When discussing contact lenses for the first time with a presbyopic patient, the practitioner’s initial thoughts might concern the prescription: how to achieve levels of distance, intermediate and near vision which are acceptable for that patient’s requirements. A thorough pre-fitting conversation will, of course, also include questions about health, taking careful note of any history of ocular or systemic disease. Knowingly or unknowingly, however, these patients will also be subject to a great number of normal ageing changes.

This article aims to look at these common physiological changes as well as some of the diseases, which become more prevalent with age, and to consider how all of these factors may influence successful, continuing contact lens wear.

The distinction between ‘normal’ ageing changes and ocular disease is often blurred, so the article is classified instead by location within the eye.

**PUPILS**

Pupil size reduces with age. In normal illumination, the average 20-year-old has a 5mm pupil, increasing to 8mm in low light conditions. By the age of 70 however, the diameter will have reduced to an average of 2.5mm in normal light, increasing only to around 3mm. Pupils this small and unreactive not only reduce the amount of light arriving at the retina, but could also make the fitting of multifocal soft lenses rather challenging, since most of these lenses are, by nature of their design, pupil-dependent.

**LIDS**

Ptosis

With normal ageing, the top lid gradually assumes a lower position, a condition known as involutional (Box 1) or aponeurotic ptosis. The aponeurosis is that portion of the levator muscle which flattens out as it inserts into the tarsal plate, and in this condition the aponeurosis degenerates and/or disinserts from the plate, allowing the lid to droop.

This lowered lid position may be need to be considered when deciding the total diameter of a corneal RGP lens. It may also cause reduced oxygen supply to the superior cornea, a situation that could be exacerbated by the wearing of low dK soft lenses.

Long term PMMA and RGP lens wearers are known to be at increased risk of developing aponeurotic ptosis, with the causes thought to be either stretching of the aponeurosis when employing the ‘pull and blink’ method of lens removal, or possibly low grade, chronic irritation of the lid. One study has suggested that there is also an increased risk in soft lens wearers.

**Ectropion**

The lower lids are also susceptible to involutional changes. Ectropion (literally ‘turning out’) may occur, due to degenerative changes in the ligaments of the inner and/or outer canthi, and in the tarsal plate. Alternating/translating bifocal contact lens designs rely on the lower lid to push the lens up, placing the reading portion in the line of gaze, and these would be unsuitable in the presence of ectropion.

A complication of ectropion is punctal eversion, in which the punctum is clearly visible because it is no longer in contact with the globe or with the lower tear.
meniscus. In this situation the tears are unable to find their natural drainage hole and so spill down the cheek (epiphora). The problem may be made worse by frequent contact lens insertion and removal.

Also, inadequate contact between the lids and the globe may prevent efficient spreading of the tear film across the cornea and contact lens. Add to all of this the increased exposure caused by the lowered lid position and it is clear that ectropion is a strong risk factor for dry eye.

**Entropion**

The most common type of entropion (‘turning in’) is also age-related, and usually affects the lower lid (Figure 1). There is a combination of causes for involutional entropion, including changes occurring in the orbicularis muscle, where its preseptal (inferior) portion becomes more mobile, allowing it to override the pretarsal (eyelid) portion, thus turning the eyelid in. The lower lid retractors, responsible for depressing the lower lid on downgaze, may become looser or disinserted. Lid laxity is also a factor. The obvious result of entropion is that the eyelashes turn inwards, causing inferior corneal and conjunctival abrasion. For therapeutic protection from the lashes, silicone hydrogel contact lenses may be considered in mild cases, and sclerals in the more advanced. However, both entropion and ectropion may be amenable to surgery, and are not necessarily conditions which patients simply have to accept as part of getting old.

**Dermatochalasis (Figure 2)**

Sometimes confused with ptosis, in this condition the skin of the eyelids becomes looser and less elastic, and may hang down in a fold over the upper lids, obscuring their roots. This can make good lid hygiene quite difficult, leading to an increase in blepharitis (see below).

**Loss of lid tension**

Occurring in both the upper and lower eyelids, loss of lid tone can make rigid contact lenses more difficult to remove, as the lids become less tight against the eye. It can also preclude the fitting of rigid alternating (translating) bifocal contact lenses, which rely on good contact between lower lid and globe in order to raise the lens on downgaze.

**Blepharitis**

One way of classifying blepharitis (Figure 3) is in terms of its cause: seborrhoeic (a disorder of the sebaceous glands), bacterial (usually staphylococcal) and Demodex (caused by the Demodex folliculorum mite). There is a general increase in blepharitis with increasing age, and Demodex has been found in 100 per cent of over 70-year-olds. Increased Demodex infestation has also been associated with contact lens wear. Since blepharitis may increase infection risk, it should be treated before commencement of contact lens fitting, by giving the relevant advice regarding ongoing lid hygiene.

**Sensitive, fragility, healing**

Corneal sensitivity decreases with age, with the threshold for touch almost doubling between the ages of 10 and 80. The majority of this change occurs after the age of 40. This reduced sensitivity has important implications for tear film quality, as discussed later.

At the same time as sensitivity decreases, corneal fragility increases at an almost identical rate, whilst the speed of healing reduces. This potentially dangerous combination means that older contact lens wearers are more likely to suffer corneal damage whilst at the same time being unaware that there is a problem. Hence there may be an argument for increasing the frequency of aftercare checks in line with increasing age.

**Endothelial changes**

Endothelial cell numbers have been found to reduce, and become less regular in shape (pleomorphism) and size (polymegathism) with increasing age, although this finding is inconsistent. Such changes in the endothelium may potentially impair its pumping mechanism, making the cornea more susceptible to oedema. This risk is exacerbated by the use of contact lenses made from materials with low oxygen transmissibility.

**Epithelial basement membrane dystrophy (EBMD)**

Also known as Cogan’s or Map-dot-fingerprint dystrophy, this is the most common corneal dystrophy, and its prevalence increases with age. Most patients are asymptomatic, and the typical corneal epithelial changes of map-like shapes, dots, and whorls like fingerprints are found only on routine examination. It is caused by a defect in the adhesion of the epithelium to the underlying basement membrane.

Some patients may progress to develop recurrent corneal erosion syndrome (RCES), and those who do may awake in the morning with extreme discomfort and lacrimation, as the epithelium lifts from the membrane. The use of ocular lubricants at night will often be helpful. More severe cases may be treated surgically, often with an excimer laser (photo therapeutic keratectomy).

Routine contact lens fitting would be inadvisable in patients with EBMD and/or RCES although, once referred, they will sometimes be fitted with a continuous wear silicone hydrogel as a bandage lens.

**Cornea guttata**

Appearing in the central cornea, guttata look like tiny droplets (gutta means ‘drop’) between the endothelium and Descemet’s layer, often interspersed with pigment granules. Although very common in the over-40s, they may represent an early manifestation of Fuch’s endothelial dystrophy, a condition much rarer but more serious, leading to chronic corneal oedema. Six-monthly review of patients demonstrating guttata may be advisable.

**CONJUNCTIVA**

**Pingoecula and pterygium**

Becoming more prevalent with increasing age, pingoeculae appear as elevations in the bulbar conjunctiva, near the limbus, at the three and/or nine o’clock positions. Varying
in colour from transparent to white to yellow, they may also be calcified (having white flecks) and are sometimes hyperaemic. The underlying cause is degeneration of the conjunctival stromal collagen and thinning of the overlying epithelium, due to exposure. Their presence may affect the fit of soft contact lenses, but is not a contraindication, although the use of contact lenses further increases the risk of pinguecula.

The incidence of pterygium also increases with age, particularly in combination with long term exposure to ultraviolet radiation. It appears as a fibrovascular growth, initially on the limbal conjunctiva, at the three and/or nine o’clock positions, and eventually encroaches on the cornea (Figure 4). Opinions vary regarding the fitting of contact lenses to patients with pterygium. If the experienced practitioner does decide to proceed with caution to fit in the early stages, frequent photographic monitoring is advised.

Since both conditions have been associated with exposure to UV, it would also seem intuitive for any contact lens fitted to contain a UV inhibitor, although arguably the best advice for these patients is the use of wraparound sunglasses and a wide-brimmed hat.

Conjunctivochalasis
This is a common consequence of ageing, in which the conjunctiva loses its adherence to the underlying tissue, forming multiple folds (Figure 5). The use of contact lenses has been shown to further increase the incidence of conjunctivochalasis. On blinking, soft contact lenses may drag the loose conjunctival tissue, rather than gliding over it.

TEAR FILM AND DRY EYE
The tear film has three essential components: the outermost lipid layer is largely secreted by the meibomian glands, and its main function is to keep the tears from evaporating. The middle aqueous layer, secreted mainly by the lacrimal gland, provides oxygen to the cornea and has antimicrobial properties. At the ocular surface, sticky mucins are secreted by the epithelial cells of the cornea and conjunctiva, while soluble mucins, found in varying quantities throughout the aqueous layer, are secreted by the goblet cells of the conjunctiva. Collectively, these mucins ensure adhesion of the aqueous layer to the ocular surface, and help to stabilise the tear film.

Two classes of dry eye have been suggested. In aqueous-deficient dry eye, there is a reduction in tear aqueous production from the lacrimal gland. In evaporative dry eye, lacrimal gland aqueous production is normal but tears are lost due to excessive evaporation, as for example in meibomian gland dysfunction.

It has been shown that there is a significant increase in both types of dry eye in subjects over the age of 40, and this affects both genders. Dry eye has been shown to be present in 17.3 per cent of 48-59-year-olds, increasing to 28 per cent in the over-80s.

Lipids
Changes occur in the meibomian glands with increasing age: their openings narrow, their rate of secretion reduces and there is a reduction in their number (meibomian gland dropout). These changes are likely to disrupt the lipid layer of the tears, leading to an increase in evaporative dry eye. Contact lens wear further destabilises the lipid layer.

Aqueous
The lacrimal gland, largely responsible for secreting the aqueous content of the tear film, has been shown to decrease in function with age, and aqueous deficient dry eye is more common in both male and female over-40s, but particularly so in females.

the latter being probably related to post-menopausal changes in sex hormones.

Mucins
Although numbers of conjunctival goblet cells appear to be maintained, their ability to secrete essential mucins reduces with age. Any reduction in these mucins has the potential to adversely affect tear film quality. A deficiency in any one of the three tear film components can impact on the other two as well (Box 2).

Other factors affecting the tear film
Sleep disturbance is more common in older people and is also associated with dry eye symptoms. Use of medications tends to increase with advancing age, and some, including hormone-replacement therapy, diuretics, antihistamines, anti-anxiety drugs, antidepressants and oral steroids, are also associated with an increased risk of dry eye. As discussed previously, ectropion and punctal eversion can also contribute to dry eye.

LENS
Cataract, and cataract surgery, become much more prevalent with increasing age. The presence of the cataract itself can cause changes to image quality, illumination and contrast sensitivity, all of which could be exacerbated by contact lenses. Tinted lenses will further reduce light transmission.

Fitness to drive may be a consideration; a patient whose visual acuity is already borderline for driving might be pushed below the legal threshold by a deposited contact lens, or one with under-corrected astigmatism. Conversely, a highly myopic patient might benefit from the increased magnification offered by a contact lens. Knowledge of the location of the cataract may be important; consider, for example, the implications of using a centre-distance or centre-near multifocal lens in the presence of a central cataract.

Cataract surgery has been shown to cause a decrease in both corneal sensitivity and in the numbers of mucin-producing conjunctival goblet cells, with implications for tear film quality and quantity, as described above. Those who have received an intraocular lens without a blue light inhibitor may be at increased risk of macular damage, since the natural protection of their old, yellowing lens has been removed. This may be an argument for always fitting these patients with blue-light-filtering spectacle lenses, but the topic is fraught with controversy.
Box 2: Inflammation and the vicious circle of dry eye

If water is lost from the eye, either by decreased aqueous secretion or increased evaporation, the concentration of electrolytes, such as sodium, potassium and bicarbonate, will be greater, i.e. there is an increase in the osmolarity of the tears. We might think of this ‘hyperosmolarity’ as the tears becoming more salty.

Any form of dry eye can interact with and exacerbate other forms of dry eye, as part of a vicious circle, in which hyperosmolarity and inflammation are key players. In short, dry eye can cause inflammation and inflammation can cause dry eye. This is because increased osmolarity may lead to an increase in the presence of inflammatory factors in the tears.

Reduced lacrimal gland output, known to be associated with ageing, increases the osmolarity of tears. The ensuing inflammation may damage the lacrimal gland, further decreasing its output, until eventually there is resultant corneal damage. The corneal damage then further reduces age-related corneal sensitivity, leading to a reduction in blinking and a still further drop in lacrimal output.

This reduction in blinking also has implications for meibomian gland secretion, since these glands rely on ‘milking’ by the force of the blink in order to secrete their contents.

Hyperosmolarity also provokes inflammation in the conjunctiva, and in the meibomian glands, leading to reductions in mucin and lipid output, both already reduced by ageing, and so the inflammatory circle continues, and dry eye increases.

MACULA
Many of the arguments applying to the cataract patient may apply equally to those with age-related macular changes, and care must be taken that the wearing of contact lenses doesn’t further compromise an already disadvantaged visual system.

Similarly, a high myope might benefit from the larger image size produced by a contact lens. The blue light argument (see above), with its associated lack of consensus, may also be relevant.

CONCLUSION
An awareness of all the changes that may occur with increasing age, and the knowledge that many of these may be exacerbated by contact lens wear, should encourage even more careful assessment of the older patient, and more considered choice of design and material. In some cases, more frequent aftercare checks may also be prudent. However, today’s contact lens practitioners have access to such a vast array of products that age should normally be no barrier to contact lens wear.

REFERENCES
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Box 3: Should diabetics wear contact lenses?

Type 2 diabetes, whose prevalence increases with age, leads to reduced corneal sensitivity and increased dry eye. The corneas of diabetics have also been found to be: more fragile; slower to heal; slower to recover from oedema; and more susceptible to infection. However, diabetes should not necessarily be seen as a barrier to contact lens wear, with studies showing that they can be safely and successfully worn.

As with all contact lens wearers, it is vital to carefully record history and symptoms, and to explain all risks and benefits. Initial and ongoing thorough assessment of anterior eye health, frequent aftercare checks, and careful choice of products will all help to ensure a positive outcome.

Another incentive for diabetics is on the horizon, with the introduction of a ‘smart’ contact lens, which will be able to analyse blood glucose levels multiple times throughout the day, and feed the data to a smartphone app, removing the need for regular finger-pricking. Google, which holds the patent, is working with Alcon to try to make this technology a reality by the end of the decade.