SUFFERING FOR BEAUTY: HARMFUL INGREDIENTS AND TRENDS IN COSMETICS

Dirty secrets inside the beauty bag.

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The United States has the largest cosmetics market in the world, and its revenue is expected to exceed $62 billion in 2016.[1] According to the consulting company Kline, natural cosmetics and skincare is estimated to be worth $33 billion, accounting for 13% of the overall global beauty market.[2] There is also a growing demand for safe cosmetics.

Part one of this four-part series ("Beauty Does Not Have to Hurt," page 42, *AOC*'s July/August 2016 issue) discussed the lack of regulatory oversight by the US Food and Drug Administration over the use of terms such as safe in the labeling of cosmetics. With cosmetics being a large and growing market, it is necessary for eye care providers to know the habits of our patients, both men and women, and to educate them about proper ocular health and cosmetic use. In part two of the series, we explore potential harms from ingredients in commonly used cosmetics, and we uncover some potentially harmful beauty trends.

NATURALLY ORGANIC OCULAR SURFACE OFFENDERS

"Nature" is all the rage in beauty and wellness products. Particularly trendy at the moment are earthy ingredients—like rocks. And the rocks that are very popular are diamonds, and not just those for sparkling adornment.

Actress Elizabeth Taylor once professed "Big girls need big diamonds." However, Ms. Taylor was referring to diamonds as jewels, not the crushed rocks we now find in luxury beauty products. Diamonds are a form of carbon, a very hard mineral. They are used not only as gemstones, but also as industrial abrasives for cutting hard materials. On your face, it is claimed that diamond dust acts like a magic wand, erasing sun damage, scars, blotchiness, and lines.

Figure 1. Eyelash length should be one-third of eye width. Eyelashes help limit tear evaporation from the surface of the eye.

Diamond dust is most often found in luxury eye cosmetics, making their prices out of reach for younger consumers. Therefore, the demographic most attracted to diamond-infused products is women in middle-age; this happens to coincide with the time many women begin to develop ocular surface disease (OSD).[3]

Can diamond dust exacerbate dry eye symptoms? Crushed rocks in the tear film? Yes, perhaps that might cause some instability. On slit-lamp examination, these crushed rocks look like shards of glass piercing the conjunctival tissue.

Adding flame to this inflammatory fire, many luxury cosmetic brands have now expanded their natural mineral ingredients to include not only diamond dust, but also hematite and tourmaline in their products.

Ms. Taylor might opine that these precious stones should be adorning fingers, ears, and throats, not the eyelids or eye contours.

Another natural mineral ingredient that should raise an eyebrow is kohl. Kohl has been popular since ancient times, used by the queens and nobles of Egypt as early as 3100 BCE.[4] Historically, people used kohl to protect their eyes from the harsh rays of the sun, as well as for treatment of eye ailments. In India, mothers applied kohl to their infants' eyes soon after birth, purportedly to strengthen the children's eyes, and others believed it could prevent children from being cursed by the evil eye.[5-10]

The Food and Drug Administration points out, however, that many people may be unaware of the lead-poisoning risk, for both adults and children, from this traditional eye cosmetic, known variously as kohl, kajal, al-kahl, and surma. Kohl is predominantly used as an eyeliner or mascara, both for beautification and as part of cultural tradition. Concerns about kohl's safety should be addressed with patients.

EYELASHES: BALANCING BEAUTY AND FUNCTION

In most Western cultures, long eyelashes are deemed aesthetically pleasing. However, when we alter the ratio that Mother Nature intended, we create unwanted consequences. The long eyelashes of babies have an adorable appeal, but babies do not experience the same effects of altered lash/lid ratio as adults. Perhaps the incredible tear stability of the young and the long lashes of infancy are designed to maximally deflect debris, an advantage given the relative lack of neurologic coordination and mobility of infancy. Or perhaps it is an illusion that the lashes are longer in the young and that the ideal protective lash/lid length ratio is preserved in infancy.

Alterations of length have been found to limit the eyelashes' unique protective features against turbulent air and debris.[11] When individuals artificially lengthen their eyelashes with cosmetics, stiff methacrylate eyelash extension glues, and synthetic lash extension fibers, the natural lash cilia flexion and resultant tear evaporation and debris-deflecting attribute may also be detrimentally altered (Figure 1).

Amador et al found that, among 22 mammalian species studied in wind tunnel experiments, the optimal lash/lid ratio of 0.34 cuts the tear evaporation rate and particle deposition rate by half.[11] Eyelashes become thinner, shorter, and lighter as women age,[12] and this may contribute to the evaporative load in older patients with OSD.

Alterations in the ideal lash/lid ratio are also seen in children with significant ocular allergies such as vernal keratoconjunctivitis (VKC). In a series of 93 children with VKC, Pucci et al found the eyelash length to be significantly longer than in normal age- and gender-matched controls.[13]

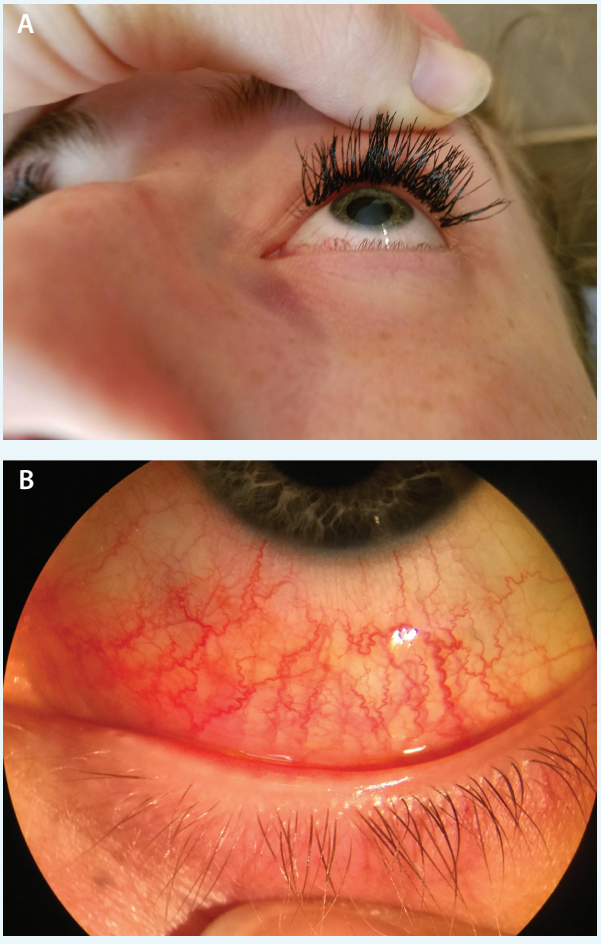

Figure 2. This young patient had false lashes applied (A). She developed a severe chemical conjunctivitis from the glue used during the application process (B).

Additionally, the degree of VKC severity was positively correlated with longer lash length.[13]

Eyelash extensions are popular, but for OSD specialists there are concerns about the consequences. As noted, altering the ideal lash/lid ratio results in altered evaporative and debris protective abilities, but in addition the adhesives used for these extensions also create havoc for the ocular surface. These adhesives are cyanoacrylate- like adhesives, with mixtures of methacrylates, volatile organic compounds, and formaldehyde (a preservative and known ocular irritant). Methacrylates are considered inert once they polymerize, but the accompanying chemicals needed to keep the acrylates in liquid form during application contribute to evaporative stress, irritation, and allergenicity. Additionally, these chemicals can leech onto the ocular surface during application of the adhesive, creating a chemical conjunctivitis (Figure 2).

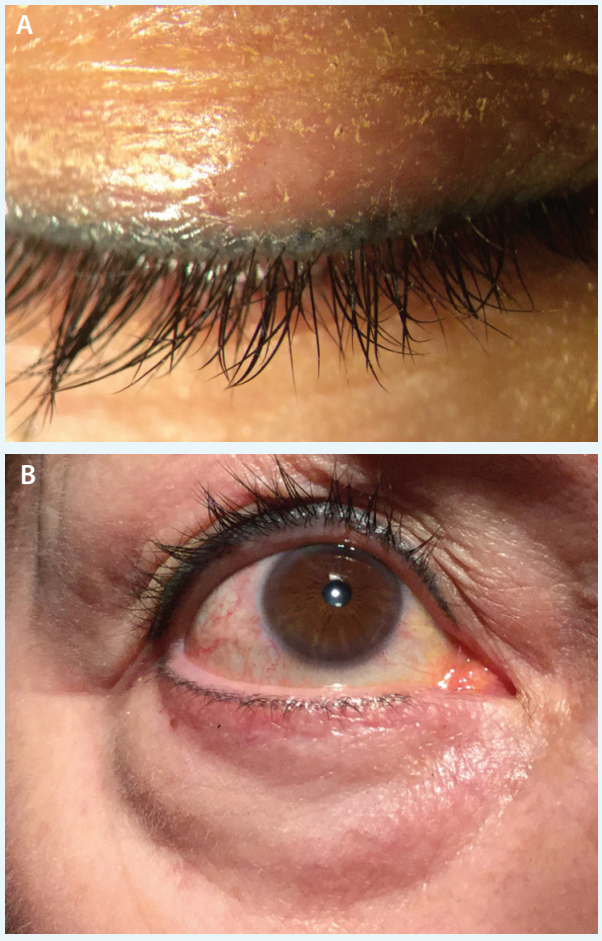

Figure 3. Permanent eyeliner in the form of a tattoo is common in the United States (A). This practice can affect tear film quality and meibomian gland function (B). Education about the risks of these permanent procedures is key for patients with dry eye disease.

Based on the available literature and clinical observations, eye care providers should advise OSD patients to avoid eyelash extensions and growth serums. Many patients with severe OSD stop using eyelid and eyelash cosmetics due to irritation. Eyelash growth products such as Latisse (bimatoprost ophthalmic solution 0.03%, Allergan), although shown to be "safe and effective",[14] the incidence of conjunctival and eyelid hyperemia was significantly greater in subjects using 0.03% bimatoprost than subjects randomized to a vehicle control.[15] Also, according to a very recent study, prostaglandin analogues (eg, bimatoprost) may induce meibomian gland dysfunction.[16]

EYELIDS: NO SILVER LINING

Lining the eyelid is another common way to enhance the eyes. Eyeliners can be found in the form of pencils, cakes, liquids, and even permanent options. The location of eyeliner application is influenced by fashion trends, which have included application close to the lash line, posterior to the lash line, and on the inner lid margin or waterline. Trends have also included the addition of bright pigments, glitter, and even gems.

It is important to make your make-up wearing patients aware of their eyelid anatomy, particularly the meibomian glands and their orifices. To the eye care practitioner, the lid is an area of great concern for overall tear film stability, but to patients this is the perfect place to apply eyeliner. Pencil eyeliner, when applied on the inner portion of the lash line, has been shown to migrate into the eye 15% to 30% of the time.[17] Although eyeliner entering the ocular surface has not been shown to induce ocular inflammation, use on consecutive days has been shown to increase lipid layer thickness and the incidence of dry eye symptoms.[17]

Conjunctival pigmentation has also been noted in patients using eyelash cosmetics, including both mascara and eyeliner.[18] This can be seen on slit-lamp examination as small brown or black flecks within the inferior palpebral conjunctival tissue.

Some women who want the luxury of waking up with makeup may elect to obtain permanent eyeliner in the form of tattoos (Figure 3). A recent study found that permanent eyeliner tattooing shortened tear film breakup time, increased corneal staining, and induced meibomian gland loss significantly in comparison with a control group with no eyeliner tattoos.[19]

Eyelash dying or tinting is another beauty trend that can cause severe allergic reactions, as many hair dyes contain para-phenylenediamine, or PPD.[20] This is a chemical found in plastics such as Kevlar (Dupont) and also used in the recent trend in henna temporary tattoos. Many individuals have reported severe conjunctival reactions, swelling, watering, and acute inflammation due to allergy to PPD in dyes used around the eyes for eyelash tinting.[21-22]

DIRTY SECRETS: INSIDE THE BEAUTY BAG

You can recommend that your patients use cosmetics containing safer ingredients, and you can educate them about the proper application of cosmetics. The next problem is assuring their compliance. One common way in which patients may fall short of our expectations is in the timely replacement of cosmetics.

Quarterly replacement of eyelash (mascara and eyeliner) and eyelid (primers and eye shadow) cosmetics is a common recommendation. How many of your patients do this? Have you discussed their cosmetic hygiene routines with them? Cosmetics are not like the bottle of milk in your refrigerator: They do not have a "use by" date stamped on them. Nonetheless, these makeup products do have built-in expiration dates. Tell your patients to treat products such as mascara and liquid eyeliner like eggs, as they have the shortest shelf lives.

MAKEUP TIPS IN THE YOUTUBE ERA

The YouTube Generation
How to apply make-up tutorials
DIY cosmetics including mascara made from crushed Oreo cookies and blueberries
Challenges: 100 layer make-up challenge where women apply 100 layers of mascara
Applying Sharpie marker for liquid eyeliner
How to apply eyeliner to the "waterline" – aka meibomian gland orifices

Young women and men often turn to YouTube to learn the latest trends in beauty and to find how-to guides for makeup application. In the past 10 years, more than 5 billion hours of beauty tutorials and explainers have been uploaded to YouTube.

Some of the videos offering tips on makeup application may be quite alarming to eye care providers. There are makeup challenges, such as applying 100 layers of mascara or foundation. There are do-it-yourself guides for making cosmetics—using anything from blueberries to crushed Oreo cookies.

Thanks to tips from celebrities like Taylor Swift, we have to be concerned about young women using Sharpie markers as liquid eyeliner. The Kardashian family is not much help either, having made false eyelashes and heavy use of eyeliner mainstream.

Stay vigilant to new beauty trends, and start conversations about proper cosmetic use early with your young patients.

Mascaras and eyeliners are made up of oil, waxes, preservatives, and pigments. Most of our female patients use eye makeup; it has been estimated that 87% of women younger than 55 years use eye cosmetics.[23] It has been estimated that 9 out of 10 women 18 to 54 years of age use mascara.[24]

These oils and waxes can not only clog the meibomian glands, they can also supplement the diet of *Demodex*. Optometrists should make patients aware of *Demodex* before an infestation can occur. Not only should you discuss *Demodex* and the need for lid hygiene with your patients, but you should address bacterial growth and contamination of makeup tubes and containers and how this can affect vision. You might point out that, every time they put the wand back into the tube, bacteria enter and contaminate the makeup.

Microbial organisms are normally present on human eyelashes. Application of eye makeup to lashes has the potential to inoculate the mascara tube or eyeliner with these microbes.[25] Mascaras are generally contaminated more than eye shadows. In a study of 150 samples, 15% of mascaras were rated as heavily contaminated (more than 104 cfu/mL of bacteria).[26]

Pack et al, upon finding microbial presence in 36.4% of mascara tubes cultured after 3 months of use, recommended keeping a mascara tube, used on a daily basis, for no more than 3 months.[25]

Pseudomonas corneal ulcers have also been associated with mascara contaminated with *P aeruginosa*.[27] If the corneal epithelium is scratched during the application of mascara, particularly with an old applicator, the cornea should be treated immediately and the mascara cultured to detect *Pseudomonas*. This is important to remember, as mascara wand injuries are common with makeup application in moving vehicles, another dirty secret of our cosmetic-loving patients. Aged mascara wands, tubes, and eyeliners can easily become contaminated with one or more species of microorganisms including the genera Bacillus spp., Staphylococcus spp., Pseudomonas spp., Proteus vulgaris, and Serratia marcescens.[27] Patients should also be made aware that they must wash their hands before makeup application. Contaminants can appear from multiple sources.

Traditionally, the contents in your patient's purse should not be public knowledge, however, what's in their beauty bag can be detrimental to their eye health. Please discuss your patients' cosmetic routine and OSD implications. Stay vigilante to new beauty trends and start the conversation early about cosmetic use with your patients, what's hiding in their beauty bag can hurt the ocular surface. ■

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