-up time.

They found that exposure to BAK could affect glaucoma patients to a higher degree, as many of these patients required multiple medications to manage their condition.

Chaglasian and Carr pointed to a study in which glaucoma patients previously treated with latanoprost and bimatoprost (with BAK) were subsequently treated with the BAK-free travoprost.

The results indicated that patients preferred travoprost, as they reported significant improvements in visual acuity, light sensitivity, grittiness, blurred vision, and during night-time, windy and low-humidity conditions.

The participants' preference for travoprost suggested that they valued therapies that minimised adverse effects.

'By focusing on not only IOP management but also on medication regimens, practitioners can reduce the risk of ocular surface disease, minimise exposure so patients will suffer from fewer adverse effects, and help improve compliance as a result,' they said.

Antimicrobial contact lenses

Studies of contact lenses coated or impregnated with minute amounts of silver, and a range of other antimicrobial agents tethered to lenses, show promise of a new generation of lenses available for wearers in two or three years.

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Institute for Eye Research and School of Optometry and Vision Science, UNSW

Microbial keratitis (MK) during lens wear continues to be a major concern for practitioners due to its potential to cause vision loss. Fortunately, its incidence has remained relatively low over a long time.

During extended wear of hydrogel (including silicone hydrogel lenses) the rate is about one in 500 wearers per year but if people wear hydrogel lenses for daily wear, the rate is about one in 2,500 wearers per year.[1]

In recent years two outbreaks of MK have occurred, both as the result of apparent failures of contact lens multipurpose disinfecting solutions (MPDS). An increase in MK caused by *Fusarium* was linked with use of the MPDS Renu MoistureLoc, whereas an increase in MK caused by *Acanthamoeba* was linked with the use of the MPDS Complete MoisturePlus.[2,3]

Of course, microbes do not only cause MK, they are also linked with non-infectious corneal inflammatory events, for example, contact lens induced peripheral ulceration and contact lens induced acute red eye. These non-infectious inflammatory events occur at rates of about one in 20 wearers per year.[4]

The continued occurrence of MK and non-infectious inflammatory events, even with the introduction of newer contact lens materials–for example, the silicone hydrogels–and newer MPDS formulations, has led to researchers in academia and industry examining whether contact lenses that contain antimicrobial substances can be developed that can reduce the incidence of these events.

An examination of the patent and journal literature shows that there are essentially two broad classifications of antimicrobial strategies that are being evaluated. One results in the release of antimicrobial agents from the lens surface (Figure 1) and the other has antimicrobial agents firmly tethered to the lens surface (Figures 2 and 4).

There are relevant regulatory issues that perhaps favour this latter strategy for everything other than agents that have been used elsewhere in the body–for example, silver, as this has been used extensively as silver-coated catheters.

Silver is an ancient antimicrobial agent. Water was purified in silver urns in classical times. It has advantages in that it is very broad spectrum, having effects on the major ocular bacterial pathogens, and having a widespread effect on bacterial

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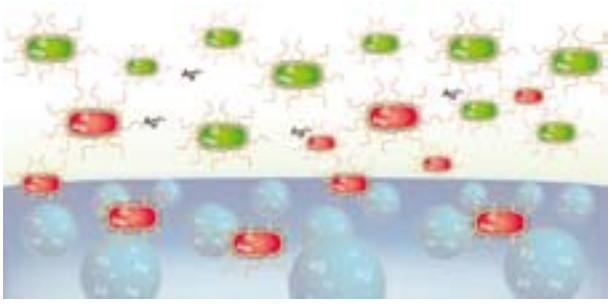


Figure 1. Representation of a contact lens containing silver. The silver is incorporated into the lens material, perhaps as nanoparticles, and silver ions (Ag^{2+}) are released to provide an antimicrobial effect. Live bacteria (in green) can settle onto the lens surface and be killed (bacteria in red) by the silver. As silver is released, there is also some killing of bacteria that are yet to adhere to the surface. (Diagram not drawn to scale)

Antimicrobial contact lenses

From page 33

physiology from perturbing membranes to interacting with DNA (thus reducing risks of developing microbial resistance—there are very few reports of bacteria acquiring resistance to silver), and being well tolerated by humans.

Large doses of silver in the eye may cause argyrosis, a bluing of the conjunctiva, and very large doses that penetrate the eye—for example, during injury in silver mines—can cause blocking of the trabecular meshwork filtering system. However, it seems from the available information in the literature and patents that contact lenses that contain silver contain such a very low, yet effective antimicrobial dose that either of these possible adverse events is extremely unlikely.

Most other potential antimicrobial lenses in the literature involve a tethered antimicrobial on the lens surface. These include tethered polyquaternary ammonium compounds or cationic peptides/proteins. The antimicrobial mode of action for both of these is essentially similar, and is based on differences in microbial and mammalian membrane physiology (Figure 3).

Mammalian membranes tend to have an overall neutral charge, whereas microbial membranes tend to be negatively charged. The positively charged nitrogen moieties in both polyquaternary ammonium compounds and cationic peptides can then disrupt the microbial membrane but do not interact with the mammalian membrane.

Both classes of agent are broad spectrum antimicrobials, affecting not only bacteria but also reportedly fungi and viruses. The relatively non-specific nature of their antimicrobial effect makes resistance unlikely. Indeed, one report has demonstrated that bacteria cannot be made resistant to a particular form of antimicrobial cationic peptide.

While the manufacture of silver-coated or impregnated lenses, and polyquaternary or cationic protein-coated lenses is described in the literature, to date there have been no reports of their use in clinical trials.

A surface bound antimicrobial agent that has been reported in the patent and journal literature is selenium (Figure 4A). Selenium is an element that is essential to human health, being a requirement in several enzymatic processes. Under certain conditions it can be antimicrobial and its antimicrobial action is essentially the production of oxygen radicals.

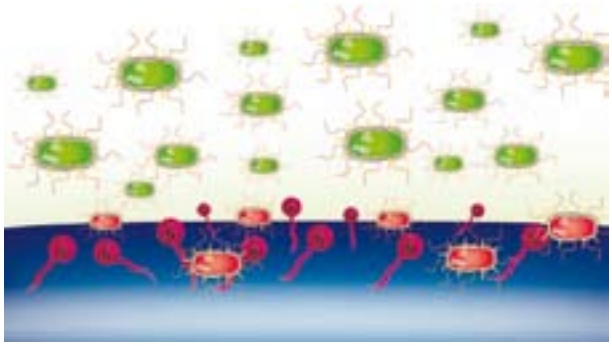
We can think of this as being a very localised production of hydrogen peroxide. Hydrogen peroxide is a very effective antimicrobial that is used in certain contact lens disinfecting solutions. A report[5] has shown that coating the surface of lenses with an organo-selenium compound renders the lenses antimicrobial. These lenses were able to be worn safely in animals' eyes.

Another surface-bound antimicrobial lens has been found to be worn safely in both animal and short duration human trials.[6] These lenses were coated with fimbrolides (also known as furanones, Figure 4B).

Fimbrolides disrupt signalling systems that microbes use to initiate their ability to adhere to surfaces, for biofilms, and produce toxins. These fimbrolides have been reported to be active against many types of bacteria that can cause ocular disease, as well as *Acanthamoeba*.[6] Short-term human clinical trials have shown that these lenses appear safe to wear.[6]

The development of antimicrobial lenses

A



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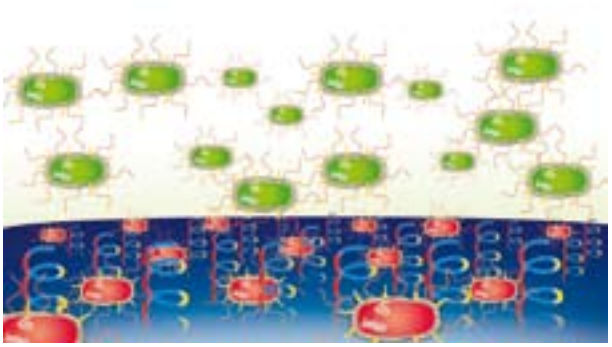

Figure 2. Demonstration of two surface-attached antimicrobial agents and their mechanism of action. Figure 2A shows a lens coated with a polymer containing a polyquaternary ammonium compound (N+) to give an antibacterial surface. Figure 2B shows a lens coated with a cationic peptide (spring-like structure) that has one side that is highly antibacterial (shown in red). As these antibacterial agents are tethered to the surface their activity is largely confined to those bacteria that adhere to the surface (dead bacteria shown in red). (Diagram not drawn to scale)

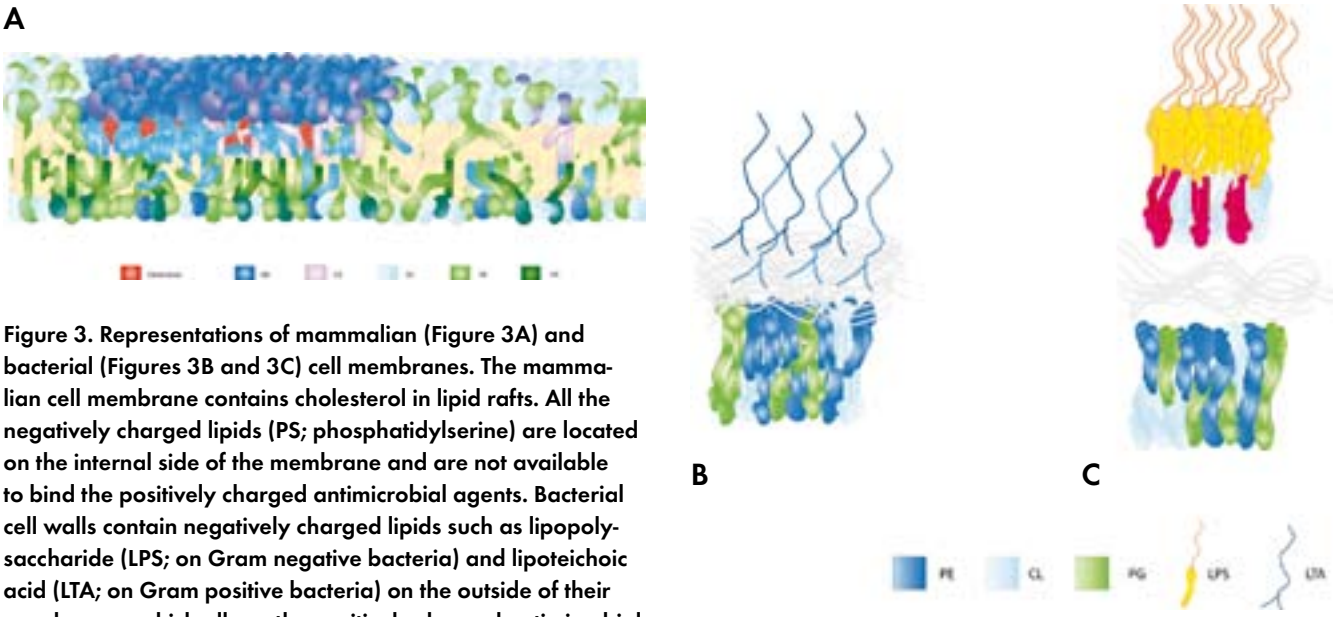

Figure 3. Representations of mammalian (Figure 3A) and bacterial (Figures 3B and 3C) cell membranes. The mammalian cell membrane contains cholesterol in lipid rafts. All the negatively charged lipids (PS; phosphatidylserine) are located on the internal side of the membrane and are not available to bind the positively charged antimicrobial agents. Bacterial cell walls contain negatively charged lipids such as lipopolysaccharide (LPS; on Gram negative bacteria) and lipoteichoic acid (LTA; on Gram positive bacteria) on the outside of their membranes, which allows the positively charged antimicrobial agents to interact and disrupt the bacterial membrane leading to bacterial death. (Diagram not drawn to scale)
SM = sphingomyelin; GS = glucosphingolipid; PC = phosphatidylcholine; PE = phosphatidylethanolamine; PS = phosphatidylserine; CL = cardiolipin; PG = phosphatidylglycerol and also, perhaps hydrogen peroxide (H_2O_2), which are highly toxic to bacteria. Fimbrolides (Furanones; Figure 4B) can kill bacteria but also make the surface less attractive for bacterial colonisation. (Diagram not drawn to scale)

is progressing, with some seemingly entering clinical trials. When can we expect to see these available for lens wearers? This is difficult to predict but I hope the first of these will become available in the next two to three years, if the clinical trial process proves that they remain safe and effective.

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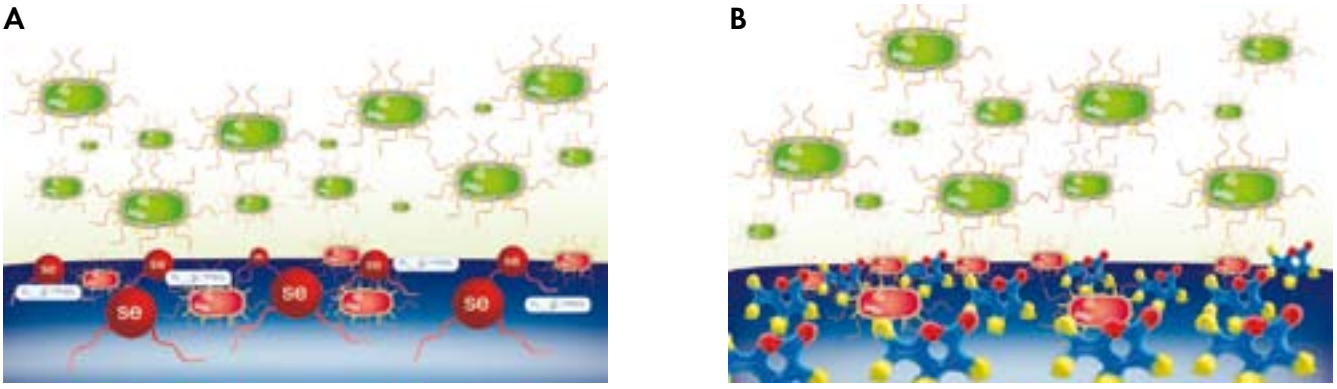

Figure 4. Representations of two more tethered antimicrobial agents. Selenium (Se; Figure 4A) catalyses the production of oxygen radicals (O_2^{-})

Lens care for about the

The design and function of orthokeratology lenses require patients to comply with the finer points of lens care

Russell Lowe
BScOptom

Orthokeratology (ortho-K), also known as overnight corneal reshaping (OCR), is performed with gas permeable* (GP) lenses, for which the material properties and care systems are well established.[1-3] From time to time, I am asked whether OCR lenses should be treated differently from conventional alignment-fitted GP lenses.

There is a case for maintaining a higher standard of care for OCR lenses due to differences in both function and design. Careful attention to the finer points of lens care, the 'one-percenters,' can significantly impact on the success of an OCR treatment program.

The two key points of difference with OCR lenses are

- the so-called reverse geometry design, meaning that the first peripheral curve is steeper than the base curve or back central optic radius (BCOR)
- the posterior or concave lens surface is ultimately responsible for the patient's uncorrected visual acuity.

These two factors have implications for cleaning and maintenance of OCR lenses.

Surface cleaning

The concave (posterior) surface of an OCR lens generates the fluid forces that are thought to be responsible for change in the shape and distribution of the anterior corneal tissue. It follows that the integrity of the posterior surface is of prime importance. Paradoxically, this surface is more difficult to clean. Good technique is needed to reliably remove accretions from inside the edge of the lens and at the transition between the base curve and the reverse curve.

I am a keen advocate of the use a stand-alone daily cleaner in preference to combined cleaning and conditioning solutions as the specialised purpose-specific formulation of surfactant cleaners generally promotes more effective surface cleaning.

Over the years we have seen outstanding results in our clinic with mildly abrasive cleaners such as the Boston Daily Cleaner (Bausch & Lomb) and PolyClens (Alcon Pharmaceuticals). It has long been acknowledged that incorporation of abrasive particles in surfactant cleaner solution enhances cleaning efficacy.[4]

Conventional wisdom[1-3] suggests GP cleaning is best performed with the lens placed in the palm of a cupped hand. The lens is then gently rubbed with the index finger of the other hand, the aim being to minimise the risk of warping and breakage. However, one must take care to avoid lens slippage that may negate an effective rubbing action relative to the posterior lens surface.

Figure 1. Fingertip method for well-controlled surface cleaning of GP lenses

I prefer a more controlled approach to surface cleaning using a fingertip method.

Start by bringing the index fingers of each hand into contact with the palms facing upward (Figure 1). The lens is carefully placed into the small cup formed between the tips of the two opposed index fingers. Using the right and left thumbs alternately, the lens is gently but firmly squeezed and rubbed from the centre (apex) to the edge with linear strokes.

Patients are advised that the lens will not break unless deformed. Mild to moderate pressure is applied with care taken not to bend the lens. Care is also taken not to contact the lens with finger- or thumb-nails. The tips of the index fingers of each hand remain in contact throughout to provide a stable platform.

The lens is progressively rotated during rubbing such that radial lines are drawn from the centre to the edge in a pattern resembling the spokes of a cartwheel. A preferred degree of rubbing force may be demonstrated by applying pressure to the patient's fingertip with your own fingers.

Rinsing

Preserved normal saline (0.9% NaCl) is now recommended for rinsing GP lenses following reports of *Acanthamoeba keratitis* associated with tap water rinsing.[5] Acanthamoeba sp. are overly represented in the published reports of microbial keratitis with OCR.[5] Practitioners who encourage tap water rinsing may face a risk of litigation in the event of an unwanted adverse event such as microbial keratitis. Notwithstanding the legal ramifications, serious microbial keratitis is a disturbing event for all parties concerned, particularly if a young child is involved. Avoidance of repeated risk behaviour is an important key to safety.

I advise patients to rub the lens surfaces during rinsing and continue until the lens no longer feels slippery, indicating that the cleaner solution has been removed. At this point, careful visual inspection of the lens for any apparent signs of defect is advisable.

ortho-k is 'one-percenters'

Pre-conditioning

I recommend 'pre-conditioning' before lens storage, meaning that the conditioning solution is actively rubbed onto the lens surfaces immediately prior to placement into the lens storage container. One tangible benefit of pre-conditioning is the further removal of rinsing agent residuals. Another may be improved chemical interaction between the lens surfaces and the storage solution, however that claim remains speculative.

Pre-application drop

When patients commence OCR treatment I prescribe a pre-application lubricating drop such as Boston Reconditioning Solution (Bausch & Lomb) or Systane (Alcon Laboratories). The lens is then placed onto the eye directly from the storage solution with care taken to avoid touching the concave surface. In the event of a contaminating fingerprint, the lens should be rubbed and rinsed with a fresh drop of conditioning solution.

Patients with pre-existing marginal dry eye or tear film instability may benefit from a high viscosity gel lubricant such as Genteal Gel (Novartis) applied as a droplet into the lens just before placement onto the eye. A small group of our patients has achieved greatly enhanced daytime uncorrected visual acuity (UCVA) outcomes with tear adjuncts such as TheraTears (Advanced Vision Research) in conjunction with prescribed blinking exercises to assist the process of lens positioning and settling before sleep.

Avoid contamination

Patients are advised to avoid contaminating the posterior lens surface during lens placement on the eye. Skin moisturiser is a common culprit causing areas of non-wetting with dire effect on the fluid forces generated by the posterior lens surface. In the event of a dropped lens, the patient is instructed to rinse and recondition the lens surfaces by rubbing with fresh conditioning solution. Use of daily cleaner followed by saline rinsing immediately prior to lens application is discouraged.

Lens surface inspection

Patients are required to bring their OCR lenses to all scheduled after-care visits. A key component of my routine six-monthly after-care examination involves dry lens surface inspection with light and dark field illumination using a 10x hand-held magnifying loupe (Bausch & Lomb). Lenses that appear relatively clean and deposit free when viewed in vivo under the slitlamp biomicroscope may look very different when the surfaces have been dried with lint-free tissue.

One advantage of GP lenses over soft lenses is that surface film deposit, scratches and other imperfections are readily revealed to patients by attaching the lens to the slitlamp fixation arm with inert adhesive such as BluTack (Bostik Australia Pty Ltd) for inspection under low (10x) magnification.

Figure 2 depicts large central proteinaceous film caused by poor cleaning technique. Film deposit distribution is variable and may concentrate at the lens centre, the reverse curve (Figure 3) or at the lens edge (Figure 4). Deposits such as these may cause complications such as lens decentration during overnight treatment, red eye and reduced corneal reshaping response.[6]

In my experience, film deposits such as those shown in Figures 2, 3 and 4 are rare when patients regularly perform surfactant cleaning as described above. A more common finding on dry lens inspection is the appearance of fine scratches and abrasions resulting from normal conditions of use. Eventually, lens replacement with a duplicate pair is indicated.[7]

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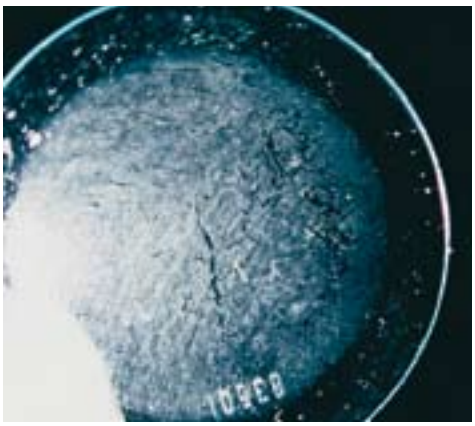

Figure 2. Large central proteinaceous film deposit with relatively clear periphery

Figure 3. Proteinaceous accretion largely in the region of the reverse curve adjacent to the treatment zone

Ortho-k 'one-percenters'

From page 37

Intensive cleaning

Progent (Menicon), a powerful oxidative cleaner,[6] is used as an in-office problem solver for the occasional patient who demonstrates significant protein film deposit. OCR patients who aggressively accumulate protein film deposit are advised to purchase Progent for their own regular use but such cases are relatively uncommon in my experience.

Lens replacement

I encourage OCR patients to undertake regular lens replacement every 12 to 24 months due to warpage, surface scratches, abrasions, cracks or chips around the lens edge that are difficult to avoid over time. One notable exception that comes to mind is patient GB who was lost to follow-up for several years. When he did return to the clinic for after-care examination, he achieved UCVA of 6/6 in each eye. His four-year-old lenses were in pristine condition without detectable film deposit although he had never used intensive cleaner.

Monitoring compliance

An integral part of my scheduled review consultations involves revision of lens care procedures, either by me or by our trained technicians. A good way to identify procedural weakness is to ask the patient to demonstrate their individual lens care methods. This commonly provides opportunities for constructive criticism. Lens storage containers are replaced free of charge at scheduled six-monthly visits.

Care plan

A cleverly structured annual care plan improves patient compliance and boosts practice revenue, clearly a win-win situation. We offer a care plan designed to encourage regular lens replacement. On payment of the annual fee, members received a laminated card listing a number of benefits that include 50 per cent off the fee for duplicate OCR lenses without limit, 40 per cent off all lens care solution purchases, and a number of other incentives. Patients often leave the office with a six-month or 12-month supply of solutions calculated to last until the next scheduled visit.

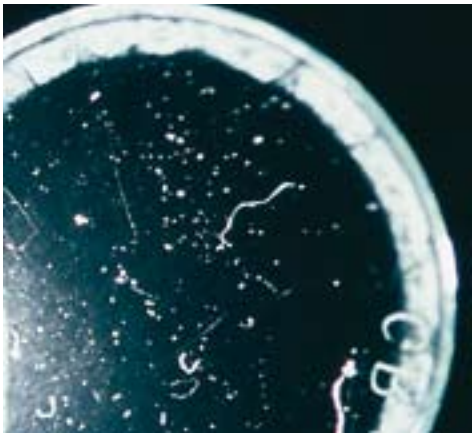

Figure 4. Proteinaceous deposit at the extreme periphery of the concave surface, a notoriously difficult area of the lens to clean

Lens material

OCR is feasible today because of the availability of high oxygen permeability (Dk) lens materials that enable overnight wear without significant compromise to corneal physiology. We now have at our disposal a number of materials that exceed the established minimum requirements for safe overnight wear. Currently the material with the highest Dk rating is Menicon Z, commercially available as the Z-CRT lens.

One shortcoming of the Z material is its relatively low surface hardness. Menicon expressly advises against the use of abrasive cleaners with the Z material due to the risk of surface damage. The Z-CRT lens is stored in multipurpose solution, Menicare Plus (Menicon) augmented with weekly use of Progent (Menicon), a powerful oxidative cleaner. I consider Progent unsafe for use by younger patients as it is highly toxic and needs full parental supervision.

I prefer to encourage young patients to become fully independent with lens care and handling methods as early as possible. Consequently, I avoid prescribing the Menicon Z material. Paragon Vision Sciences traditionally manufactures the CRT lens in the more robust HDS 100 material, now available through local distributors Contact Lens Centre Australia. Clearly, practitioners will make their own decisions in this regard.

Long-term success

For OCR to become widely accepted as a good alternative to refractive surgery[8] we need sustainable treatment programs that deliver clear UCVA for decades without corneal compromise. Our practice has a growing number of enthusiastic OCR patients, many of whom have had more than 10 years of successful therapy. Regular after-care and careful attention to detail are key elements to long-term success.[9]

Conclusion

Corneal reshaping is an elite refractive treatment. We pay careful attention to a host of 'one-percenters' to help keep our patients at the peak of their visual performance. According to the well-known sporting adage, it's the one-percenters that win the game.

I do not expect all practitioners to agree with my views nor is it important that they should. The purpose of this article is to provide a brief account of my experience in this exciting and relatively new field of eye care in the hope that others may benefit.

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* 'GP' rather than 'RGP' is used throughout this article in deference to Dr Ed Bennett's call to drop the term 'rigid' to more clearly differentiate from hard lenses made of polymethyl methacrylate (PMMA). ■

Disclosure
Russell Lowe is a professional consultant for Paragon Vision Sciences, manufacturer of Paragon CRT lenses.

PBS List of Medicines for Optometrists 13 February 2009

Antiglaucoma preparations

	Product	Max qty	Repeats
Antiglaucoma preparation			
Betaxolol eye drops, suspension, 2.5 mg (as hydrochloride)/mL, 5 mL	Betoptic S	1	5
Betaxolol eye drops, solution, 5 mg (as hydrochloride)/mL, 5 mL	Betoptic BetoQuin	1	5
Bimatoprost eye drops 300 mg/mL, 3 mL	Lumigan	1	5
Brimonidine eye drops containing brimonidine tartrate 2 mg/mL, 5 mL	Alphagan Enidin	1	5
Brimonidine with Timolol eye drops containing brimonidine tartrate 2 mg with timolol 5 mg (as maleate)/mL, 5 mL	Combigan	1	5
Brinzolamide eye drops 10 mg/mL, 5 mL	Azopt BrinzoQuin	1	5
Dorzolamide eye drops 20 mg (as hydrochloride)/mL, 5 mL	Trusopt	1	5
Dorzolamide with Timolol eye drops containing dorzolamide 20 mg (as hydrochloride) with timolol 5 mg (as maleate)/mL, 5 mL	Cosopt	1	5
Latanoprost eye drops 50 micrograms/mL, 2.5 mL	Xalatan	1	5
Latanoprost with Timolol eye drops 50 micrograms latanoprost with timolol 5 mg (as maleate)/mL, 2.5 mL	Xalacom	1	5
Pilocarpine eye drops containing pilocarpine hydrochloride 10 mg/mL, 15 mL	Isopto Carpine PV Carpine Pilopt	1	5
Pilocarpine eye drops containing pilocarpine hydrochloride 20 mg/mL, 15 mL	Isopto Carpine PV Carpine Pilopt	1	5
Pilocarpine eye drops containing pilocarpine hydrochloride 40 mg/mL, 15 mL	Isopto Carpine PV Carpine Pilopt	1	5
Pilocarpine eye drops containing pilocarpine hydrochloride 60 mg/mL, 15 mL	PV Carpine Pilopt	1	5
Timolol eye drops 2.5 mg (as maleate)/mL, 5 mL	Tenopt Timoptol	1	5
Timolol eye drops 5 mg (as maleate)/mL, 5 mL	Tenopt Timoptol	1	5
Timolol eye drops (gellan gum solution) 2.5 mg (as maleate)/mL, 2.5 mL	Timoptol XE	1	5
Timolol eye drops (gellan gum solution) 5 mg (as maleate)/mL, 2.5 mL	Timoptol XE	1	5
Timolol eye gel 1 mg (as maleate)/g, 5 g	Nyogel	1	5
Travoprost eye drops 40 micrograms/mL, 2.5 mL	Travatan	1	5
Travoprost with Timolol eye drops 40 micrograms travoprost with timolol 5 mg (as maleate)/mL, 2.5 mL	Duotrav	1	5

Restrictions on the use of the above preparations are to be advised

PBS List of Medicines for Optometrists 13 February 2009

	Product	Restriction	Max qty	Repeats
Anti-viral eye preparations		Restricted:		
Aciclovir eye ointment 30 mg per g (3%), 4.5 g	Zovirax	Herpes simplex keratitis	1	0
Antibiotics		Unrestricted		
Chloramphenicol eye drops 5 mg/mL (0.5%), 10 mL	Chlorsig		1	2
	Chloromycetin		1	2
Chloramphenicol eye ointment 10 mg/g (1%), 4 g	Chlorsig		1	0
	Chloromycetin		1	0
Sulfacetamide Sodium eye drops 100 mg per mL (10%), 15 mL	Bleph-10		1	2
Anti-inflammatory agents		Unrestricted		
Fluorometholone eye drops 1mg/mL (1%), 5mL	Flucon		1	0
	FML Liquifilm		1	0
Fluorometholone acetate eye drops 1 mg/mL (0.1%), 5 mL	Flarex		1	0
Flurbiprofen Sodium eye drops 300 µg/mL (0.03%) single dose units 0.4 mL, 5	Ocufen		1	0
Hydrocortisone Acetate eye ointment 5 mg/g (0.5%), 5 g	Hycor		1	0
Hydrocortisone Acetate eye ointment 10 mg/g (1%), 5 g	Hycor		1	0
Anti-allergy agents		Restricted:		
Sodium cromoglycate eye drops 20 mg/mL (2%), 10 mL	Cromolux	Vernal kerato-conjunctivitis	1	5
	Opticrom		1	5
Topical ocular lubricants		Restricted:		
Carbomer 980 ocular lubricating gel 2 mg/g (0.2%), 10 g	Geltears	Severe dry eye inc Sjogren's synd	1	5
	PAA		1	5
	Viscotears Liquid Gel		1	5
Carmellose sodium eye drops 10 mg/mL (1%), 15 mL	Refresh Liquigel		1	5
Carmellose sodium eye drops 5 mg/mL (0.5%), 15 ml	Refresh Tears plus		1	5
Hypromellose eye drops 3 mg/mL (0.3%), 15 mL (contains sodium perborate)	In a Wink Moist'ing		1	5
	Genteal		1	5
Hypromellose eye drops 5 mg/mL (0.5%), 15 mL	Isopto Tears		1	5
	Methopt		1	5
Hypromellose with Carbomer 980 ocular lubricating gel 3 mg-2 mg/g (0.3-0.2%), 10 g	HPMC PAA		1	5
	Genteal gel		1	5
Hypromellose with Dextran eye drops 3 mg-1 mg/mL (0.3%-0.1%), 15 mL	Poly-Tears		1	5
	Tears Naturale		1	5
Polyethylene glycol 400 with Propylene glycol drops 4 mg-3 mg/mL (0.4-0.3%); 15 mL	Systane		1	5
Polyvinyl alcohol eye drops 14 mg/mL (1.4%), 15 mL	PVA Tears		1	5
Polyvinyl alcohol eye drops 30 mg/mL (3%), 15 mL	PVA Forte		1	5
Polyvinyl alcohol eye drops 14 mg/mL (1.4%), 15 mL	Liquifilm Tears		1	5
Polyvinyl alcohol eye drops 30 mg/mL (3%), 15 mL	Liquifilm Forte		1	5
Polyvinyl alcohol eye drops 14 mg/mL (1.4%), 15 mL (contains sodium chorite/hydrogen peroxide as preservative)	Vistil		1	5
Polyvinyl alcohol eye drops 30 mg/mL (3%), 15 mL (contains sodium chorite/hydrogen peroxide as preservative)	Vistil Forte		1	5
Unpreserved unit dose ocular lubricants		Authority required:		
Carbomer 974 ocular lubricating gel 3 mg/g (0.3%), single dose units 0.5 g, 30	Poly Gel	Severe dry eye syndrome in patients sensitive to	3	5
Carbomer 980 eye drops 2 mg per (0.2%) , single dose units 0.6 mL, 30	Viscotears	preservatives in multi-dose eye drops	3	5
Carmellose sodium eye drops 5 mg/mL (0.5%), single dose units 0.4 mL, 30	Cellufresh		3	5
Carmellose sodium eye drops 10 mg/mL (1%) , single dose unit 0.4 mL, 30	Celluvisc		3	5
Carmellose sodium eye drops 2.5 mg/mL (0.25%), single dose units, 0.6 mL, 24	TheraTears		4	5
Carmellose sodium ocular lubricating gel 10 mg/mL (1%), single dose 0.6 mL, 28	TheraTears		3	5
Hypromellose with Dextran eyedrops 3-1 mg/mL (0.3-0.1%), single 0.4 mL, 28	Bion Tears		3	5
Tamarindus indica seed polysaccharide eye drops 10 mg/mL, 0.5 mL, 20	Visine Professional		3	5
Polyethylene glycol 400 with Propylene glycol drops 4 mg-3 mg/mL (0.4-0.3%); single dose units 0.7 mL, 28	Systane		3	5
Topical ocular lubricant ointments		Unrestricted		
Paraffin compound eye ointment 3.5 g	Polyvisc		2	5
Paraffin pack containing 2 tubes compound eye ointment 3.5 g	Polyvisc (2 pack)		1	5
Paraffin compound eye ointment 3.5 g	Duratears		2	5
Paraffin pack containing 2 tubes compound eye ointment 3.5 g	Ircal (2 pack)		1	5
	Lacri-Lube (2 pack)		1	5

Controlled substances that may be used or prescribed by optometrists

Ocular Medicine	Vic	Tas	Qld	NSW & ACT	NT	SA	WA*	PBS Optometry	PBS Listed
Anti-infectives									
Chloramphenicol	✓	✓	✓	✓	✓	✓	–	✓	✓
Ciprofloxacin	✓	✓	✓	–	✓	✓	–	–	✓
Framycetin	✓	✓	✓	✓	✓	✓	–	–	✓
Gentamicin sulfate	✓	✓	✓	–	✓	✓	–	–	✓
Ofloxacin	✓	✓	✓	–	✓	✓	–	–	✓
Sulfacetamide	✓	✓	✓	✓	✓	✓	✓	✓	✓
Tetracycline	✓	✓	✓	✓	✓	✓	–	N/L	N/L
Tobramycin	✓	✓	✓	–	✓	✓	–	–	✓
Aciclovir	✓	✓	✓	–	✓	✓	–	✓	✓
Anti-inflammatories									
Dexamethasone	✓	✓	◆	–	✓	✓	–	–	✓
Fluorometholone	✓	✓	✓	✓	✓	✓	–	✓	✓
Fluorometholone acetate	✓	✓	✓	✓	✓	✓	–	✓	✓
Hydrocortisone	✓	✓	✓	✓	✓	✓	–	✓	✓
Prednisolone	✓	✓	◆	–	✓	✓	–	–	✓
Diclofenac	✓	✓	✓	✓	✓	✓	–	N/L	N/L
Flurbiprofen	✓	✓	✓	✓	✓	✓	–	✓	✓
Ketorolac	✓	✓	✓	✓	✓	✓	–	N/L	N/L
Decongestants & anti-allergics									
Ketotifen	✓	✓	✓	✓	✓	✓	✓	N/L	N/L
Levocabastine	✓	✓	✓	✓	✓	✓	–	N/L	N/L
Lodoxamide	✓	✓	✓	✓	✓	✓	–	N/L	N/L
Olopatadine	✓	✓	✓	✓	✓	✓	–	N/L	N/L
Sodium cromoglycate	✓	✓	✓	✓	✓	✓	✓	✓	✓
Anti-glaucoma preparations									
Apraclonidine	✓	–	◆	✓	✓	✓	–	–	✓
Betaxolol	✓	–	◆	✓	✓	✓	–	✓	✓
Bimatoprost	✓	–	◆	✓	✓	✓	–	✓	✓
Brimonidine	✓	–	◆	✓	✓	✓	–	✓	✓
Brinzolamide	✓	–	◆	✓	✓	✓	–	✓	✓
Dorzolamide	✓	–	◆	✓	✓	✓	–	✓	✓
Latanoprost	✓	–	◆	✓	✓	✓	–	✓	✓
Pilocarpine	✓	–	◆	✓	✓	✓	–	✓	✓
Timolol	✓	–	◆	✓	✓	✓	–	✓	✓
Travoprost	✓	–	◆	✓	✓	✓	–	✓	✓
Mydriatics & cycloplegics									
Atropine	✓	✓	✓	✓	✓	✓	–	–	✓
Cyclopentolate	✓	✓	✓	✓	✓	✓	✓	N/L	N/L
Homatropine	✓	✓	✓	✓	✓	✓	–	–	✓
Pilocarpine	✓	✓	✓	–	✓	✓	–	–	✓
Phenylephrine	✓	✓	✓	✓	✓	✓	–	N/L	N/L
Tropicamide	✓	✓	✓	✓	✓	✓	✓	N/L	N/L
Local anaesthetics									
Amethocaine	✓	✓	✓	✓	✓	✓	–	N/L	N/L
Lignocaine	✓	✓	–	–	✓	✓	–	N/L	N/L
Oxybuprocaine	✓	✓	✓	✓	✓	✓	✓	N/L	N/L
Proxymetacaine	✓	✓	✓	✓	✓	✓	✓	N/L	N/L

◆ The use of these medicines by optometrists is currently being considered
* Optometrists in Western Australia do not have access to the PBS

N/L Substance is not listed under the PBS

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