management of the patient with contact lens-related dry eye is often challenging to the eyecare practitioner (ECP). In the second part of ‘Dry eye in contact lens wear’, the authors discuss the management of ocular surface and lens-related difficulties experienced by patients.

DISORDERS OF THE LID MARGIN
In managing the patient with contact lens-related dry eye, it is important to treat any co-existing lid margin or ocular surface disease. Critically to the ECP, the presence of meibomian gland dysfunction (MGD) or blepharitis in the lens wearer may underlie the discomfort that the contact lens patient may be experiencing.

Blepharitis, an inflammation of the eyelid, may be caused by a number of conditions such as staphylococcus epidermis, staphylococcus aureus or the presence of demodex mites. While the exact mechanism underlying the lid response is unknown, it is widely believed that the inflammation is due to direct infection of the glands of the eyelid. Figure 1 shows lash crusting in a case of anterior blepharitis.

MGD is a condition where the production of meibum, the main constituent of the tear film lipid layer is disrupted, typically leading to blockage of the glands with a wax-like substance. This disruption may be caused by a number of factors such as infection, toxicity, gland keratinisation and some systemic conditions – leading to a reduction in the quality and quantity of meibum produced. Management of lid margin conditions centres on the maintenance of lid hygiene. With increased interest in the management of ocular surface conditions, a number of products have emerged on the market to aid the eyecare practitioner (Box 1, Figure 2). Traditional management of ocular surface conditions has centred around the use of dilute baby shampoo and home-made sodium bicarbonate solution, as recommended by the UK College of Optometrists.

Figure 1: Crusting between lashes in blepharitis

This article has been approved for 1 CET point by the GOC. It is open to all FBDO members, and associate member optometrists. The multiple-choice questions (MCQs) for this month’s CET are available online only, to comply with the GOC’s Good Practice Guidance for this type of CET. Insert your answers to the six MCQs online at www.abdo.org.uk. After log-in, go to ‘CET Online’. Questions will be presented in random order. Please ensure that your email address and GOC number are up-to-date. The pass mark is 60 per cent. The answers will appear in the October 2016 issue of Dispensing Optics. The closing date is 13 September 2016.

COMPETENCIES COVERED
Dispensing opticians: Communication, Ocular Examination, Ocular Abnormalities, Contact Lenses, Standards of Practice
Contact Lens Opticians: Communication, Ocular Examination, Contact Lenses, Standards of Practice
Optometrists: Communication, Ocular Disease, Standards of Practice, Contact Lenses
Optometrists guidelines\textsuperscript{30}. While readily available, these management options have been found to encourage a further destabilising effect on the tear film\textsuperscript{31}. Many options now exist for the management of lid margin conditions, some of which contain antimicrobials that are designed for use on their own or in conjunction with sterile wool pads to cleanse the lid margin while minimising the insult to the ocular surface. The waxes in blocking glands in MGD are known to have an increased melting point\textsuperscript{32}. In order to effectively unblock these glands, it has been found that a constant heat of 45 degrees for at least four minutes is required\textsuperscript{33}. To achieve this consistent temperature, specialised heat therapy masks have been developed, and with consistent use have been found to effectively manage MGD and improve tear film stability\textsuperscript{34,35}.

Practitioners should be aware that direct heat to the eyelids, such as the warm compresses used for MGD, can stimulate mast cell degranulation\textsuperscript{36} – and may mimic an inflammatory action, in some cases increasing symptoms. ECPs should consider prescribing a cold compress shortly following the warm compress to control further inflammatory response.

For more severe cases of lid margin disease, new in-clinic treatment options are becoming available, such as fast rotating lid cleaning devices which, when used in conjunction with 50 per cent tea tree oil, have been found to be effective in alleviating the symptoms of dryness and improving MGD\textsuperscript{30,37,38}. Other promising treatments using thermal pulsation to improve gland function offer an exciting insight into future treatment of patients with lid margin conditions\textsuperscript{39}.

**MANAGING LENS DISCOMFORT**

Management of lens discomfort should begin with an assessment of the fit of the contact lens using a biomicroscope. The initial aim is to identify obvious features causing issue such as damage to the lens edge or areas of the lens that are not wetting. Assessment should check the fit of the contact lens on the cornea, and that the lens moves sufficiently both in the primary and secondary positions of gaze.

The presence of deposits on a lens may lead to discomfort by reducing the wettability of the lens on the eye. The contact lens on the cornea, and that the lens moves sufficiently both in the primary and secondary positions of gaze.

Patients wearing flat fitting soft lenses often complain of discomfort on lens insertion\textsuperscript{40}. This may be caused by interaction of the lens edge with the eyelid and care should be taken to confirm that the lens has been inserted by the patient correctly (an incorrectly fitted inverted lens may also appear as flat fitting), with lens type or base curve modified appropriately.

Discomfort may also occur in stiffer materials with higher modulus of elasticity, which may give stand-off or lens fluting leading to discomfort during lid interaction\textsuperscript{41}. Generally, steep fitting lenses exhibit comfort on insertion but often develop ocular surface problems such as mechanical irritation and corneal epithelial dysfunction after a period of wear\textsuperscript{42}, believed to be due to a build-up of wasted deposits and minimal tear exchange.

**Box 1: Ophthalmic imaging and lid hygiene**

Often overlooked in busy practice, the importance of high quality imaging cannot be overstated. In practice, the authors use the ARC program that is capable of capturing high resolution still and video recordings. Not only useful for record keeping, high quality imaging can be useful in encouraging patient compliance. The old adage goes, ‘A picture is worth a thousand words’, and being able to show the effects of dryness on the eye, or the presence of collarettes in blepharitis can help compliance dramatically.

Blepharitis and meibomian gland dysfunction often co-exist, especially in the symptomatic patient. The management of these disorders centres around lid hygiene, encouraging meibomian gland function whilst aiming to reduce microbial load and encourage surface healing. A typical daily treatment plan for this patient would be:

1. Eyelid compression using a warm compression mask for four minutes, encouraging the melting of waxy meibomian blockages and clearance of the glands.
2. Digital cleansing of the lid margin using an antimicrobial lid cleanser, manually removing and reducing the microbial load of the eyelid.
3. Cold compression of the eyelid for three to four minutes to cool and reduce redness and discomfort of the eye.
4. Installation of a hypotonic ocular lubricant: to support the tear film, and to ‘wash out’ any debris from the lid hygiene process.

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**Figure 2: Some products designed to treat dry eye**

**Figure 3: Using a gel-filled microwavable mask**
nature of the deposit typically depends upon the class of lens being worn, with denatured proteins typically depositing on hydrogel materials while silicone hydrogel lenses are more prone to lipid deposits. Improving the quality of lens care has been shown to reduce the build up of deposits. Studies have shown that lens cleaning with products containing polyquaternium is more effective in reducing deposit formation than products containing polyhexadine biguanide or peroxide-based systems. Other useful components for dealing with lens deposits include the addition of a surfactant or alcohol-based cleaning agent to remove lipid deposits, and the inclusion of citrate-based cleaning agent in the removal of protein deposits.

For the patient with chronic lens deposits, practitioners should consider modification of lens parameters. The movement from extended or continuous wear to a daily wear lens reduces the risk of clinically significant deposits forming on the lens dramatically and should be considered in cases where chronic deposit formation is identified.

DEALING WITH SOLUTIONS SENSITIVITY
ECPs will be familiar with the problem of sensitivity to a particular contact lens solution. It is known that some solutions contain components that may contribute to the development of hypersensitivity, toxicity and the potential to damage the ocular surface and lead to the development of symptoms of dryness and discomfort. Cleaning solutions are less likely to induce dryness and discomfort where wetting agents have been added to them.

The picture is mixed, however, and it has been found that the effect of solution depends upon the material of the lens used, with some solutions having a more beneficial effect than others with certain materials. Paradoxically, it may not always be the case that the best solution for a lens is created by the manufacturer of the contact lens. In cases where reaction, or intolerance to a particular lens cleaning solution is suspected, it is advisable to switch the patient to another solution type that is known to work well with that lens type.

For patients experiencing constant discomfort from the care solution that their lens is cleaned in, an effective way to avoid this is to remove the need for a care system and move to a daily disposable lens type. The removal of the care system removes the risk of care system interaction with the eye or lens. Indeed, it has been shown that moving from a daily wear lens to a daily disposable modality leads to a reduction in the incidence of contact lens-related dryness. This is perhaps understandable as it is well known that continuous wear soft lens users experience a reduction in the wettability and comfort of lenses over time, with the small risk of a reduction in the quality of vision with continuous use due to dryness.

It should be noted that in the case of a daily wear lens, the contents of the blister pack still serve as a single-use sterile care agent. For patients prone to dryness induced by sensitivity to the care agent used, it has been found that pre-conditioning the contact lens with carboxymethyl cellulose drops could provide a more physiologically suitable environment for the new lens, improving comfort and reducing associated dryness.
BENEFITS OF DIFFERENT LENS TYPES

Extensive research has been undertaken on the importance of oxygen transmissibility through a contact lens and its impact on ocular health. Traditional hydrogel lenses increased oxygen permeability by an increase in water content, which while improving short-term comfort, increased the risk of dehydration of the lens surface. With the development of silicone hydrogel lenses, oxygen permeability is controlled by the silicone content of a lens, while the quality of lens surface and the use of appropriate hydrophilic wetting agents determine the comfort of a lens.

Few studies have been undertaken looking at the difference in contact lens-related dryness and comfort between hydrogel and silicone hydrogel contact lenses. Those that have been carried out have found that modification of the lens material of the symptomatic hydrogel wearer to silicone hydrogel lenses may reduce symptoms in up to half of patients regardless of the patient’s wearing modality. While much research still needs to be done, current evidence suggests that silicone hydrogel lenses may offer a route of increased comfort and a reduction in the symptoms of contact lens-related dry eye.

Like soft lenses, in the case of ocular dryness with gas permeable (GP) lenses it is important to ensure a correct lens fit. Symptoms of dryness with GP lenses are closely correlated with lens fit, with an aligned fit providing greater comfort over the long term. This principle is of particular importance in cases of fitting lenses to astigmatic corneas. Fitting toric lenses and lenses with toric peripheries to patients with astigmatic corneas has been shown to reduce symptoms of dryness in GP wearers, and should be considered for all patients with significant corneal astigmatism.

For the symptomatic GP wearer following the development of ultra-high oxygen permeable materials, the option exists to increase the diameter of the contact lens used. In cases of severe dryness in the GP lens wearer, it may be prudent to consider moving the patient to a semi-scleral or full scleral lens design. These lenses allow for a significant ‘reservoir’ of tear fluid to be maintained behind the lens to ensure comfort. These lens designs also benefit from having minimal interaction with the eyelid during the blinking process, improving patient comfort significantly.

MANAGING DRY EYE

Dryness of the ocular surface with or without lenses is often part of a cycle of dis-regulation of the tear film. Ocular surface dryness is often driven by increased osmolarity and low-level inflammation of the ocular surface. The implications of this are damage to the ocular surface, further destabilisation of the tear film and a general reduction in the quality of vision.

Chronic increased osmolarity has been shown to lead to a reduction in corneal sensitivity and to goblet cell dropout, leading to reduction in both aqueous and mucous production. Chronic low-level inflammation of the lid margin leads to folds in the conjunctiva known as lid parallel conjunctival folds (LIPCOF) and the development of lid wiper epitheliopathy (Box 2).

The control of contact lens-related dry eye with ocular lubricants requires ECPs to consider the interaction of the content of ocular lubricants with the lenses worn by patients. Tear replacing lubricants should be ECPs to consider the interaction of the content of ocular lubricants with the lenses worn by patients. Tear replacing lubricants should be used to manage contact lens dry eye.
Unpreserved hypotonic lubricants, particularly those using hyaluronic acid and carboxymethyl cellulose (CMC), have been found to be effective in reducing osmolarity and inflammation in patients suffering dryness, with some studies suggesting that the combined use of CMC containing agents prior to silicone hydrogel use offering protection to the ocular surface. Ocular lubricants containing balanced electrolyte profiles have been shown with frequent use to improve both goblet cell density and corneal glycogen production, and reduce vital staining of the ocular surface.

Contact lens wearers who experience dryness should be encouraged to use a hypotonic ocular lubricant prior to the insertion of their contact lenses, and to continue to use the lubricant throughout lens wear when required. Patients with more extensive dryness should be encouraged to use ocular lubricants more frequently, with use early in the morning and early evening to counter the periods of the day where tear film osmolarity is at its highest.

In cases of chronic dryness, where the frequency of installation of lubricants is too high for the patient, more invasive measures need to be considered. Occlusion of the nasolacrimal duct has been shown to increase tear film volume and return a level of stability to the tear film. The benefits of occlusion may be carried out diagnostically using temporary collagen punctal plugs, which once inserted occlude the nasolacrimal duct for a period of up to two weeks, allowing practitioner and patient to assess the benefits of occlusion. Longer-term occlusion may be carried out using silicone-based punctal plugs such as the Eagle Vision Plug. Occlusion by punctal plugs can be successfully carried out in clinical practice under topical anaesthesia, requiring minimal chair time and investment in equipment.

NUTRITIONAL FACTORS
Many ECPs will be familiar with the importance of adequate hydration for patients experiencing ocular dryness, with studies recommending six to eight glasses of water a day. It has been found that consumption of alcohol has a negative impact on the hydration of the tear film in contact lens wear, and symptomatic patients should be warned of this connection.

Recent work highlights the increased importance of nutritional supplementation, in particular the importance of essential fatty acids such as omega-3 in the effective management of dryness. Essential fatty acids are those that cannot be synthesised in the body but are required for healthy function. They are crucial as they are converted by the body into prostaglandins, mediating components in the inflammatory pathway.

It is believed that the typical western diet does not contain enough omega-3 and by contrast contains an excess of omega-6 in a ratio of roughly 1:15-20. Some studies have suggested that a ratio of 1:4 might be more suitable, reducing low-level inflammation. Increased omega-3 supplementation has also been found to both increase tear film volume and the production of meibum, with subsequent alleviation in the symptoms of dryness. Nutritional supplementation should, therefore, be considered as a first-line treatment in all patients with ocular dryness.

With the advent of therapeutic prescribing, extended options become available to the therapeutically qualified ECP. The mainstay of these treatment options aims to reduce the influence of ocular surface disease in the management of contact lens-related dry eye.

Oral antibiotics such as azithromycin and doxycycline have been shown to be effective in the management of stubborn cases of blepharitis, the latter being particularly effective in patients with rosacea. The action of both antibiotics is by binding to the bacterial ribosome and inhibiting mRNA translation.

Independent prescribers may prescribe off-label products for the management of dry eye, so long as it is in the best interest of the patient. Cyclosporine 0.05 per cent, a T-cell inhibitor which acts by reducing inflammatory activation and cellular apoptosis, has been licensed by the US Food and Drug Administration for the management of moderate to severe dry eye conditions. Cyclosporine reduces inflammation and increases tear production. It also has relatively few side-effects due to its low systemic absorption.

In conditions of ocular dryness, an ever-present element is inflammation of the ocular surface. In severe cases, optometric practitioners in conjunction with ophthalmology colleagues may consider the use of topical steroids to reduce the surface inflammation. Topical steroid use for as little as one week has been shown to reduce the symptoms associated with ocular surface disease. Practitioners should be cautious to monitor intraocular pressure and lens integrity due to the increased risk of developing sub-capsular cataract and glaucoma.

CONCLUSION
Patients who experience dry eyes associated with contact lens use are at higher risk of lens dropout. For these patients, early intervention and management of potential problems can dramatically reduce this risk, leading to a reduction of symptoms and contact lens dropout. Routinely, and in cases of symptomatic patients, a thorough examination is required to assess the causes of contact lens-related dryness. Effective management requires consideration of lens type, material and modality, cleaning solutions used, lens interactions with the tear film and ocular surface, in addition to a broader picture of the patient’s general health.

Practitioners should consider that often there may be multiple causes of lens-related dryness and should be confident in managing patients using a combination of therapies, and where necessary be ready to refer patients with complex needs to a more experienced practitioner. Successful intervention in cases of ocular dryness reaffirms patient confidence in the professionalism of their practitioner and reduces the likelihood of lens drop out, maintaining patient satisfaction and guaranteeing patient loyalty for years to come.

FURTHER RESOURCES (for MCQs and study)

REFERENCES
(continued from Part 1)