Tinted and therapeutic lenses

In an adjunct to their basic contact lens fitting series, **Andy** and **Ngaire Franklin** give an overview of both cosmetic and therapeutic contact lenses. **Module C16225, one general CET point for optometrists and dispensing opticians, one specialist point for contact lens opticians**

Soft contact lenses may be tinted for a number of reasons. Handling tints make the lens more visible against a white background, so they are easier to find in the case, and if they are dropped on to a work surface or sink. This works rather less well if the background surface is itself coloured, of course. Cosmetic lenses are used to modify or change the appearance of the eyes. UV-blocking lenses reduce the levels of UVA and UVB radiation reaching the retina and lens. Sports tints have recently been introduced to assist performance in sports such as golf and shooting (Figure 1).

Figure 1 Promotional shot for early sports CL (image courtesy of Bausch+ Lomb)

Cosmetic lenses

Coloured contact lenses allow a patient to modify or completely change the appearance of their eyes. In the US, about 8 per cent of soft lens wearers have coloured lenses, though in Europe the figure is lower, around 6 per cent, though one in five adults in the UK say they would consider trying them. The majority of these are young, between 16 and 35, which suggests that a significant part of the motivation is concerned with finding a mate. A significant number of those who do not require visual correction wear plano coloured lenses purely for cosmetic reasons. Until recently, the supply of plano lenses was effectively unrestricted as they were not classified as optical appliances under UK or US law. Hairdressers, beauty salons and clothes shops all supplied these lenses, and mail-order and internet sources were also active. There were reports of wearers sharing and exchanging lenses and many of the outlets failed to give adequate advice on lens care and hygiene. Not surprisingly, reports of microbial keratitis soon followed. In the UK, plano cosmetic lenses are now effectively under the same legislation as the rest in that they can only be supplied to a specification issued by a registered medical practitioner, optometrist or dispensing optician, and the seller must make arrangements to receive reasonable aftercare. Similar legislation will be implemented in the US.

The psychology of eye colour is complex. In a survey of American women, respondents were given a set of eight attributes – creative, devious, kind, intelligent, sexy, shy, sweet and trustworthy – which they were asked to attribute to various eye colours. Blue eyes were most associated with sweet (42 per cent) sexy (21 per cent) and kind (10 per cent) (Figure 2). No wonder blondes have more fun! Green eyes were sexy (29 per cent), creative (25 per cent) and devious (20 per cent). Brown eyes were perceived as intelligent (34 per cent) trustworthy (16 per cent) and kind (13 per cent). It should be stressed that there is considerable variation between individuals and that the survey was of an ethnically and culturally diverse sample, with 29 per cent blue eyes, 29 per cent green and 42 per cent brown, with the rest having eyes described as honey, grey, turquoise and amethyst. It would seem then that a certain eye colour could emphasise certain desirable traits in an individual on first acquaintance. There is also the desire to stand out in a crowd. In countries where darker irides are usually associated with darker skin tones, green or blue eyes may be striking, and the use of 'fun' lenses with patterns with deliberately unnatural colours or patterns may well break the ice at parties. Carefully chosen, coloured lenses may have the desired effect, but there is also potential for 'fashion disasters' that leave the wearer looking ill, or a little demented.

Cosmetic lenses may be divided into three main categories:

- Enhancers are translucent lenses which allow the natural iris colour to show through. Light incident on the iris is scattered by the iris stroma. Short wavelength light is absorbed by the chromatophores within the stroma. Blue eyes have relatively few chromatophores, so more light is reflected back towards an observer. An enhancer lens placed on a blue eye will modify the spectrum of light incident on the iris and because quite a lot of it is reflected back, a marked effect on iris colour will be observed. On darker eyes, little of the incident light is reflected, so the effect of an enhancer tint will be marginal.
- Opaque tints act as the main reflecting surface, so they have more effect on the iris appearance whatever the underlying colour. Solid opaque

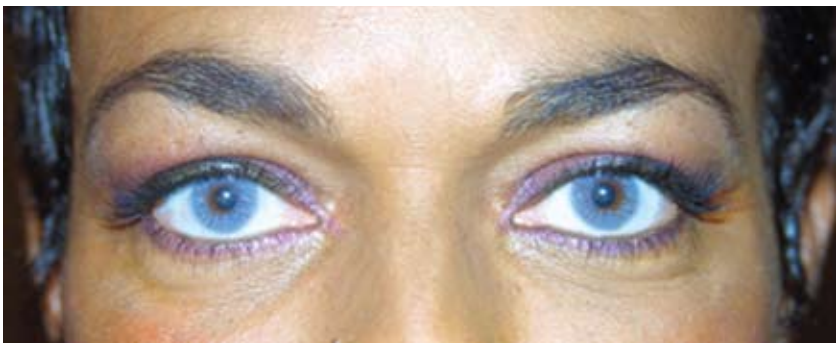

Figure 2 Eye colour seems to change what people think of you

tints give a strange, doll-like appearance to the eyes, so most have an iris pattern incorporated, sometimes in more than one colour (Figure 3).

- 'Fun' or 'crazy' lenses are not designed to be natural. They are opaque lenses with patterns or pictures that make a statement, sometimes showing allegiance to a sports team or socio-political message.

Translucent tints may be created by four basic methods:

- Dye dispersion, where the tint is added to the lens polymer, is mostly used on RGP lenses
- Vat dyeing involves dipping the finished lens in dye for a predetermined time. The dye penetrates only the surface so the level of tint is independent of lens power or thickness
- Chemical bond tinting uses a catalyst in the soaking process to produce a stable uniform tint
- Printing allows an iris pattern and a clear pupil area may also be incorporated.

Opaque tints may be produced in three ways:

- Dot matrix printing allows some of the original iris pattern to show through
- Laminate construction allows the iris pattern to be protected within the lens
- Opaque backing is where the iris pattern and clear pupil is applied to the back of the lens, which may allow a more natural appearance.

Most translucent and opaque lenses have a clear peripheral zone so that the sclera looks natural. Opaque lenses also have a clear pupil area to avoid loss of contrast. Enhancers may incorporate a pupil area, particularly if the colour is dense, but many do not as the absence of a transition zone gives a more natural result.

For a good cosmetic result it is desirable that the lens should not move too much, as a mobile lens may give an effect which is unsettling to an observer. Furthermore, with opaque lenses some disruption of vision may occur if the clear pupil moves relative to that of the eye. Therefore, from an aesthetic and visual point of view, an immobile lens is ideal, and many coloured lenses tend to be on the large side. However, immobility may not be a desirable characteristic from a physiological viewpoint. It may be tricky to fit a lens which meets all of these requirements simultaneously, which may be why eye care practitioners are on the whole less enthusiastic about cosmetic lenses than the public at large.

Figure 3 Coloured lenses are comprised of multiple print layers (image courtesy of Johnson & Johnson)

Tinting will affect the performance of the lens slightly in comparison with a clear lens. There may be slight effects on contrast sensitivity and on visual fields, though probably not clinically significant ones. Many patients will make the observation that flare can be a problem in low light levels when wearing 'Iris' pattern lenses. Corneal oedema may be slightly more likely with laminated designs due to increased lens thickness, though most tinting processes do not affect oxygen transmission. Some tinting processes alter the surface charge of the lens surface that could affect wettability, comfort and protein deposition, but as most coloured lenses are disposable the effects are limited.

Solutions are rarely a problem, though non-alcohol based intensive cleaners may cause colour fading. Contrary to popular belief, peroxide systems do not appear to cause fading on modern lenses, though if the lenses are worn intermittently, multipurpose solutions are a safer storage option as they offer continuous disinfection.

UV-absorbing lenses

Ultra-violet light in the bands between 315-400nm (UVA) and 280-315nm (UVB) has been implicated as a potential cause of cataract and macular degeneration, though the degree of risk is at present unclear. The lens absorbs most of the UV light in adults, but considerably less in children. It has been estimated that most of the UV exposure to the retina takes place before the age of 25, by which time the ageing process of the lens provides increased protection to the retina. In young eyes, it may be that the metabolism of the retina is sufficiently robust to resist any malign effects of the exposure, whereas similar levels of radiation might cause significant damage in an older eye. Some degree of UV protection might be appropriate then in young patients, particularly those with light-coloured irides or a lifestyle in which frequent exposure to high levels of sunlight is likely, and in post-cataract patients who have lost the natural UV filter provided by the lens. A number of lenses are available which offer enhanced UV absorption, and these may be identified from the ACLM manual. It should be stressed that none of these are claimed to offer total UV protection, so in bright sunlight sunglasses are still required.

Therapeutic lenses

Most contact lenses are fitted electively, either to correct vision or for cosmetic effect, but some are fitted for therapeutic reasons. For the most part, therapeutic fitting is done in hospitals, but the practitioner may occasionally encounter such patients either in aftercare or in fitting under medical direction. The very nature of the pathological conditions requiring therapeutic lenses means that the patient is likely to present with one or more contraindication to contact lens wear, and there is likely to be an increased risk of complications. The contraindications may be ocular, with dry eyes or epithelial compromise that would normally preclude contact lens fitting, or systemic such as poorly controlled diabetes or arthritis. A balance must be struck between potential benefits and adverse consequences and the patient must be kept informed of both. Lenses may need to be worn on an extended wear basis, as the normal insertion and removal procedures may disrupt an already fragile cornea. Deficient tear films may cause rapid deposition, and frequent replacement may be necessary. Various types of lens are used in therapeutic applications, both rigid and soft. The soft lenses employed have traditionally been mid to high water content, either custom made or commercially available. Recently, silicone hydrogels have become important due to their combination of high oxygen permeability and resistance to deposits.

Therapeutic lenses are employed for a number of reasons:

- Correction of irregular or unusual corneal shape
- Pain relief
- Following chemical injuries
- Maintenance of a pre-corneal tear film
- Protection
- To allow healing following trauma or surgery
- Drug delivery.

Correction of unusual or irregular corneal topography is more often associated with rigid lenses, both corneal and scleral. However, soft lenses are sometimes used successfully in early keratoconus, and in contact lens fitting following refractive surgery.

Pain relief is a relatively common reason for contact lens use. Small corneal abrasions usually heal quickly, but persistent or recurrent epithelial lesions may require a lens to protect the injury from the lid. A number of conditions may require a soft 'bandage' lens to relieve epithelial pain.

- Recurrent erosion syndrome may follow minor trauma to the cornea, and is often associated with basement membrane dystrophy (eg Cogan's microcystic dystrophy, map-dot-fingerprint dystrophies). A bandage lens may prevent the lid margin pulling on the unstable area of epithelium. This often occurs if the eyes are opened during the night or first thing in the morning, so if a lens is used, overnight wear would be most effective. Usually lens fitting is only tried if meibomian gland dysfunction has been eliminated and ocular lubricants have failed to ameliorate the condition
- Corneal dystrophies such as Reis-Buckler's, Meesman's, lattice and Fuchs' dystrophies may also cause pain. In the latter stages of Fuchs' dystrophy bullous keratopathy may cause considerable pain and a bandage lens may relieve this
- Thygeson's superficial punctate keratopathy may be managed with a soft lens, but topical steroids are more often employed
- Filamentary keratitis may occur in two forms. The 'wet' variety is not accompanied by dry eye and may be seen with herpes simplex keratitis, recurrent erosion, dystonia and in superior limbic keratitis. Soft lenses are often successful. However the 'dry' form, which is accompanied by a deficient tear volume, is more often managed with rigid scleral lenses
- Epithelial degenerations such as Salzmann's nodular degeneration, rosacea keratopathy and atopic keratoconjunctivitis may need a soft lens for pain relief, but if conjunctival disease is also present, rigid sclerals may be more successful, and may improve the vision somewhat.

Following chemical injuries, pain relief may be provided by a soft lens, but if the limbal stem cells are destroyed the presence of a contact lens will not prevent invasion of the cornea by epithelial cells derived from the conjunctiva. Scleral lenses may be used to maintain the fornices.

If the tear layer is deficient, it is usually managed with tear supplements and lubricants. The canaliculi may be blocked with punctal plugs. Hydrogel lenses tend to dry out and either tighten or fall out entirely. Silicone hydrogels are more useful, having a low water content and good resistance to deposition, but often a sealed scleral lens that vaults both the cornea and limbus is a better option. It will allow the maintenance of a precorneal tear film, even when the corneal surface is rendered hydrophobic by dysplasia or mucus deficiency. As the lens is sealed, an RGP material is required to prevent excessive corneal oedema.

Protection from the lids and the environment may be required if the lids are immobile following VII nerve disease, damaged by trauma or surgery or turned in or out by chronic cicatrising conditions such as Stevens-Johnson disease or ocular pemphigoid. Options for management include tarsorrhaphy, paralysis of the levator superioris with botulinum toxin and contact lenses, either soft lenses or scleral RGPs.

Following trauma or surgery, healing may be more rapid if a bandage lens protects the wound. Small aqueous leaks after trauma or trabeculectomy may be sealed, provided that the lens is large enough (up to 20mm). Penetrating injury may be helped by the lens acting as both seal and splint. A slightly tighter fit is often used here.

Hydrogel lenses have been used to deliver 4 per cent pilocarpine in the treatment of acute closed-angle glaucoma by soaking them in the solution before insertion. Antibiotics, antivirals, epidermal growth factor and fibronectin have also been delivered in this way.

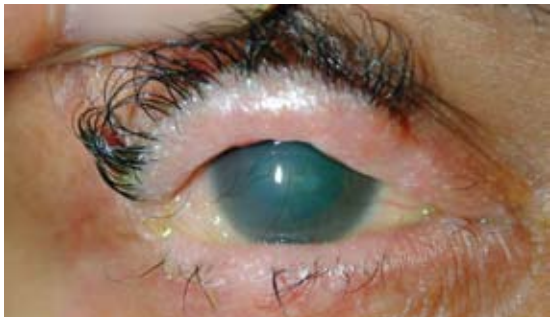

Figure 4 Stevens-Johnson disease

MULTIPLE-CHOICE QUESTIONS – take part at opticianonline.net

1 Which is the commonest age range for use of cosmetic lenses?
A Under 18s
B 16 to 35 years
C 35 to 50 years
D Over 65s

2 Which of the following is NOT used to manufacture translucent tints?
A Dye dispersion
B Laminate construction
C Chemical bond printing
D Vat dyeing

3 Which of the following is NOT used in manufacturing opaque tints?
A Dot matrix printing
B Laminate construction
C Opaque backing
D Vat dyeing

4 Which of the following might be associated with recurrent erosion syndrome?
A Map-dot-finger dystrophy
B Fuchs' endothelial dystrophy
C Bullous keratopathy
D Reis-Buckler's dystrophy

5 Exposure keratopathy is most likely to result from palsy of which nerve?
A III
B IV
C V
D VII

6 Which of the following lens materials is least likely to exacerbate an eye with reduced tear volume?
A Mid-water conventional hydrogel
B RGP
C Silicone hydrogel
D High-water conventional hydrogel

Successful participation in this module counts as one credit towards the GOC CET scheme administered by Vantage and one towards the Association of Optometrists Ireland's scheme.
The deadline for responses is April 28 2011

Further reading

Buckley R Therapeutic Applications in *Contact lens Practice* (N.Efron ed) Butterworth Heinemann 2002, pp 325-331.
Veys J, Meyler J, DaviesI, Therapeutic contact lenses in *Essential Contact Lens Practice* Butterworth-Heinemann, 2002, pp89-95.

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