



The Cost of Beauty: The Eyelashes edition

CPD points: 3 Clinical



Nina Kriel

BOptom, BScHons, BA Hons, OD, LLB

Perhaps writing these articles has made me more aware of eyelashes and beauty treatments because I feel like I'm seeing more and more. [Rihanna's sunnies](#) had eyelashes at the Met Gala last year, and Betsey Johnson was on the same page with their marketing. Eyelashes seem to have become a more-is-more thing in the last few years, and the trend is international: They are heavily [used](#) from the United States to Ghana, Japan and China. A [study in Nigeria](#), for example, found that 39% of female students at college used eyelashes, mostly (56%) for aesthetic reasons.



Why eye care practitioners ?

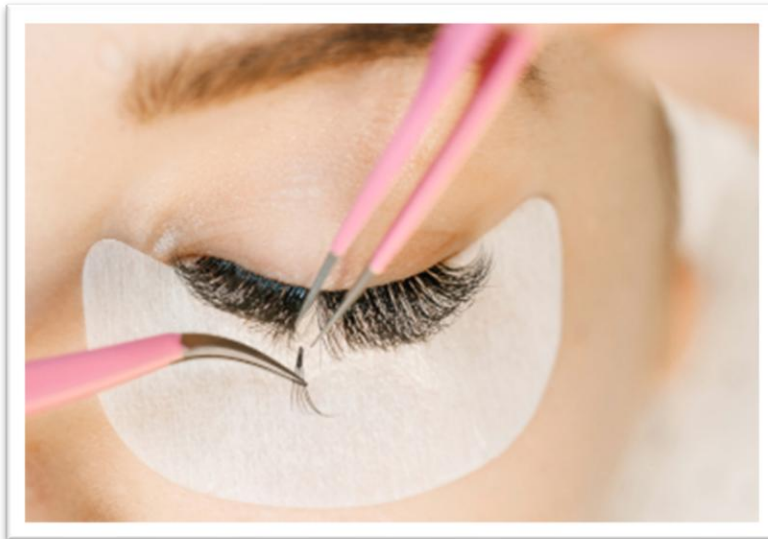
The scope of our profession is expanding to emphasize a more holistic approach healthcare, rather than eyecare and eyewear. As we have done with ocular surface disease, we need to [elevate ocular aesthetics](#) to a science in our practices. It makes sense when we are treating dry eye, to address the cosmetic products/ procedures that our patients use and the side effects they may cause, as foundation to their dry eye treatment. The current market for false eyelashes is estimated to be [US \\$1.8 billion](#), driven in part by social media endorsements and makeup tutorials. Leaving our patients to internet reviews and viral TikTok videos* is irresponsible. If we don't approach eyecare holistically, we don't get the outcomes we want and our patients don't get the outcomes they deserve. To better counsel patients about the risks, offer safer alternatives, and manage patients following these trends, we need to keep up. Trends change quickly. Fazit Beauty's Gold Glitter Freckles saw 1000% increase in sales and web traffic within 12 hours of [Taylor Swift](#) wearing them. If she starts wearing an eye makeup product, we want our patients to think: I love that, let me see what my optometrist thinks. We can foster that kind of relationship by keeping health advice in the spotlight, rather than judgement.

Let's talk lashes

We have about [80 eyelashes](#) in our lower eyelids in 2 rows, and about double that in 6 rows in the top lid. The eyelids sense movement or touch, triggering the blink reflex to protect the cornea. As with other hair, eyelashes have sebaceous glands (glands of Zeis) to maintain lubrication and flexibility. Eyelashes don't have the erector pilori muscles; so can't stand on end. Perhaps just as well. [Gaze tracking](#) studies from the 1960s confirm that humans have evolved to pay particular attention to the eyes and surrounding area when we first meet someone, and bristling eyelashes would probably give too much away at a first encounter.

The number of our eyelash follicles is fixed during embryonic development and once lost, they don't regenerate. The natural life cycle of the eyelash has three phases: Anagen, catagen and telogen. Lashes grow to about 10 mm during the short anagen phase and then there is a long, resting telogen phase before they shed naturally, at the rate of 1 - 4 lashes per day. Eyelashes are more darkly pigmented than other hair but may lose colour (poliosis) due to genetic and other conditions.

A [theoretical bionics model](#) has identified an ideal length for mammalian eyelashes, at least for inhibiting evaporation. Increasing the eyelash length from zero to an optimal length can reduce water evaporation by 11% to 31%, peaking when the eyelashes are 0.35 ± 0.15 times the eye width. Any longer, and the lashes actually channel airflow over the cornea rather than diverting it, resulting in greater evaporation. At their optimal length, eyelashes minimise shear stress, shear rate and contamination at the ocular surface. Human eyelashes are usually slightly longer than this optimal length, probably for the additional protection from dust and sunlight.



Eyelash **extensions** are attached to the base of the user's own lashes. It's time consuming, using up to 200 extensions individually applied. The glue takes 5–6 h to solidify, so it can readily migrate to the ocular surface while 'wet'.

Although lash extensions require minimal daily maintenance, they can cause [mechanical limitations](#), like lagophthalmos, which could lead to dry eye while sleeping and bacterial build up. Ocular side effects are common, with 73.3% to 97.5% of users experiencing symptoms such as redness, pain, watery eyes, heavy eyelids, foreign body sensation, and burning. [Itching](#) (46%) was the most common symptom.

A [prospective study](#) (n=32) measured symptoms and clinical parameters such as conjunctival vascular density, tear meniscus height, non-invasive tear break-up time, bulbar redness, meibography, lipid layer thickness and corneal staining, starting from 1 hour after lashes were applied. An hour in, 84% of participants were experiencing symptoms, 59% being a foreign body sensation. Re-assessments were done after 1 day, 1 week and 1 month. The Ocular Surface Disease Index (OSDI) scores were not statistically different between baseline, 1 week, and 1 month after eyelash extension ($P > 0.05$). Tear meniscus height increased significantly at 1h after eyelash extensions, and then decreased to their lowest at 1 week. Tear break up times were also at their lowest after 1 week of wear. At 1 hour after applying the lashes, corneal staining was at its highest. There were no significant differences in the

conjunctival or bulbar redness, meiboscore or lipid layer thickness but the findings do support a loss of ocular surface homeostasis.

In a survey of 205 Japanese women, 27% experienced redness, discomfort, itching or eyelid swelling after the application of extensions. A [literature review](#) found allergic blepharitis to be the most common complication of eyelash extensions - 79% of reports. The glue, lashes or even the gel pad (applied to the lower lid during the procedure and may contain the preservative methylisothiazolinone) can individually or all lead to contact dermatitis.

A study out of the UK showed that [1 in 4](#) women do not remove their makeup at night. Patients who wear eyelash extensions or false lashes may be less likely to maintain proper eyelid hygiene, hoping to extend the life of their lashes. Unfortunately, this increases their risk for [blepharitis and demodex](#). Practitioners should encourage patients to remove their make up at night to for better ocular and lash health. [O'Dell and Periman et al](#) found that SPEED scores were higher in makeup users that did not use makeup removers (Mean:10.5 ±6.75) than those who did (Mean 7.6±4.62). The type of makeup remover is also worth discussing: Oil based products like argan or jojoba oil are better than those containing detergents break up the lipid layer of the tear film.

[SPEED versus OSDI](#)

Standard Patient Evaluation of Eye Dryness (SPEED) and the Ocular Surface Disease Index (OSDI) are both questionnaire-based measures of dry eye symptoms. SPEED includes questions about the severity of symptoms over the last 3 months, OSDI covers the last week, and doesn't check how bad. The OSDI includes questions about environmental triggers, and is considered slightly more repeatable and reliable.

The history of beauty products is a long one, covered in another article. Let's stick to lashes for now. To emphasise lashes, our existing lashes can be

- Tinted
- Curled
- Permed, or
- Mascara added.

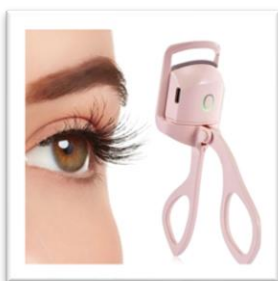
Growth serums stimulate lash growth and thickness.

The first patent on artificial eyelashes dates back to 1910. Today eyelashes are added, either as

- extensions, or
- an additional line of false lashes.

We'll cover the risks for adverse effects, which can be either mechanical, pathogenic or chemical.

Starting with our own lashes, there are 'improvements' to be made. In pursuit of achieving a more 'expressive' eye the first eyelash **curler** (the 'Kurlash') was introduced by William J Beldue in 1931. Fast forward and the forecast is



for heated eyelash curlers to reach US \$1.6 billion by 2032. Potential complications include mild (nickel allergy and contact dermatitis) and in the event of device (or user) malfunction a penetrating corneal injury with traumatic cataract formation and vitreous disturbance.

Eyelash **perming** (aka lifting) is a chemical procedure that changes the curvature of the eyelashes for a period of 6–8 weeks. The perming process requires the lashes to be temporarily glued to a rod made of silicone, metal or plastic. Imagine a curler in your hair, for the same purpose. Chemicals are used for perming (typically thioglycolic acid or peroxide) and then a neutraliser is applied with a final conditioning treatment step. Home kits and salon options are available. Toxic keratoconjunctivitis and contact dermatitis from the adhesives and perming solutions are known to occur, and may be

underreported. Curling has a similar effect to adding length to the lash in that airflow over the cornea is no longer optimal.

Eyelashes can be **tinted** to reduce the need for mascara. Hydrogen peroxide is used as a developer, together with hair dye. Some of the products include black henna and paraphenylenediamine, which have been related to severe blepharoconjunctivitis, periorbital contact dermatitis and eyelid edema.

[Henna](#) is a reddish-brown dye prepared from the dried leaves of the mignonette tree (*Lawsonia inermis*). It is used for temporary tattoos, often during cultural and religious ceremonies, and in hair colour to emphasise and enrich auburn tones. It is US FDA approved for hair colour, but not for periocular use. It is commonly thought of as safe because it is a natural product. For eyelash tinting, it is mixed with a coal-tar hair dye containing paraphenylenediamine to strengthen and darken the colour. A five-year prospective study of 544 participants showed that 83% of those using dyes experienced worsening of their allergic symptoms. The most common side effects are dermatitis, blepharoconjunctivitis, silver staining (argyrosis) of the ocular adnexa. Silver exposure may stimulate benign and malignant lesions, such as conjunctival melanoma. Xanthelasma and corneal erosions were uncommon side effects. Petroleum jelly applied to the skin to prevent or reduce dye contact may also cause irritation.

Lash Serums

Lash serums are applied to the eyelid and lashes to thicken and lengthen them. As you know, [bimatoprost](#) is a prostaglandin analogue (PGA) which is FDA approved to lower IOP in the management of glaucoma. Allergan saw an opportunity in the side effects – more, thicker and darker



eyelashes – and produced a topical version of bimatoprost, brand-named *Latisse*, to be applied to the eyelid margin with a small brush once a day. It was originally FDA approved for the treatment of hypotrichiasis, then trichotillomania, chemotherapy-induced eyelash loss and alopecia areata eyelash loss.

How does it work? It targets the anagen phase of the eyelash growth cycle which improves eyelash growth and melanin deposition. [Anagen](#) is the active growth phase in which the hair follicle takes on its onion-like shape and works to produce the hair fibre. The anagen phase can be further broken down into proanagen and metanagen phases. Proanagen sees the follicle proliferating hair progenitor cells and begin the differentiation process. The metanagen phase starts when the new hair shaft appears on the skin's surface. For eyelashes, the growth cycle is 4 – 6 weeks, but since not all eyelashes are in sync, the peak effects of PGAs are typically seen after 16 weeks of use. Side effects include conjunctival hyperemia, skin or iris pigmentation, pruritus (itching), eyelash loss, ptosis, trichiasis, malar hypertrichosis, and lowered IOP. There is a positive correlation between PGA use and Meibomian gland dysfunction (MGD) and dry eye disease. Bimatoprost, even at extremely low doses, significantly decreases the intracellular phosphorylation of AKT, a mediator of cell survival. In eyedrop formulation and doses, PGAs can cause blepharophimosis, (narrowing of the palpebral aperture) thinning of the eyelid skin and reduced orbital fat.

Sales of bimatoprost in this format reached almost \$50 million in its first year and the (unregulated) beauty industry took notice. Soon, PGA was being included in over the counter eyelash growth serums.*

*Advise patients to look for any active ingredients containing 'prost' e.g. isopropyl cloprostenate.

*Certain countries, such as [Canada](#), prohibit the inclusion of prostaglandins in cosmetic products.

We already prescribe and use prostaglandins, albeit for other reasons (glaucoma). They're effective and convenient, but we know that 92% of glaucoma patients using only [prostaglandin analogs had MGD](#) compared 58% in those using a different class of medication. Let's deep dive into a study seeking to evaluate the risks of progressing signs and symptoms of ocular surface disease associated with the use of eyelash growth products.

A [literature review](#) of 3 electronic databases found 5206 reports; 3459 of which remained after duplicates were removed. Of 46 full-text articles found eligible, 33 were excluded, leaving 14 trials (13 reports) for the metanalysis, Primary outcomes:

- Subjective outcome: Participant-reported symptoms, based on a validated scale or scoring system such as the Ocular Surface Disease Index (OSDI), visual analogue scale (VAS), or others.
- Clinical outcomes: Ocular surface parameters, such as fluorescein corneal staining scores, tear film break-up time or tear osmolarity.

Secondary outcomes: Eyelash length, eyelash thickness, incident ocular and non-ocular adverse events.

The active ingredients in the intervention treatments included: bimatoprost (11 trials), latanoprost (1 trial), 15-keto fluprostenol isopropyl ester (1 trial), and dechloro ethylcloprostenolamide (1 trial).

The comparison ('control') treatments included: Vehicle (8 trials), placebo (including saline, 3 trials), or no treatment (1 trial). In one trial latanoprost and bimatoprost – both active ingredients – were compared with one another.

Primary outcomes: None of the trials included patient-reported dry eye symptoms and ocular surface signs.

Secondary outcomes:

- Eyelash **length** in the 7 studies (n=964) that looked at 4 months or less, increased by a mean difference of 1.32 mm. In the 3 studies that covered 6 months (n=418) the mean difference was 1.21 mm.

- Eyelash **thickness** increased by 0.47 mm³ (4 months) and 0.56 mm³ (6 months.)
- Incident conjunctival **hyperemia** (RR 6.09), incident ocular surface symptoms (RR 2.38 and 2.77 for 4 and 6-month studies respectively) and symptoms leading to cessation of the treatment (RR 1.68 and RR 3.41 for the 4 month and the 6 month groups.

Several symptoms and signs, including ocular irritation, pain (or stinging), and pruritis, were judged to be relevant to the ocular surface and included for this outcome.

A total of 7 non-ocular adverse events were reported in 4 of the 14 trials. The non-ocular adverse events included facial eczema, contact dermatitis, cancer recurrence (lymphoma), facial pain and dissociative disorder, with one person developing each of these.

None of the 14 eligible trials reported on the specific outcomes so, due to lack of literature, it was not possible to answer: Is the use of eyelash growth products associated with symptoms or signs of ocular surface disease?



To date, only one clinical study, though not a randomized trial, has attempted to assess the effect of bimatoprost as an eyelash growth product specifically on the ocular surface using a validated dry eye questionnaire and a suite of ocular surface assessments including non-invasive tear break-up time, ocular surface staining, ocular redness grading and tear osmolarity..

The study included 28 female volunteers for a 2-month, [prospective uncontrolled](#), open-label clinical study using Latisse (Bimatoprost preserved with BAK) for two months. None had dry eye. Eyelash length, subjective symptoms, tear film stability, osmolarity, ocular redness and intraocular pressure were evaluated at baseline (T0) and at one month (T1) and at two months (T2).

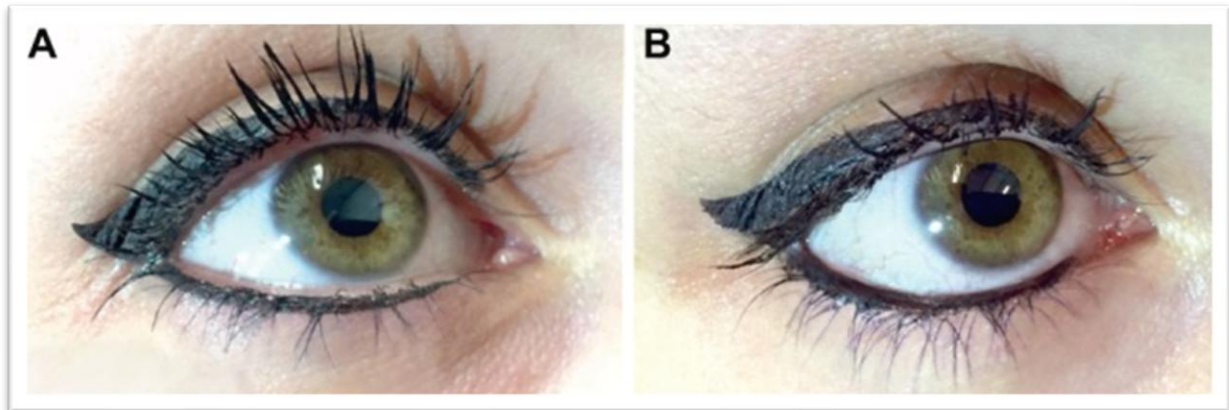
Fifteen of the 28 completed the study. Five discontinued the study due to burning upon instillation and 8 were lost to follow-up. Average eyelash length increased at each time ($p < 0.001$). Dryness, burning and grittiness remained low (less than 25/100) throughout the trial with dryness showing a significant change between T0 and T1 ($p = 0.04$), but not between T1 and T2 ($p > 0.05$). No difference ($p > 0.05$) was noted for the non-invasive break-up time, photochromametry or tear osmolarity. Intraocular pressure showed a decrease with time but translated to only a one to two mmHg change, which was not clinically relevant. The authors concluded that the product increases lash length in less than 2 months, but that patients should be educated in the use and potential side effects, particularly discomfort on instillation. Bimatoprost was the most commonly studied eyelash growth factor, but various others are included in this [comprehensive overview of eyelash serums](#). [One in 3](#) over-the-counter lash growth serums contain synthetic prostaglandin analogs, with castor oil, peptides, growth factors, and benzalkonium chloride (BAK) as a preservative. BAK can cause burning upon application and adversely impact the ocular surface.

Many lash serums are considered cosmetic, rather than medical, so they may be sold without safety information and patients may not think it relevant to ask. Suspect, and ask about the use of lash growth products if you notice abnormally long eye lashes, and side effects such as orbital fat atrophy and increased brown iris pigmentation while you're doing your slitlamp exam. If you can, take photographs of the changes. Visual evidence is always the most convincing. Warn patients using bimatoprost products that itching and hyperemia are the most common side effects and that reversible lid hyperpigmentation may also occur.

Mascara and Eyeliner

Mascara emphasises the eye by making eyelashes appear darker and thicker. With blinking and rubbing, ingredients can get onto the ocular

surface. Eyeliner is sometimes applied to the mucous membrane at the mucocutaneous junction of the eyelid margin, where it can potentially block meibomian glands.

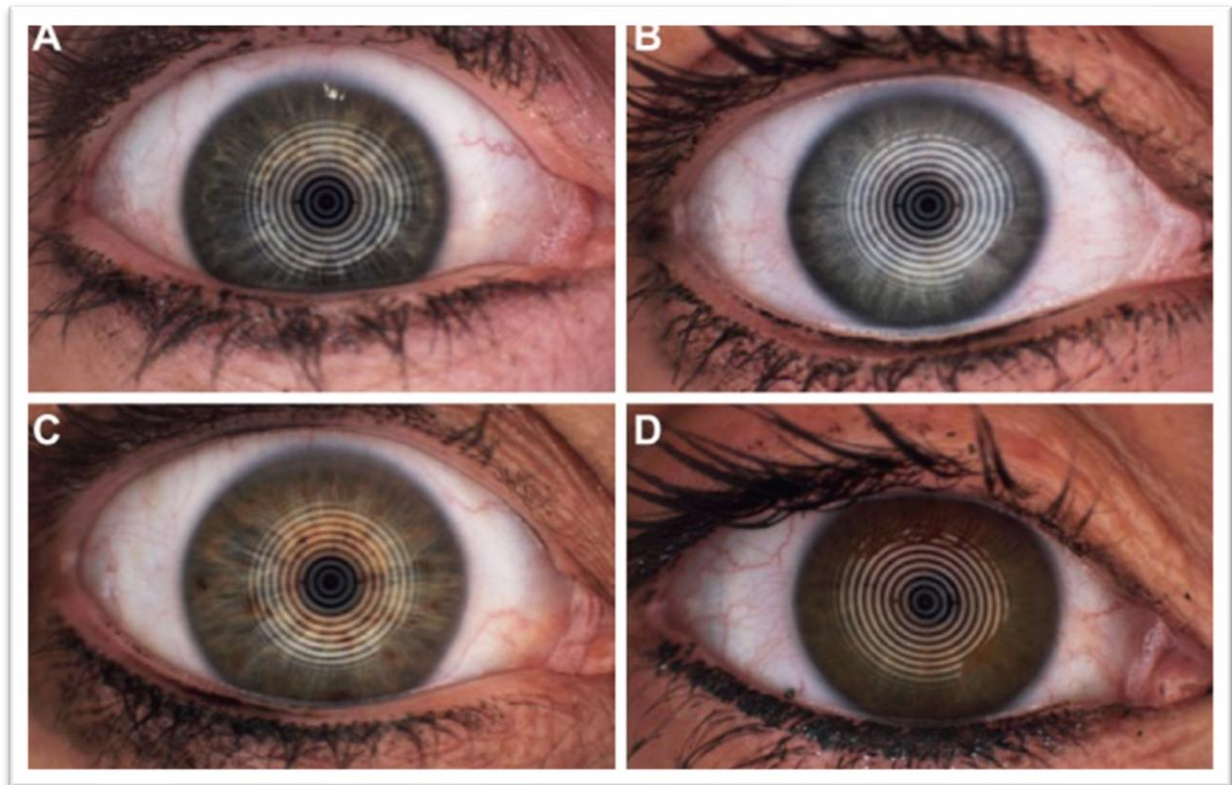


[Eyeliner](#) applied to (A) the periocular skin of the lower eyelid, external to the lash line and (B) to the surface of the lower eyelid margin, within the lash line ('tightlining').

A study by the University of Waterloo showed that eyeliner applied to the inner eye margin migrated into the eye and tear film [15-30%](#) more than when it is applied outside the lash line. Our dry eye treatments can actually facilitate migration of such makeup products, further contaminating the ocular surface and causing even more of the very tearing and frequent blinking that we were trying to address. Observational [studies](#) confirm that the tear film thickness is reduced in those using cosmetics such as eye liners.

Blinking, and particularly forced blinking, are believed to contribute to particle migration into the tear film. Another hypothesis is that the action of the muscles of Riolan – a group of vertically aligned fibers under to the periocular palpebral skin – may also be involved. The function of the muscles of Riolan is not fully understood, but they may be promote meibomian gland secretions, preserve the close approximation of the eyelid margin to the globe, and retain the orientation of the eyelashes. They may effect minute vertical movements of the eyelid skin, contributing to the transfer of periocular particles toward the ocular surface. The eyelid being warmer than

the periocular eyelid skin may reduce the viscosity of cosmetic products applied, further enhancing motility. The suction forces that result from the surface tension of the tear meniscus may also promote the movement of cosmetic products that are in close proximity to the lid margin, toward the ocular surface.

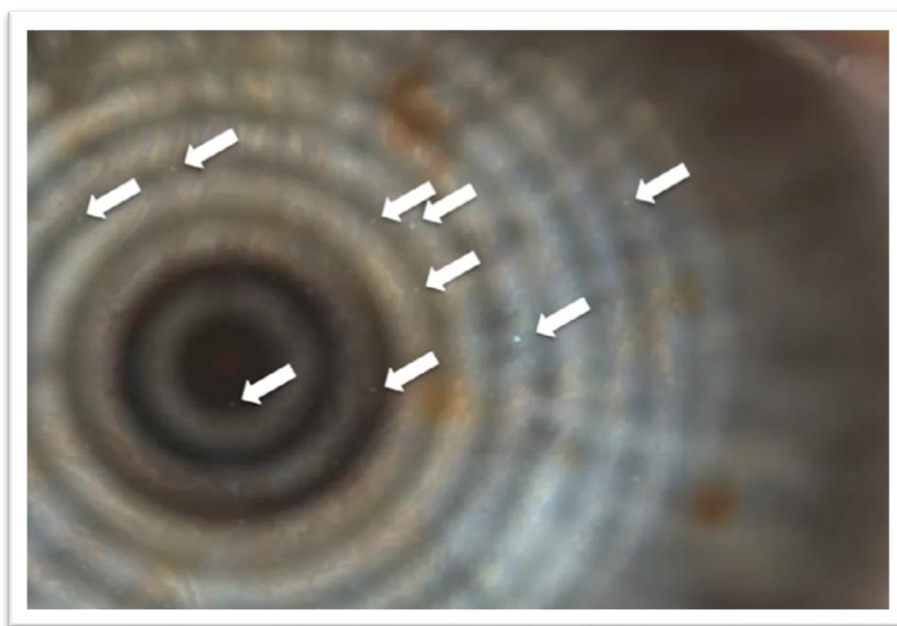


(A–C) Varying levels of [eyeliner drift](#) onto the eyelid margin following periocular eyeliner application, observed incidentally during bulbar hyperaemia examination; (D) Kohl eyeliner applied posterior to the lash line, directly onto the mucocutaneous junction, with visible debris within the interpalpebral zone.

Two prospective studies have investigated the influence of the position of application to tear film contamination levels: A randomized, parallel group [study of 75](#) participants compared tear film contamination levels when applying a mixture of hydroxycellulose gel and fluorescein at the outer, middle, and inner eyelash lines. (The mixture was more hydrophilic than some of the commercially available formulations, so as they say in the classics, 'results may vary'.) On slit lamp examination with blue light, the fluorescence could be detected. A Schirmer test was also done and the paper's colour

was used to semi-quantitatively determine the level of tear film contamination. Ocular surface migration and tear film contamination levels were significantly greater and quicker when product was applied at the inner eyelash line.

Another [pilot](#) randomized crossover study of 3 participants investigated the migration of glitter particles in a commercially available pearlescent eyeliner pencil into the tear film. This product consisted of a more hydrophobic mixture of waxes, oils, and pigments. Eyeliner application at the periocular skin was associated with slower and reduced levels of tear film contamination. Tear film contamination levels peaked within 10 minutes of product application, and were negligible following 2 hours.



Pearlescent cosmetic particles in the tear film (arrows), visible incidentally during high resolution slit lamp video recording for lipid evaluation.

Once inside the eye, the material particles are driven by processes such as diffusion, drift, and mass flow. The distribution of electrically neutral constituents may be dictated primarily by diffusional movement down the concentration gradient. Charged constituents can drift through the tear film according to the distribution of electrolytes and negatively charged glycocalyx molecules beneath the aqueous-mucin phase. The mass flow of the tear volume is driven by the lacrimal pump and blinking mechanism,

facilitating the clearance of particulate matter within the tear film through the lacrimal drainage system.

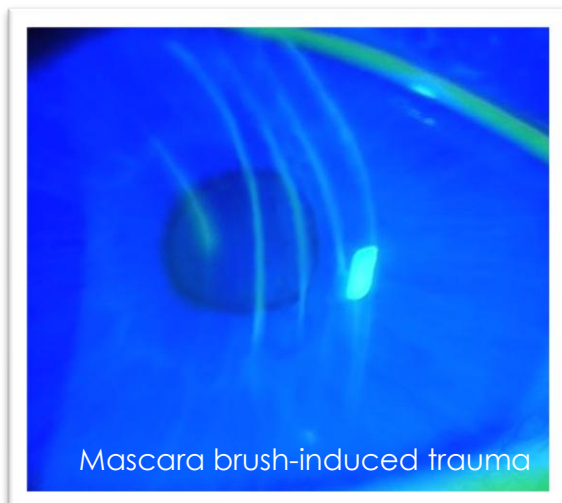
As we know, the top layer of the tear film is a continuous lipid layer secreted by the meibomian glands. Debris is bound to disrupt and destabilise this layer and may block and/ or contaminate the meibomian glands. The result is increased tear evaporation.

An [observational study](#) of 180 participants reported a significant correlation between eye cosmetic wear and reduced tear film lipid layer thickness. The secondary analysis of another observational study of 281 participants found that female eye cosmetic wearers were less likely to exhibit foaming at the inner palpebral canthus than female participants who were not wearers of eye cosmetics. Eyelid margin foam is thought to consist of sebum and meibum, and reduced foaming was correlated with symptoms of dry eye. This contrasts with the belief that eyelid foaming relates to meibomian gland dysfunction, representing bacterial lipase induced saponification of lipid secretions.

A [pilot study](#) used infrared spectroscopy to examine the effects of mixing liquid and pencil eyeliners on the molecular structure and lipid phase transition of human meibum. Cosmetic products were found to have much higher lipid phase transition temperatures than meibum, and when mixed with pencil eyeliner, meibum's transition temperature was also found to increase by 4.2°C contributing to an overall increase in viscosity, which was thought to have the potential of exerting adverse effects on tear film stability.

A randomized [crossover study](#) of 24 participants compared the effects of 7-day pencil eyeliner application at the periorbital skin and mucocutaneous junction. Interestingly, in this study mucocutaneous junction application was associated with improved lipid layer thickness, decreased ocular comfort,

and no changes in tear film stability. Nevertheless, the Ocular Surface Disease Index (OSDI) scores were significantly worse when applying product at the mucocutaneous junction. The study investigators concluded that the migration of lipophilic eyeliner constituents was likely to explain the increased lipid content observed within the tear film, and the worse OSDI score reflected the disrupted ocular surface homeostasis.



Mascara has been documented to obstruct the nasolacrimal duct and canaliculi, cause pigmentation of the palpebral conjunctiva or even for a mascaroma (a mass composed of keratin with mascara). Milphosis (loss of eyelashes) or madarosis (loss of eyebrows or eyelashes) are also unwanted complications.

Waterproof eyeliner and mascara require more stringent eye makeup removers, which may pose additional risks to the ocular surface. An in vivo clinical study demonstrated the migration of cosmetic removal products into the tear film, even when applied over closed eyelids. A prospective [study](#) of 20 participants compared the effects of three eye cosmetic removal products on tear film measurements. The oil- and alcohol-free formulation, an oil-based microemulsion, and a hyaluronic acid-containing micelle solution all increased tear film evaporation and, rather unexpectedly, the oil-based microemulsion was associated with the greatest reduction in lipid layer quality and tear film stability. Hypochlorous acid is a safe cleaning solution with broad anti-viral, anti-fungal and anti-microbial properties and doesn't affect most of the glues used for extensions.

Finally, we know that digital expression of meibomian glands can improved tear film stability and reduce the rate of tear evaporation. It is possibly that regular eyelid hygiene and digital manipulation associated with the routine removal of eye cosmetic products may potentially counteract some of the adverse effects associated with cosmetic product migration into the tear film.

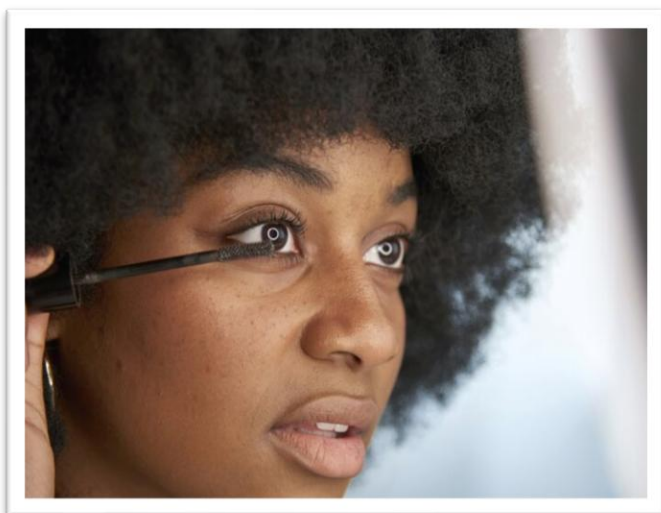
Eyeliner tattoo

Eyeliner can be tattooed, depositing pigment along the lash line. None of the pigments are FDA approved. Tattooing can cause physical damage to the meibomian glands with dye obstructing the duct, causing chronic lid margin inflammation or an allergic reaction. Studies have linked [dermatitis, tear film instability, and meibomian gland atrophy](#) to eyelid tattooing. Infections, eyelid scarring and even full thickness lid margin penetration have been reported.

Patients show increased corneal staining, shorter tear break up time, and greater amounts of meibomian gland dropout after tattoos.

Being permanent, it is convenient. Try to find out what's motivating the patient to enquire. Many of my friends - we're that age now - are considering or have had tattoos done because of supra-orbital dermatochalasis so that their liners and mascara end up on their top eyelid and then on their spectacles. By working on the cause, you may address both, or the real problem.

Tattoo removal – more common for brow tattoos – can be done by ND:YAG or Alexandrite picosecond laser. Both lasers are effective in removing pigment but the effect on meibomian glands is not known. Of course, severe eye damage can occur if the placement of metal corneal shields is not utilized during the treatment.



In [unpreserved products](#) such as mascara, microbial presence was found in over 35% of tested mascaras. A separate study reported 79% of used mascaras tested positive for *Staphylococcus aureus* and 13% were contaminated with *Pseudomonas aeruginosa*.

Higher numbers of use, and more users, increase the risk e.g. shared brushes – e.g. at a beautician – and tester products. [Sedzikowska et al](#) showed that demodex survived in a mascara sample for 56 hours! Cosmetic products are increasingly being preserved to prevent bacterial, fungal, yeast and mould contamination so that they can be used for longer.

Benzalkonium chloride (BAK), once the most common choice, seems to be falling from favour. BAK is a bactericidal quaternary ammonium that was commonly used in contact lens and ophthalmic solutions and remains a popular preservative in make up products. It has a long half-life retention and has been found in ocular tissues of rabbits, 168 h after a single topical drop of 0.01% BAK. In the European Union (EU), BAK is authorized for use in cosmetic products at maximum concentrations of 0.1% (1 mg/ml), but even at lower exposure, it kills human corneal, conjunctival and meibomian gland epithelial cells *in vitro* within 18 hours of exposure. *In vivo*, BAK has been reported to induce tear film instability, goblet cell loss, conjunctival squamous metaplasia and apoptosis, corneal neurotoxicity and disruption of the corneal epithelium barrier. On the ocular surface, [BAK](#) can lead to irritation, burning, itching, foreign body sensation, conjunctival hyperemia, blepharitis, meibomian gland loss and dry eye disease.

Formaldehyde-releasing compounds

Formaldehyde-releasing compounds (e.g. DMDM-hydantoin; quaternium-15; imidazolidinyl urea; diazolidinyl urea; and 2-bromo-2-nitropropane-1, 3-diol)



have an easily detachable formaldehyde moiety, so the biocidal formaldehyde is gradually releasing small amounts. There are regulated maximum limits – 0.2% in the EU and 0.074% recommended by the Cosmetic Ingredient Review (CIR) – formaldehyde is toxic to human corneal, conjunctival and meibomian gland epithelial cells *in vitro* at concentrations hundreds of times lower. Apoptosis/ necrosis increases within 3 minutes in rabbit epithelium *in vitro* when in contact with 0.1% mg formaldehyde. Levels as low as 0.00005 - 0.0001% can elicit ocular irritation and conjunctival redness. The mutagenic, carcinogenic and pro-allergenic potential of [formaldehyde](#) has prompted increased public health attention resulting in the International Agency for Research on Cancer to classify it as carcinogenic to humans.

Parabens

Over 22 000 cosmetic products in the USA contain parabens, the most common being methylparaben and ethylparaben. Again, while regulated, both methyl and ethyl-paraben reduce the survival of meibomian gland epithelial cells *in vitro* in concentrations much lower than the maximum approved limits. Parabens are allergens and endocrine disruptors, causing MGD and dry eye by 2 pathways:

- Causing local estrogenic effects by inhibiting oestrogen sulfotransferase activity. (Oestrogens decrease the secretagogue-induced cyclic AMP in human meibomian gland epithelial cells.)
- Expressing antiandrogen activity

Parabens may increase the risk of malignancies (e.g. breast cancer).

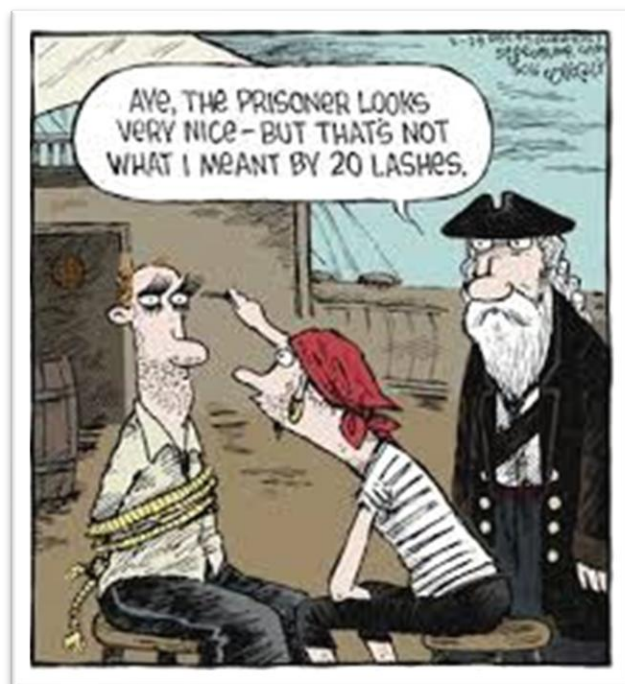
Phenoxyethanol

Phenoxyethanol is a broad-spectrum preservative that is active against a wide range of gram-negative and gram-positive bacteria, yeasts, and moulds, and is permitted in consumer products up to a concentration of 1.0%. As we are coming to expect, lower doses have been shown to affect the meibomian epithelium. Dermal absorption is high and such absorption can induce hepatotoxicity, renal toxicity and haemolysis so contact with the eyes is best avoided.

Thimerosal

Although thimerosal is no longer used in CL solutions, it is still found in makeup removers, eye moisturizers, mascaras and bleaching creams. Allergic reactions are common – about 11% of patch testing is positive in the US and Canada. In addition, it is a neurotoxin and endocrine disruptor.

The glues and adhesive products used to affix extensions or full eyelashes contain some of the ingredients listed above as well as ammonia, lead, latex and cyanoacrylate (which emits [formaldehyde](#)). These are either known to be irritants or have the potential to trigger allergies.



A single eyelash lifespan is 4–11 months, and there will be lashes in all of the 3 stages of growth so the procedure is typically repeated monthly. Removing lashes may require harsh solvents. The eyelashes themselves and the glue, are flammable, and there is [a report](#) of eyelashes being set alight during a minor oculoplastic procedure. Other products may cause adverse reactions in and around the eye:

Acrylates

We've heard of methacrylate and polymethyl methacrylate (PMMA), used safely in soft and hard contact lenses. PMMA gives a matte, non-greasy finish to products such as artificial nails and adhesives, nail polishes, artificial eyelashes and hair fixatives. Hydroxyethyl methacrylate (HEMA) and poly(2-hydroxyethyl methacrylate) (PHEMA) are both also used to make soft contact lenses and artificial corneal prostheses. Ethyl acrylate is also used in paints, textiles, pharmaceuticals and cosmetics. Ethyl, 2-ethyl hexyl and butyl acrylates are all used in adhesives. They can trigger contact dermatitis. Certain acrylates may be carcinogenic.

Carnauba wax

Carnauba wax is an emulsifier and hydrophobic agent used to get a smooth, glossy finish on everything from nail polish to eyeshadows to cars. It is derived from the tropical palm *Copernicia Cerifera* and is the hardest known plant wax. Despite being 'natural' it can cause eyelid contact dermatitis.



Castor oil

Castor oil is used as an eyelash conditioner, in eye cream, eyeliner, eyeshadow, glitter, makeup primer, makeup remover, mascara and serum. Anecdotal evidence suggests that castor oil stimulates eyelash growth, but there is no clear evidence. However, one of the components of castor oil, ricinoleic acid, inhibits prostaglandin D2 which has been linked

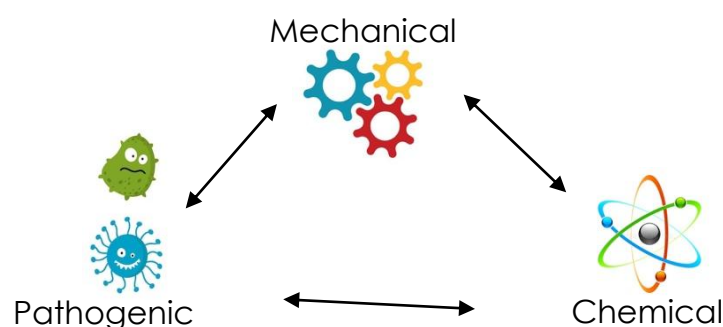
with androgenic alopecia, so more research is needed. Castor oil is generally well tolerated on the skin, but in the eye can cause discomfort and epithelial cell disruption.

Tea tree oil and terpinen-4-ol

Tea tree oil and its most active ingredient, terpinen-4-ol (T4O), effectively reduce mite counts in *Demodex* blepharitis. *Demodex* mites are killed within 88 min of exposure *in vitro* to 1% T4O and within 40 min in 4% T4O. The American Academy of Ophthalmology recommends a daily lid scrub with 50% tea tree oil and lid massage with 5% tea tree oil ointment for ocular *Demodex* infestations. Tea tree oil products are advertised as eye makeup removers, moisturizers, toners, and cleansers for eyelids, eyelashes and eyelash extensions. Tea tree oil used chronically is an endocrine disruptor and possesses anti-androgen and estrogen properties that may lead to MGD and dry eye disease.

Summary

Ocular surface health can be compromised by certain cosmetics used around the eyes. However, because of the psychology behind wearing makeup, it is unlikely that our recommendation to stop wearing it will be accepted by most, if any, patients. It may help to break down the processes affecting the ocular surface into: Mechanical (M), pathogenic (P), and chemical (C).



Generally speaking, thick lashes are healthier than long lashes. Eyelashes are meant to be a specific length to deflect wind and debris away from the eye (M) and are typically one third of the width of the eye. Prescription- and OTC prostaglandin-infused eyelash growth serums are best avoided, as they have the potential to create inflammatory side effects (C). Amino-acid polypeptide serums are probably safer, as they condition natural lashes. Lash extensions with formaldehyde-based glues may result in allergic and inflammatory side effects (M, C). Eyelash extensions should be cleaned daily with either hypochlorous acid or non-irritating lash shampoos to avoid attracting excessive *Staphylococcus aureus* or *Demodex* mites (P). Waterproof mascaras are thought to be the most irritating (C); however, they may be less likely to migrate from the lashes into the tear film (M). Some research suggests that the effectiveness of dry eye treatments, such as artificial tears, might be compromised in patients who use cosmetic products around the eye area due to the cosmetics contaminating the artificial tears upon administration (M, C). We may need to start the management of dry eye with a change to using an eye-friendly mascara to break the cycle.

If you've clicked on the links, you will already know that I've relied heavily on these two substantial references: CORE's [Contact Lens Update](#) recently dedicated an entire issue to cosmetic trends and the [TFOS](#) group's extensive (54 pages of it!) report. For more information, please click on their links.

Encourage all staff in the practice to understand that it's more complicated than simply adding moisture to dry eyes or washing away anything that gets into the eye. As the patient's first contact, reception and support staff are best placed to introduce the concepts to patients and start educating them about the cost of beauty.

Link to Questions: <https://forms.gle/2QxMryXAjPwTeJxC8>

Questions

- 1) How many eyelashes are typically found in the lower eyelid?
 - a. About 40
 - b. About 80
 - c. About 120

- 2) What triggers the blink reflex?
 - a. Light and airflow
 - b. Movement or touch
 - c. All of the above

- 3) Which glands are associated with eyelashes for lubrication?
 - a. Piloni glands
 - b. Glands of Zeis
 - c. Sweat glands

- 4) How long is the typical natural anagen phase of an eyelash?
 - a. 1-2 weeks
 - b. 4-6 weeks
 - c. 8-12 weeks

- 5) What is the optimal eyelash length to minimize evaporation, according to the bionics model?
 - a. 0.25 times the eye width
 - b. 0.35 times the eye width
 - c. 0.45 times the eye width

- 6) What is the most common symptom of eyelash extension side effects?

- a. Redness
- b. Itching
- c. Burning

7) Eyelash extensions can cause what condition during sleep?

- a. Lagophthalmos
- b. Epiphora
- c. Mydriasis

8) Lash serums stimulate growth by targeting which phase of the eyelash growth cycle?

- a. Telogen
- b. Catagen
- c. Anagen

9) In studies, what was the mean increase in eyelash length after using prostaglandin analog serums for 4 months?

- a. 0.8 mm
- b. 1.3 mm
- c. 2.1 mm

10) Prostaglandin analogues in eyelash growth serums have been linked to which common side effect?

- a. Increased tear production
- b. Hyperemia (redness)
- c. Corneal thinning

11) Where can eyeliner potentially block glands?

- a. Meibomian glands
- b. Sweat glands
- c. Glands of Wolfram

12)Applying eyeliner to the inner eye margin increases migration into the eye by:

- a. 5-10%
- b. 15-30%
- c. 50-70%

13)Forced blinking can contribute to:

- a. Orbicularis fatigue
- b. Particle migration into the tear film
- c. Eye dryness

14)The muscles of Riolan are believed to:

- a. Help with blinking speed
- b. Preserve the close approximation of the eyelid margin to the globe
- c. Increase tear production

15)Tear film contamination levels are highest when eyeliner is applied:

- a. On the inner eyelash line
- b. Above the eyelash line
- c. On the lower lid only

16)A study on glitter eyeliner found tear film contamination peaks within:

- a. 5 minutes
- b. 10 minutes
- c. 90 minutes

17)Once inside the eye, particles are moved by:

- a. Diffusion, drift, and mass flow
- b. Evaporation and blinking

c. Inflammation and cell repair

18) Which of these is a safe eye makeup remover?

a. Benzalkonium chloride

b. Hypochlorous acid

c. Formaldehyde

19) Carnauba wax is known to cause:

a. Eyelid contact dermatitis

b. Enhanced eyelash growth

c. Decreased meibomian gland function

20) Castor oil is thought to affect eyelashes by:

a. Stimulating growth

b. Causing rapid loss

c. Decreasing thickness