

Too much radiation? Various causes of photodamages

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An important topic for advice particularly during warm seasons is how to deal with radiation. Drug interaction or an overdose of sunlight can take a toll on the skin of customers. You are asked for advice!

Photodamages occur in a variety of ways. Accordingly, prevention and treatment differ from person to person. At a first glance everything seems as clear as daylight. Radiation damages the skin and accelerates the aging process. This should be avoided at any price – with prevention and aftercare. Free radicals and enzymes play a particular role in this context.

Radicals everywhere

Virtually every wave length of the solar spectrum causes free radicals in the unprotected skin – with varying energy and intensity. As far as the radiation is temporary this is not a problem for the intact and healthy skin. Melanin converts radiation into heat with 100% efficiency. Also vitamin D is formed which is involved in many physiological processes while its deficiency seems to correlate with the incidence of cancer diseases. Most of the healing processes particularly after infections but also after photodamages such as sunburns occur with radical formation. The radicals then are not caused by an external source of radiation but formed by the body itself. Also febrile temperature rises are part of an immune response. The intended healing effects with an infrared lamp is based on a rise of temperature and the formation of radicals.

These are facts that represent a dilemma for the prevention but also for the treatment of photodamages. What can be done for optimal protection without impairing the natural physiological processes? To extend the self-protection time during sun exposure the skin needs preparations with protecting UV filters. It should however be mentioned that a higher factor (SPF) than the calculated protective time interval is not advantageous. Day creams with UV filters also are not purposeful if the sun exposure consists of going from one building to another. Radical scavengers in the form of antioxidants are counterproductive in protective preparations since they inhibit the melanin formation. This also applies to the treatment of acute photodamages. Antioxidants make no

sense at this stage. They impede melanin formation and the self-recovery process. Effective preparations, by contrast, are protease inhibitors such as boswellic acids (frankincense resin) that inhibit the collagen degradation caused by matrix metalloproteases (MMP). Ascorbyl phosphate, a vitamin C derivative, is used later on as an active agent in the anti-aging treatment to support the formation of collagen.

Under scorching sun

Sun erythema is the most frequent photodamage that particularly affects Celtic skin with a self-protection time of less than 10 minutes. The self-protection time is determined by the UV index that depends on the seasons and daytime, the altitude, latitude and last but not least also on the cloudiness. Current local UV information can be obtained via internet. Since the protective time interval calculated from self-protection time and sun protection factor is fraught with uncertainties it is recommended to limit sun exposure to two thirds of the calculated time. Physical protection provided by clothing and seeking shade has absolute priority among the protective measures against premature skin aging that also is accelerated by the infrared radiation of the sun.

Most effective for the treatment of sun erythema are lipid-free active agent lotions and sera, above all:¹

- Echinacea extract (alias coneflower)^{2 3} is a remedy with anti-inflammatory ef-

¹ Lautenschläger H, Lichtgeschädigte Haut: Sonnenbad – das hilft danach, *Kosmetische Praxis* 2006 (3), 8-9

² Speroni E, Govoni P, Guizzardi S, Renzulli C, Guerra MC, Anti-inflammatory and cicatrizing activity of Echinacea pallida Nutt. root extract, *J Ethnopharmacol.* 2002 Feb;79(2):265-72

³ Azadeh Manayi, Mahdi Vazirian and Soodabeh Saeidnia, Echinacea purpurea: Pharmacology, phytochemistry and analysis

fects in popular medicine and assumed to have immune-stimulating effects too.

- D-panthenol supports cell proliferation, moisturizes and has anti-itching effects.
- Aloe vera⁴ gels have wound-healing effects and form a lightly cooling moisturizing film on the skin surface.
- Liposomes concentrates based on phosphatidylcholine have anti-inflammatory effects due to the contained essential fatty acids and choline. They can also contain the amino acids that occur in the Natural Moisturizing Factor (NMF).
- A similar strategy is pursued with biodegradable liquid nanodispersions that include herbal oils with a high content of essential fatty acids such as linoleic acid, alpha-linolenic acid and gamma-linolenic acid – examples are linseed-, kiwi seed- and evening primrose oil.

Potentially sensitizing ingredients such as preservatives and perfumes are contraindicated as they can easily penetrate through a disordered skin barrier.

Additional causes of photodamages⁵

- Photodermatoses are a side effect of pharmaceutical drugs – among others of the group of thiazide derivatives (diuretics), phenothiazines (neuroleptic agents), cytostatic agents, quinine derivatives (malaria preparations), tetracyclines (antibiotics) and NSAID (Non-Steroidal Anti-Inflammatory Drugs). Photodermatoses mainly develop on skin areas that are not protected by clothing. By analogy, orally taken phytopharmaceuticals can cause photosensitizations. The furocoumarins of angelica preparations can be mentioned as an example here.
- Mallorca acne is triggered by components of cosmetic preparations that form aggressive radicals under sun

exposure. Ethoxylated alcohols and polyethylene glycols (PEG) but also unsaturated fatty acids including the above-mentioned essential fatty acids belong to these substances. The latter-mentioned substances are appropriate for the nightly application and not suitable during the day when the skin is exposed to the sun. PEGs should be completely avoided as they are non-biodegradable and increase the loss of natural substances of the body due to their reinvigorated emulsifier features during skin cleansing (washout effect).

- With sun exposure allergenic compounds can form from ethereal compounds - as for instance ascaridol from tea tree oil – and from halogenated hydrocarbons (preservatives, antiseptics). Also abietic acid of colophony resin forms allergenic oxygen compounds.
- Phototoxic reactions in the form of skin rashes occur after contact with particular plants. The already mentioned furocoumarines (psoralens) found for instance in cartwheel flower (alias giant hogweed, giant cow parsley) and in cow parsnip are responsible for grass dermatitis. Perioral dermatitis can be caused by contact with lemon and orange peels.
- Spot-like hyperpigmentations are triggered by the hypericin contained in oral amber (alias St.John's wort) oil preparations.

This kind of photodamages is symptomatically treated, or in other words, with anti-inflammatory components (frankincense, witch hazel, echinacea) and, when applicable, also with anti-itching active agents (urea, allantoin, D-panthenol). Most important however is discontinuing the respective drugs, or the damaging cosmetic preparations and essential oils, respectively the protection by adequate clothing (grasses).

Abrasive peelings and active agents that inhibit the re-formation of melanin can help reduce hyperpigmentations. Such active agents, for instance, are ascorbyl phosphate and tranexamic acid. On the other hand it should be mentioned that the above-listed photodamages are temporary even if they can be as persistent as hyperpigmentations.

Permanent symptoms

Endogenic causes are a different kettle of fish altogether, as for instance:

methods, *Pharmacogn Rev.* 2015 Jan-Jun; 9(17): 63–72

⁴ Seyyed Abbas Hashemi, Seyyed Abdollah Madani and Saied Abediankenari, *The Review on Properties of Aloe Vera in Healing of Cutaneous Wounds*, *Biomed Res Int.* 2015; 2015: 714216.

⁵ Lautenschläger H, *Schattenseiten – Erscheinungsformen von Lichtdermatosen*, *Kosmetik International* 2013 (5), 32-35

- genetic defects such as xeroderma pigmentosum
- autoimmune disorders such as lupus erythematosus
- metabolism disorders such as erythropoietic protoporphyria
- idiopathic photodermatoses, i.e. dermatoses of unknown origin

In these cases, patients can only stay in rooms that are screened against the respective damaging wave lengths. In these rooms a normal skin care is sufficient. If the photodamage starts to appear, a medical doctor has to be consulted immediately.

Skin cancer diseases belong to the persistent photodamages acquired during life time in which, in consultation with medical doctors, cosmetics often can only provide decorative assistance. In the case of precancerous skin conditions, such as actinic keratosis, a systematic and indication accompanying skin care can be applied. This can be a combination of frankincense extracts and phosphatidylcholine in nanodispersions.⁶

In the case of therapy

External radiotherapy of internal carcinoma uses the skin as a passageway with the potential consequence of causing delayed formation of basal cells, DNA damages and a stimulation of collagen-degrading matrix metalloproteinases.⁷ Unlike sun radiation, the skin cannot be protected in this case. Radioactive irradiation inevitably leads to a formation of radicals – also in the deeper layers of the skin. Potential consequences are actinic damages, atrophy, decreased sebum secretion, dehydrated skin, itching and formation of erythema – similar to sunburns. The skin desquamates and in the case of severe damages, it becomes weepy and even peels off. In the case that tyrosinase is stimulated the skin will become pigmented due to the formation of melanin. When hair root cells are damaged, hair will shed and the function of sweat glands will be impaired. In the epidermis, the radicals are partly scavenged by the amino acids of the NMF and by hyaluronic acid which is responsible for the skin turgor. That is why amino acids and hyaluronic acid are appropriate remedies for the conditioning skin care before radiotherapy will start. The same applies to the aftercare with active

agents that also are mentioned for the treatment of sunburns. To treat erythema the active agents should be used in the form of aqueous sera or gels and in the case of dry skin conditions they are mixed with creams. Astringent active agents can be beneficial such as hamamelis (alias witch hazel) extract and tannic acid-containing tea and tannin preparations. For a gentle cleansing of the skin, tenside free, water-dispersible formulations with phosphatidylcholine and herbal oils are appropriate preparations with simultaneous skin care effect (2-in-1 products).

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⁶ Lautenschläger H, Weihrauch – Harz mit Heilkraft, medical Beauty Forum 2015 (4), 12-16

⁷ Lautenschläger H, Hautpflege bei Strahlentherapie – Beruhigen, stärken & schützen, Beauty Forum 2008 (8), 32-34