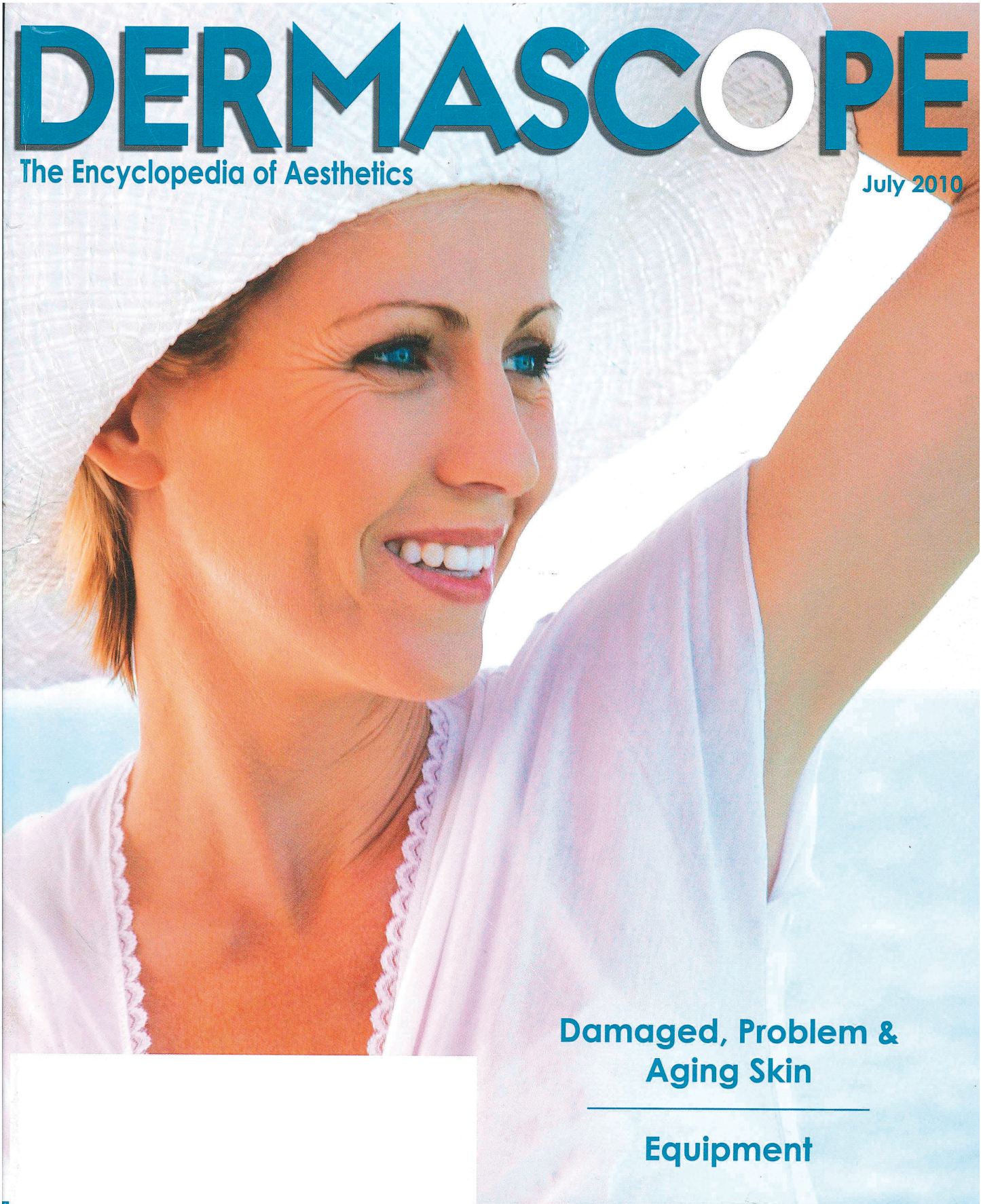


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The Role of **SUN EXPOSURE** in Skin Aging

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The quest for a youthful appearance is universal. Unfortunately, age-related changes in our facial structure and appearance are partially intrinsic – aging that is unavoidable and happens due to genetics and the passage of time. Although we cannot stop the hands of time, the greatest cause of the visible signs of aging is directly linked to environmental sources and is preventable. This extrinsic aging is primarily attributed to sun exposure and is one of the most avoidable causes of wrinkling, laxity, skin discoloration, extracellular matrix (ECM) breakdown, and most importantly, skin cancer. Understanding the UV exposure related cascade of events that takes place in the skin and identifying strategies to halt these reactions will allow clinicians to properly protect their patients from unnecessary premature skin aging and skin cancer.



The Characteristics of Visible Aging

Human skin is comprised of the epidermis, the dermis, and underlying adipose tissue. The majority of a healthy dermis is the ECM. The ECM is a complex framework of biomolecules designed to support and protect the cells of the dermis. A strong ECM must be present to support the skin's outer appearance and health. The ECM is made up of structural proteins (collagen and elastin), adhesive proteins (laminins and fibronectin), glycosaminoglycans (GAG), and proteoglycans. Collagen fibers work to give strength and structure to the skin, while elastin fibers allow the skin to stretch and return to its original shape. The GAGs that surrounds this structure are: hyaluronic acid, heparin sulfate, chondroitin sulfate, heparin, and dermatan sulfate. Hyaluronic acid, the most widely studied GAG, can hold up to 1,000 times its weight in water within the matrix, making skin healthy, plump, and youthful-looking.

Through time and exogenous offenders, the ECM is slowly degraded by symbiotic enzymes known as matrix metalloproteinase (MMP). MMP, such as collagenase, elastase, and hyaluronidase are responsible for the recycling and destroying of the ECM's components. Although a small amount of these enzymes are necessary for the breakdown of 'used up' proteins to maintain healthy skin, an over production of MMP occurs in response to external damaging factors leading to accelerated visible aging.

Some commonly recognized presentations of visible aging are:

Collagen and matrix degradation

- Sagging and laxity
- Rhytids
- Epidermal and dermal atrophy
- Enlargement of pores

Textural variances

- Dryness and dehydration
- Coarsening
- Epidermal keratinization

Dyschromias

- Hyperpigmentation
- Telangiectasias

The Passage of Time

Intrinsic aging is characterized by the natural breakdown of epidermal, dermal, and subcutaneous structures. Demonstrated chronological changes include slowed desquamation that leads to cellular build-up. This causes the skin's surface texture to coarsen, making fine lines and wrinkles more apparent. Over time, production of structural components of the dermis such as collagen, elastin, and GAG slows, leading to a 20 percent decrease in overall dermal thickness. Additionally, subcutaneous adipose (fatty) tissue diminishes, contributing further to lost volume and facial laxity. Still, these physiological changes are likely responsible for a mere 15 percent of the visible signs of aging, while the other 85 percent are attributed to largely avoidable external factors such as sun exposure, pollution, smoking, and inflammation.

The Primary External Offender

It is well established that UV exposure is a universal threat to healthy skin. UV rays are divided into three types based on wavelength. The shortest are UVC (200–280 nm). Currently, the ozone layer prevents this short wave UV radiation from reaching the Earth's surface. Midrange UVB (280–320 nm) and long-wave UVA (320–400 nm) are the rays responsible for premature photoaging, immune dysfunction, and some cancers. UVB rays are thought to be responsible for the majority of the UV-related negative effects in the skin. UV radiation is particularly damaging to the skin as it has been shown to not only increase levels of the damaging free radicals reactive oxygen species (ROS), but it also causes a reduction in the antioxidants that are naturally present in human skin.

In a study of 8,000 Americans, published in the *Journal of Dermatologic Surgery*, 94 percent were concerned

that exposure to UV radiation could lead to skin cancer. Unfortunately, 68 percent also felt that they looked better and healthier with a tan. Basal cell carcinoma; squamous cell carcinoma; and melanoma, the deadliest form of skin cancer, are all caused by UV exposure. Additionally, 50 percent of all cancer in the U.S. is skin cancer. With skin cancer rates rising, and the clear connection between UV exposure and the visible signs of aging, there simply is no 'healthy tan.' So, what really happens when the skin is exposed to the sun?

The MMP enzymes in the skin are markedly increased as a result of UV exposure leading to a breakdown of the ECM. UV radiation also stimulates an increase in free radicals. There are many types of free radicals, yet ROS have been widely studied due to their known damaging effects in the skin. Of the wide variety of environmental offenders, UV radiation is a primary contributor to the overproduction of ROS and its resultant oxidative stress in the skin. UV exposure also reduces the natural antioxidant defense system in the skin, making it more susceptible to the free radical onslaught. Wrinkling, laxity, enlargement of pores, loss of elasticity, heightened melanogenesis, and visible telangiectasias are all common as a direct result of UV exposure.

Strategies for Delaying Visible Aging


Sunscreen is, above all, the most important aspect of an age control regimen. A broad-spectrum sunscreen product must be applied each morning to prevent further damage. Choose an SPF of at least 15 and look for ingredients like zinc oxide, titanium dioxide, avobenzone (Parsol), or ecamsule (Mexoryl®) to ensure adequate UVA and UVB protection. Due to the proven increase in free radicals and reduction in naturally occurring antioxidant levels caused by UV exposure, it is also wise to have topical antioxidants in the morning as part of every age control regimen. A particular type of botanical antioxidants that have been widely studied for their UVB-induced free radical scavenging ability is phenolic antioxidants. Look for sun protection products that contain additional antioxidants as well as topical antioxidant products to add to daily care regimens for maximum protection. Some antioxidants to look for are: EGCG from green tea, resveratrol, genestein, cocoa seed extract, coffee berry, and silymarin. Caffeine is also an exciting ingredient, as it has demonstrated the ability to force damaged skin cells into apoptosis (death), which inhibits the potential for skin carcinogenesis.



In addition to retinol, L-ascorbic acid (the bioavailable form of vitamin C) at 15 to 20 percent concentrations is excellent for daily collagen promotion, hyperpigmentation reduction, anti-inflammatory benefits, antioxidant protection, and MMP inhibition. Topical peptides are also an effective way to increase collagen production and reduce the appearance of fine lines and wrinkles. Look for ingredients such as acetyl hexapeptide-8, palmitoyl oligopeptide, and palmitoyl pentapeptide-4. Antioxidants and MMP inhibiting ingredients should also be applied daily to encourage regeneration of the ECM. These agents include resveratrol, soy isoflavones, EGCG, and tocopherols or tocotrienols (vitamin E).

Although preventing damage is best, much of what clinicians will see is patients with years of UV-related damage in need of corrective treatment. Patients should receive monthly in-office exfoliating treatments to ensure proper desquamation and to assist in the penetration of active topical products. Blended acid chemical peels that combine multiple acids and additional hydrating, soothing and brightening ingredients are a good choice for treating photoaged skin. These types of treatments create results without downtime or side effects. Trichloroacetic acid (TCA) up to 20 percent will exfoliate and smooth textural imperfections such as wrinkling and moderate acne scarring. Lactic acid up to 45 percent will effectively loosen surface cells for exfoliation while hydrating the skin

and inhibiting melanogenesis. Retinol is a well-rounded topical agent and is beneficial in concentrations up to 10 percent for in-office procedures and up to one percent in daily care products. Retinol will increase cell turnover, inhibit melanogenesis, increase collagen and elastin synthesis, and reduce free radical damage and MMP production.

Educating patients on the dangers of sun exposure is often difficult. Although paradigms are shifting and being tan is not as fashionable as it once was, we still must be diligent in protecting our patients from skin cancer. Approximately 90 million Americans use or have used some type of anti-aging products, so knowing that sun exposure is the greatest inducer of premature visible aging can be an easier route to convince patients to wear daily sun protection. Using a combination of regular in-office treatments, daily sun protection, topical antioxidants, retinol, and peptides you can effectively help your patients preserve, promote, and protect healthy and youthful skin. 



Jennifer Linder, M.D., serves as Chief Scientific Officer for PCA SKIN®, guiding all product development and clinical trials for the company. A board-certified dermatologist and a fellowship-trained skin cancer surgeon using the Mohs micrographic technique, Dr. Linder is one of the foremost U.S. experts in the use of the cosmetic filler, Sculptra. She holds a clinical faculty position in the Department of Dermatology at the University of California, San Francisco.