What causes dark circles under the eyes?

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Abstract
Dark circles under the eyes (DC) are defined as bilateral, round, homogeneous pigment macules on the infraorbital regions. Despite its significant prevalence, there are a few published studies about its pathogenesis. DC are caused by multiple etiologic factors that include dermal melanin deposition, postinflammatory hyperpigmentation secondary to atopic or allergic contact dermatitis, periorbital edema, superficial location of vasculature, and shadowing due to skin laxity. The purpose of this review is to discuss some of the available evidences about the anatomic features that could explain dark circles and the proposed treatments for this unpleasant condition.

Keywords: dark circles, eye bags, periorbital hyperpigmentation

Introduction
Aesthetic facial concerns have been the main reason for dermatological consults in the last few years. Pigmentary disorders, like melasma, solar melanos, rhytides, and loss of elasticity are among the most common complaints. As patients grow older, although physically and intellectually active, the importance of a younger or at least well-cared look increases. Besides the common alterations related to the intrinsic and extrinsic aging processes, there is one that affects individuals of any age, both genders and all races: the so-called “dark circles under the eyes” (DC). Unfortunately, this manifestation worsens with skin sagging and abnormal lipid deposits that appear later in life.

Dark circle is not a formal medical term, but both patients and dermatologists use it to indicate periorbital hypercromic macules and patches. Although considered a phenomenon within the limit of physiology, patients, especially women, are really bothered and concerned about it, even relating the presence of dark circles with significant impairment on their quality of life. Skin conditions that are neither health threatening nor associated with significant morbidity, but that can affect the individual’s emotional well-being, are gaining increased attention. Among the pigmentary disorders, the most striking examples are melasma and vitiligo, conditions that clearly influence the quality of life, without an important relation to its objective clinical severity, from the medical point of view. Dark circles interfere with the face appearance, giving the patient a tired, sad, or hangover look. Disguising the lesions is almost mandatory for some individuals who depend on a well-cared and positive appearance for their work or social activities. Despite its prevalence, there are few published studies about dark circles and its pathogenesis. As the individual anatomical basis for DC is not clearly defined, treatments may render suboptimal results. The purpose of this review article is to discuss some of the available evidences about the anatomic features that could explain dark circles and the proposed treatments for this unpleasant condition.

There are no data about the prevalence of DC mainly because of its transitory and floating nature, the lack of reasonable etiologic explanations, and the fact that the condition is considered just a cosmetic nuisance. A study carried out by Gupta et al. evaluated the prevalence of dissatisfaction with the appearance of skin of 32 women with the eating disorders anorexia nervosa and bulimia nervosa, compared with 34 healthy controls. They found that 9% of American women below 30 years were dissatisfied...
with darkness under the eyes against 38\% of women with eating disorders \((P < 0.007)\). These figures give us an idea about how commonly this complaint is reported by patients in daily dermatological practice.

Dark rings under the eyes are defined as bilateral, round, homogeneous pigment macules on the infraorbital regions. There is no doubt that they are worsened by general fatigue, especially lack of sleep. This idea is corroborated by the daily fluctuation of the lesions intensity, according to the patient status. For this reason, they have been regarded as a mere physiologic phenomenon. Dark circles are more pronounced in certain ethnic groups and are also frequently seen in multiple members of the same family. These hereditary observations raise a question: are there any anatomic or histological characteristics in these populations that could give us a reasonable etiologic explanation?

Histological characteristics of infraorbital darkening suggest that they are caused by multiple etiologic factors that include dermal melanin deposition, postinflammatory hyperpigmentation secondary to atopic or allergic contact dermatitis, periorbital edema, superficial location of vasculature, and shadowing due to skin laxity.

Dermal melanin deposition

Watanabe et al.\(^5\) studied periorbital biopsies of 12 Japanese patients with DC, showing that all of them had dermal melanosis in the histology. According to the authors, the melanosis could be interpreted as dermal melanocytosis based on the findings of the anti-S100 protein and Masson-Fontana silver stainings. However, if melanocytosis is a fixed finding, what could explain the daily fluctuation on these patients’ condition? The authors speculate that thickening of the dermis, caused by edema, leads to an enhanced incidence of diffused light reflection from the pigments, which then results in increased darkness of the skin. They concluded this, based on the studies of West et al.\(^7\) that successfully treated infraorbital pigmentation using carbon dioxide (CO\(_2\)) laser, without any corresponding improvement in melanin spectrometry readings. These authors speculated that the efficacy of the CO\(_2\) laser depended on the tightening of dermal tissues and improvement on the skin surface texture, which caused the Tyndall effect (Fig. 1a,b).

Postinflammatory hyperpigmentation secondary to atopic or allergic contact dermatitis

Dark circles are prevalent in allergic individuals. In this set of population, they are believed to be caused by rubbing and scratching the skin around the eyes and by accumulation of fluid due to facial allergy\(^8,9\) (Fig. 2).

Periorbital edema

The eyelid region seems to have a “sponge” property that helps the accumulation of fluid in systemic or local edema situations. Diagnostic features that suggest eyelid fluid deposit include its worsening in the morning or after a salty meal, the purplish color, and the undefined contours of the regional fat complements. The history of variability in intensity and extension is important to determine the influence of edema on DC. Besides, when compared with the normal orbital fat, edema is still present in down-gaze and does not change much in up-gaze.\(^10\)

Superficial location of vasculature

As patients grow older, loss of the subcutaneous periorbital fat and skin atrophy may lead to unveiling of the
orbital vasculature. The bluish color is secondary to the visible dermal capillary network (Fig. 3a,b).

**Tear trough depression**

The tear trough is a depression centered over the medial inferior orbital rim. It deepens as patients age because the infraorbital fat is displaced anteriorly, creating shadowing below it on the dependence of lighting conditions. The condition aggravates with the eyelid and midface aging because of the loss of subcutaneous fat with thinning of the skin over the orbital rim ligaments that, combined with cheek descent, confer a hollowness aspect to orbital rim area (Fig. 4a,b).

**Treatment**

Among the available alternatives to treat dark circles are bleaching creams, topical retinoic acid, chemical peels, and, recently, laser therapy. Despite the great number of available topical medications and creams to attenuate dark circles, there are no evidence-based studies to support their use. In the last decade, laser and intense pulsed light are increasingly being used in cosmetic dermatology.

West and Alster treated 12 female patients with skin types I–III using CO₂ laser resurfacing. The average of three melanin measurements was obtained from the infraorbital regions using a reflectance spectrometer, before the procedure and 3, 6, and 9 weeks after treatment. Clinical improvement was scored independently by two blinded evaluators using a 1 to 4 scale with < 25% lightening (1); 25–50% (2); 51–75% (3); and > 75% clearance (4). The obtained average score was 2.5 corresponding to an improvement of 50% 9 weeks after laser resurfacing. The after treatment melanin readings were not significantly different from those obtained preoperatively. Recently, Watanabe et al. treated eight patients with dark circles, one to five times, using Q-switched ruby laser (694 nm). Five cases received more than one session. The clinical improvement of four patients was scored as good (two cases) and excellent (two cases).

Epstein, in 1999, used transconjunctival blepharoplasty and deep-depth phenol chemical peel simultaneously to treat hyperpigmentation of the skin and pseudoherniation of the orbital fat, both contributing causes for infraorbital darkening. The authors referred successful outcomes and a low incidence of complications. Manuskiatti et al. recommended a multiple stage treatment, considering the different etiologic factors related to DC: the shadowing secondary to the bulging contour of the...
lower eyelid, bluish color secondary to the visible dermal capillary network, and brown color caused by dermal melanin. They used CO$_2$ laser first to ablate the epidermis, eliminate competing epidermal melanocytes, and remove the epidermis itself. Then, they applied Q-switched alexandrite laser that emits light at 755 nm wavelength and removes dermal melanin more efficiently. The hyperpigmentation starts fading in 6 to 8 weeks, and the healing process was completed with a very acceptable cosmetic result.

Treatment of dark circles related to tear trough depression is more complex, including invasive surgical procedures to elevate the soft tissues from the underlying maxilla, fat repositioning or fat extrusion, and septal reset. The use of hyaluronic acid gel to fill the periorbital hollows and restore volume emerges as a less invasive procedure with promising results.  

Conclusions

Despite its prevalence and cosmetic importance, there are few published studies in the scientific literature about dark circles. Even a good definition of this condition is lacking. We think the term infraorbital ring-shaped melanosis proposed by Watanabe et al. does not encompass its etiology in a global manner.

As there is neither a general understanding about dark circles pathogenesis nor a consensus about the major responsible features, treatments are chosen in a simplified way, rendering suboptimal results most of the time. It is important to identify the specific anatomic problem of each patient in order to individualize treatment. Actually, published studies about dark circles constitute short case series without any separation among different groups according major causative aspects.

Finally, dermatologists frequently face this complaint and are the most prepared specialists to deal with almost all causative aspects of dark circles. This editorial aims to enhance curiosity about dark circles, stimulating dermatologists to conduct more detailed basic research and efficacy studies on this subject.

References

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