Treatment of Periorbital Hyperpigmentation

Periorbital hyperpigmentation is a generally benign, extremely common condition that is notoriously resistant to treatment. According to the author, the key to successful treatment is determining the primary cause and complying with maintenance and preventive regimens. A multimodal approach may be required, encompassing topical bleaching agents, chemical peels, laser therapy, and/or surgery. (*Aesthetic Surg J* 2005;25:618-624.)

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The eyes, a focal point of facial expression, not only convey the full range of human emotion but also have a significant impact on how one is perceived in terms of health and beauty. Efforts to enhance and accentuate the eyes range from simple application of moisturizing creams and colored pigments to medical procedures such as injections and surgery. Improvement of the eyes and periorbital area is of particular concern to an aging person with fine lines, loose skin, excess fat, and hyperpigmentation (dark circles). Such conditions, resulting from a combination of thin skin, shifting gravity, loss of collagen, and excess sun exposure, are generally medically benign but nonetheless unattractive, frequently causing a sad, tired, or unhealthy appearance that many find troubling.

Although there are several medical techniques that successfully address fine wrinkling and contour deficiencies, dark under-eye circles have been notoriously resistant to treatment. Traditional therapies such as hydroquinone-based bleaching creams are frustratingly slow and yield minimal, barely perceptible results. Poor outcomes combined with a scarcity of scientific literature have frustrated many physicians attempting to help patients address this problem. The gap in medical treatment is filled by a proliferation of consumer products with unsubstantiated claims of miracle cures.

Although medical treatment is not always indicated, there are some newer approaches and combined therapies that offer hope for the treatment of dark circles. In many patients, periorbital hyperpigmentation has a variety of causes requiring a multimodal approach that may include topical bleaching agents, chemical peels, laser therapy, and/or surgery. Although not every patient can achieve satisfactory improvement, successful outcomes are possible depending on (1) appropriate patient selection based on primary cause, and (2) careful counseling about compliance with maintenance and preventive regimens. Here, I share my experience in treating this condition and provide patient selection guidelines that will optimize treatment results.

Etiology

Periorbital hyperpigmentation is caused by various overlapping endogenous and exogenous factors. Genetic tendency, sun exposure, and advanced age are the foremost causes (Table 1). Although no comprehensive epidemiology exists, women may be affected more frequently than men because of hormonal factors.

Clinical observation is usually sufficient to determine the primary cause of periorbital hyperpigmentation; confirmation by histological examination is rarely necessary. Although most cases are of benign origin, it is wise to take a complete history to rule out underlying disease. Some medical problems that may contribute to dark under-eye circles include disorders of the heart, thyroid, kidney, or liver; hereditary blood disorders; Vitamin K deficiency; Addison's disease; or circulatory conditions that cause excess fluid retention. Ask patients about the use of any medications that cause blood vessels to dilate. Also ask about any contact, airborne or food allergy, asthma, or eczema that may cause itching, excessive touching or scratching, and subsequent postinflammatory hyperpigmentation. Finally, ask patients about any previous cosmetic procedures such as blepharoplasty, rhinoplasty, or chemical peels. Some lifestyle factors that may contribute to dark under-eye circles include lack of sleep, overuse of alcohol, use of contact lenses, smoking, or excessive intake of soda or caffeinated beverages. Other

Table 1. Causes of periorbital hyperpigmentation

Endogenous	Exogenous
Genetics/heredity	Sun exposure
Advanced age	Allergies (contact and airborne)
Excessive vascularity	Fatigue/eye strain
Vitamin K deficiency	Postinflammatory hyperpigmentation
Facial structure/anatomy	Hormonal therapy (oral contraceptives, hormone replacement therapy)
Chronic sinusitis	
Infraorbital swelling	
Thin skin	

than severe malnutrition, nutritional factors are generally not a cause. If patients complain of a sudden onset of symptoms or unexplained progression, a complete medical work up may be indicated.

Presentation and Classification

Periorbital hyperpigmentation presents with one or more of the following characteristics: (1) diffuse and concentrated melanin deposits (hyperpigmentation), (2) excessive or superficial subcutaneous vasculature, and (3) shadows caused by pseudoherniated orbital fat.

Hyperpigmentation occurring in the dermis, epidermis, or both is a darkening of the skin caused by an increase in the production or distribution of melanin. Periorbital hyperpigmentation usually appears as a curved band of brownish or bluish skin approximating the shape of the underlying inferior orbital rim. Epidermal melanin appears brown; dermal melanin appears blue or blue gray. Woods lamp examination may distinguish between dermal and epidermal melanin deposition. Stretching the skin in the affected area does not improve the appearance of pigmentation. Note the area of involvement as well as the pattern of progression.

Hypervascularity causes dark circles having a purple or blue tinge, rather than brown. In most patients the affected area encompasses the entire lower lid, concentrated along the lower aspect of the eyelid beneath the orbital fat. This condition is exacerbated by thin skin, which is usually secondary to advanced age, as well as loss of collagen and fat. It is notable that the skin in the periorbital area is the thinnest and softest of any bodily area, with an average thickness of 0.5 mm compared with 2-mm thickness in other areas. Pressing down on the affected area and pulling skin to the side will improve the appearance of dark circles caused by subcutaneous capillaries.

Pseudoherniated fat located underneath the orbital rim causes a ballooning of the lower eyelid, resulting in dark shadows. Many patients also exhibit other factors that contribute to the problem, including an excess of loose skin, dermal hyperpigmentation, and hypervascularity. Facial structure can also impact the appearance of dark circles. Expressive gestures such as frowning, smiling, or laughing reposition muscles and skin in the periorbital area, altering the pattern of light on the face and often emphasizing dark shadows. Similarly, facial bone structure can influence the way light is dispersed across the face. For example, those with a high nasal radix and deep-set eyes often appear to have dark circles. It is particularly important to factor in the impact of facial structure when contemplating rhinoplasty, blepharoplasty, facial implants, or other procedures that may alter facial contour.

Treatment and Prevention

Treatment begins with identifying and understanding the primary cause of hyperpigmentation as well as the contributing factors. In many patients, optimal results require a multimodality approach to treatment and prevention (Table 2). The treatment course for this disorder is frequently lengthy, so patients and physicians must together plan the best course of treatment to achieve desired results. Treatment options include topical agents and sunscreens, chemical peels, Botox, soft-tissue fillers, laser therapy, surgery, alternative cures, and over-the-counter cosmetics (Table 3).

Topical agents and sunscreens

Because excessive pigmentation is so frequently the major cause or most significant factor causing dark circles, the first line of treatment and prevention is the use of a broad-spectrum (ultraviolet A/ultraviolet B [UVA/UVB]) sunscreen. For broader UVA coverage, I prefer products containing Mexoryl, an ingredient not yet approved in the United States but readily available in Canada and Europe. However, I advise patients to be

Table 2. Classification and treatment of periorbital hyperpigmentation

Primary cause	Clinical characteristics	Treatment options
Hyperpigmentation	Brownish discoloration	Topical bleaching agents Chemical peels Ablative or nonablative laser Chemical and physical sun protection
Excessive vascularization	Bluish pigmentation	Pigment-targeting laser
Anatomic	Lax skin; herniated fat	Blepharoplasty Botox Soft tissue fillers

Table 3. Comparison of treatment options for periorbital hyperpigmentation

Type	Description	Advantages	Disadvantages
Topical Prescription drugs	Usually contain >2% hydroquinone	Low risk; highly effective with appropriate patient selection and technique; may be combined with surgical and laser treatment	Risk of irritation with long-term use
Cosmetic over-the-counter preparations	Vitamins and botanicals; phenolic agents containing less than 2% hydroquinone	Low risk; can improve skin tone, giving the appearance of a smoother surface	Risk of irritation, minimal efficacy, and lack of good clinical studies
Chemical peel	Phenol, trichloroacetic acid, glycolic acids, salicylic acids	Highly effective with appropriate patient selection and technique; may be combined with surgical and laser treatment	Risk of scarring, pigment change, and demarcation
Laser Ablative	CO_2	Can stimulate collagen production, lighten and tighten skin simultaneously, and provide lasting results	Pain, long recovery, risk of scarring, and pigment changes
Nonablative	Intense pulsed light	Can stimulate collagen production, lighten and tighten skin simultaneously, and provide lasting results; targets dark and red pigment	Bruising and occasional hyperpigmentation
Surgery Blepharoplasty	Removal or repositioning of periorbital fat and/or excess skin	Improves contour	Several weeks' recovery, and risk of scarring and contour deformities

cautious using chemical sunscreens in the delicate eye area; application should not extend up to the eyelid margin. Physical sunscreens like zinc oxide and titanium dioxide provide excellent protection from UVA/UVB. Some of the older formulations are thick and leave a chalky residue, so I recommend one of the newer silicone formulations that work better around the eye. For patients with very sensitive skin, a concealing makeup with a titanium base may be best. I also advise the use of large, all-weather UV coated sunglasses that block 99% to 100% of UVA/UVB.

After sun protection, the next most important tool for treating dark under-eye circles is a phenolic or nonphenolic topical bleaching agent, particularly hydroquinone and tretinoin. The mechanism of action for most bleaching agents, including hydroquinone, is inhibition of the enzyme tyrosinase, which prevents the conversion of dopa to melanin. Treatment with hydroquinone can be effective but slow, usually requiring a prescription-strength dose of 4% to achieve good results. Higher concentrations can be compounded (if indicated) but may be irritating, so any increase above 4% should be gradual. Side effects also include allergic contact dermatitis and postinflammatory hyperpigmentation. Long-term use can lead to exogenous ochronosis in many patients and should be avoided by people with darker skin types due to its potential to cause irritation, which overstimulates melanocytes. Patients who tolerate treatment well are required to continue with a maintenance regimen of 2% hydroquinone, available without prescription.

Tretinoin, a derivative of Vitamin A acid, is an effective albeit slow bleaching agent that can be safely used in the eye area in a 1% concentration in an emollient cream base (Figure 1). Tretinoin is a retinoid, a class of drugs that work by dispersing keratinocyte pigment granules, interfering with pigment transfer and accelerating epidermal turnover. Side effects may include erythema and peeling. Monitor use for excessive irritation that may exacerbate existing hyperpigmentation. Providing patients with detailed instructions can be very helpful.

The addition of topical steroids to tretinoin helps increase epidermal skin thickness and enhance the depigmenting effects. Combination therapy using 2% to 5% hydroquinone, 1% tretinoin, and 0.1% dexamethasone (the Kligman formula) is the current gold standard for topical bleaching. Although the formula has proven safe and effective for most patients, long-term use in the periorbital area is a concern, so you may need to consider less irritating bleaching creams.

Kojic acid or botanicals such as arbutin are recommended for patients who cannot tolerate hydroquinone. Kojic acid is a naturally occurring hydrophilic fungal derivative, usually available in concentrations ranging from 1% to 4%. Similar in efficacy to hydroquinone (Figure 2), long-term use may result in contact dermatitis and erythema. An extract of the bearberry plant, arbutin, is widely used in Asia as a depigmenting agent. This octyl-beta-D-glucopyranoside derivative of hydroquinone acts by inhibiting tyrosinase and is available in 3% concentrations. Higher concentrations, though more effective, may also cause or exacerbate hyperpigmentation. Azelaic acid is a naturally occurring nonphenolic agent that acts selectively on abnormal melanocytes by inhibiting DNA synthesis and mitochondrial enzymes. It is considered to be equal to or better than 2% hydroquinone, but may cause pruritis in some patients.

Topical antioxidants in addition to Vitamin A are of increasing interest. Vitamin E may help treat existing hyperpigmentation, whereas Vitamin C (L-ascorbic acid) may play a role in prevention. When adding vitamin-derived agents to any treatment regimen, it is important to understand how ingredients interact or counteract. For example, alpha-hydroxy acids and Vitamin A tend to inactivate Vitamin C. Another concern is lack of stability, which can greatly impact potency and, thus, efficacy. Vitamin K has long been touted as a potential treatment for dark circles because of its presumed effect on the clotting mechanism. I have studied various formulations of Vitamin K in topical preparations. Although some patients may achieve good results, my personal experience has been that they are only minimally useful.

In the future, formulary improvements that enhance stability, providing targeted delivery of ingredients with proven efficacy, may lead to faster results, reduced side effects, and better outcomes. Two interesting bleaching agents under development include the quick-acting N-acetyl-4-cysteaminyl phenol (NCAP) and glycyrrhetinic acid, derived from Glycyrrhiza glabra (licorice), which appears to inhibit tyrosinase activity, UVB-induced erythema, and pigmentation in topical concentrations of 0.5%. Agents that prevent as well as repair sun damage such as ultrasomes, the liposomal encapsulated enzyme UV-endonuclease, may also play an important role in treating and preventing periorbital hyperpigmentation in the future.

Chemical peels

Chemical peels to address lower eyelid hyperpigmentation may be used alone or in combination with other treatments, such as topical bleaching agents. Trichloro-

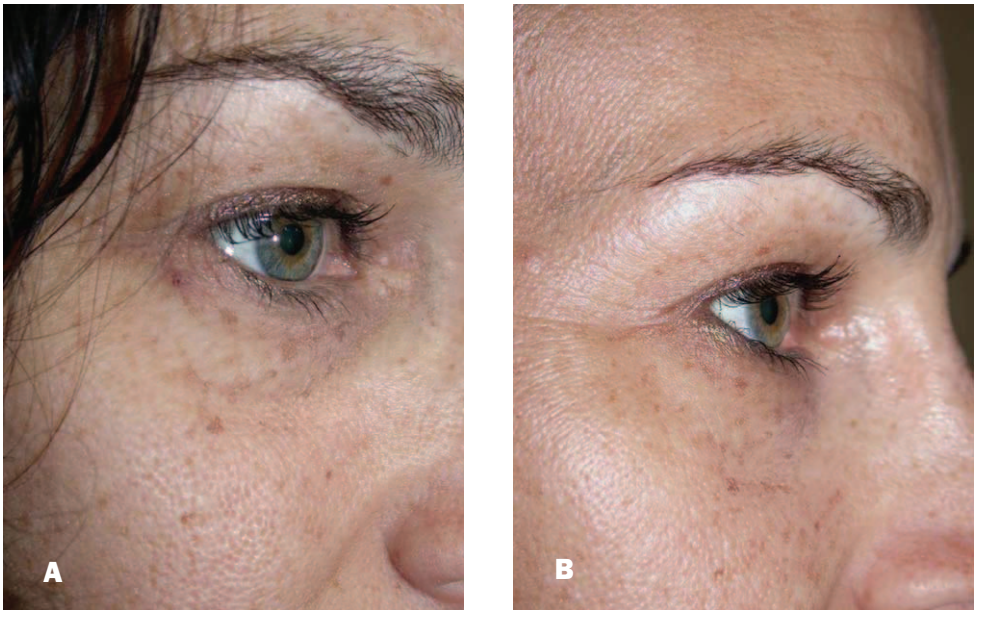

Figure 1. A, *Pretreatment view of a 44-year-old woman.* **B,** *Posttreatment view 5 weeks after continuous treatment for periorbital hyperpigmentation with a bleaching cream containing retinol (Young Pharmaceuticals, Inc.).*

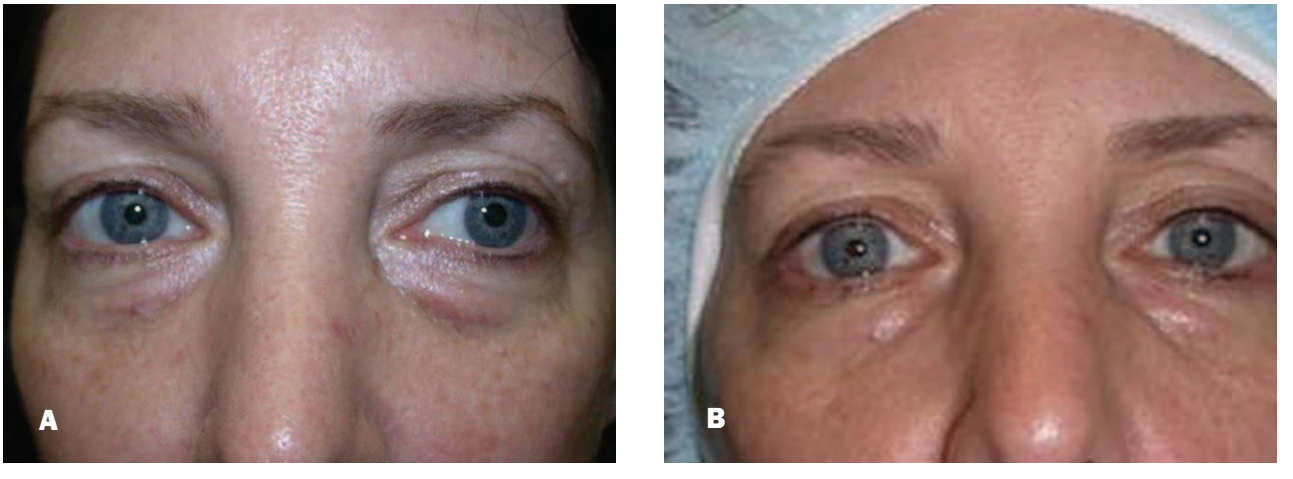

Figure 2. A, *Pretreatment view of a 52-year-old woman.* **B,** *Posttreatment view 4 weeks after continuous treatment for periorbital hyperpigmentation with a bleaching cream containing kojic acid (Young Pharmaceuticals, Inc.).*

acetic acid (TCA) peels in concentrations ranging from 20% to 35% are preferable to salicylic or glycolic acid. Phenol, another agent sometimes used for chemical peels, acts by reducing the ability of melanocytes to produce melanin and is traditionally limited to patients who are Fitzpatrick types I to III. Because of risks of scarring, hypopigmentation, and systemic toxicity, I do not recommend phenol peels.

Careful selection of patients for chemical peeling should involve not only identification of Fitzpatrick skin type, but also determination of ethnic background. Different ethnic groups may respond unpredictably to chemical peeling regardless of skin phenotype. For Fitzpatrick types I and II, a concentration of up to 35% TCA can be safely used. For medium to darker skins (Fitzpatrick III and IV), it is best to extend the peel to the entire face to avoid postpeel demarcation. For optimal outcome, I recommend pretreatment with tretinoin and use of a hydroquinone bleaching agent for 2 months before undergoing a chemical peel. Patients should expect a 1-month recovery period and must be particularly strict about sun protection, using broad-spectrum sunscreens for at least 6 months postpeel. Chemical peels are contraindicated in patients in whom dark circles are primarily caused by hypervascularity because of the risk of worsening their appearance.

Botox and soft tissue fillers

In patients in whom the active pretarsal muscle impacts the shape of the infraorbital rim, judicious use of Botox (Allergan Inc., Irvine, CA) may lessen the appearance of dark circles. Use of soft tissue fillers such as Restylane (Q-Med, Uppsala, Sweden) may succeed in filling in the sulcus to lessen the demarcation between actively contracting muscle and the flat plane of the cheek.

Laser therapy

Noninvasive lasers that target pigment and vascularity may be an effective method of treating dermal melanin deposition or hypervascularity. Noninvasive lasers that have been shown to be effective include the intense pulsed light (IPL) and Q-switched ruby. These lasers work by targeting a light beam to excess pigment and vascularity, causing rupture and reabsorption. Optimal improvement usually requires several treatments over 3 to 4 months. Side effects include transient hyperpigmentation, which can be treated with topical bleaching agents. Patients opting for laser therapy must be advised that bruising can last up to 2 weeks.

Resurfacing lasers like the carbon dioxide (CO_2) or Erbium:YAG may be an option for some patients. These lasers cause a thermal injury that can stimulate collagen, lighten pigment, and tighten skin simultaneously. Outcomes, although highly dependent on operator skill, can be quite good. In considering this option, patients must fully understand the significant risks for negative side effects including permanent pigment changes, both hypo- and hyperpigmentation, resulting in obvious demarcation, ectropion, pain, infection, and a long recovery period (up to 6 months).

Surgery

The goal of blepharoplasty is to eliminate skin laxity and redundancy, remove or reposition pseudoherniated fat, and correct abnormal eyelid position. Blepharoplasty may also be helpful in eliminating dark circles caused by shadows that are cast by fat deposits and/or excess skin. Patients should be advised to pick a skilled surgeon to avoid an overly aggressive removal of fat and skin that can lead to a deeper and lower eyelid contour, causing a hollow appearance that exacerbates dark circles. I prefer that patients undergo repositioning of fat over the orbital rim via the transconjunctival approach rather than the traditional transcutaneous method, so that no external visible scar is created.

Patients undergoing blepharoplasty may also need to address skin discoloration and fine wrinkling. Many surgeons recommend chemical peels or laser resurfacing performed in conjunction with surgery. Although this may seem more convenient for both patient and surgeon, I advise my patients to postpone resurfacing until 6 months after undergoing blepharoplasty. Frequently, resurfacing will not accomplish the kind of dramatic result that would justify the prolonged healing period.

Alternative cures

Popular literature is replete with homeopathic regimens or devices to cure puffy eyes and dark circles. Cool tea bags, sliced potatoes or cucumbers, yogurt, and honey masks are among the treatments that are purported to help. Frozen gel-filled eye masks feel great and can temporarily help to improve puffiness but usually do not have a noticeable impact on dark circles. Manual massage to stimulate and enhance lymphatic circulation could theoretically help with puffiness; however, excessive handling and pulling of the delicate periorbital skin is not advised.

The use of hemorrhoid creams such as Preparation H (Wyeth, Madison, NJ) and topical conjugated estrogen Premarin (Wyeth) has been widely touted in the popular press as the "model's secret" to combat dark circles. Preparation H contains phenylephrine, which shrinks blood vessels and reduces puffiness. It also causes redness and irritation, and there are no scientific studies supporting its safety for use in the delicate eye area. Although it may exert a temporary positive effect, I do not recommend this product for my patients. As for topical estrogens, they do help firm the skin, but there is no evidence to support their use for dark circles.

Lifestyle changes may make a difference for some patients. For example, if fluid retention is a concern, salt intake must be monitored. Sleeping with extra pillows to elevate the head is helpful in preventing edema in the eye area.

Over-the-counter cosmetics

Patients frequently inquire about the efficacy of cosmetic eye creams to treat their dark circles. The use of a moisturizing eye cream can help to improve the overall appearance of periorbital skin by aiding in moisture retention. This plumping effect can make thin skin around the eyes appear smoother and more even; however, these effects are temporary.

For most patients, the risk of trying new cosmetic products is very low. However, despite the overly optimistic promises of cosmetic manufacturers, I advise explaining to patients why the chances for real or lasting

success with over-the-counter cosmetic products are slim. When patients plan to add a new product to an existing regimen, be sure to help them determine how the new product can be most safely incorporated.

Conclusion

Despite our best efforts, a significant reduction in the extent and intensity of dark circles may not be a realistic goal for all patients. Even those amenable to treatment are often subject to relapse, particularly when the primary cause is hyperpigmentation. For those patients who have achieved a good result, it is critical to stress the importance of compliance with maintenance and preventive regimens. In addition to diligent sun protection, patients should be aware of other environmental triggers such as lack of sleep, excess salt intake, sleeping position, allergens, and cosmetic irritants that might exacerbate the appearance of their dark circles.

For patients unwilling to undergo medical treatment, those whose condition cannot be helped by existing technology, or patients who will experience a long interval between the onset of treatment and any noticeable improvement, coping strategies should focus on preventing the problem from worsening and using effective concealment techniques until better treatment options are available. Many highly effective cover-up products are available that successfully conceal dark circles, and physicians treating this condition should be familiar with them. Facial self-tanners may also help obscure the contrast between dark and light skin, as well as providing a refreshed and rested look. Patients should be encouraged to seek expert advice from a cosmetic sales person or makeup artist for appropriate product selection and skillful application. Eyeglasses, (prescription or cosmetic) styled so that the rim hides the dark circles, may be helpful for men or those women who don't want to use makeup.

Whatever the course of action, physicians must work with patients so that they fully understand the various causes of their dark circles and the different approaches to treatment or camouflage. The ability to separate fact from fiction can be helpful in guiding and motivating confused or discouraged patients to stay the course and find a solution that works. The high level of interest in developing better treatment options bodes well for new technologies that may provide greater success. ■

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1090-820X/$30.00

doi:10.1016/j.asj.2005.09.018