Chapter 5
Skincare tools for preventing and treating signs of skin aging and aesthetic conditions in atopic patients

Atopic patients are characterized by the premature appearance of age-related skin changes. The main culprits behind this phenomenon are the apparent features of atopic skin — insufficient resistance to external destructive factors due to a broken epidermal barrier. However, hidden causes also act from within. Immune dysfunction, one of the main factors in the pathogenesis of AD, is the basis for persistent chronic inflammation, which, even in remission, can smolder asymptomatically and contribute to the skin aging process.

We will start by discussing the modern skincare approaches that can be adopted for treating atopic skin. By considering the role of chronic inflammation in aging, we will better understand the features of atopic skin and justify the choice of specific cosmetic products and procedures.

5.1. Inflammation and preventive anti-aging strategies

The term "inflammaging" is a portmanteau combining "inflammation" and "aging" as a reference to aging due to inflammation. This concept was first mentioned in the scientific press in 2000. In the *Annals of the New York Academy of Sciences*, it was proposed by Claudio Franceschi, a renowned Italian immunologist and professor at the University of Bologna (**Fig. II-5-1**). What is inflammation, and how can we influence it?

Figure II-5-1. Claudio Franceschi at the Genetics of Aging and Longevity Conference (April 22, 2012)

Figure II-5-2. Cover of the *Time* magazine (February 2004)

Franceschi's main idea is that chronic inflammation, which can be subtle, i.e., without vivid clinical symptoms or asymptomatic, undermines the body's vitality (including the skin) and accelerates the aging processes in all organs and systems.

In 2004, an intriguing headline, "The Secret Killer," appeared on the cover of *Time* magazine (**Fig. II-5-2**). In the article associated with this title, the authors discussed the link between inflammation and neoplasms, heart attacks, Alzheimer's disease, and many other ailments. They argued that internal inflammation can contribute to the emergence of various diseases, including those serious enough to be fatal.

Since the 2000s, physicians of various specialties have actively studied and discussed the topic, identifying the key features of inflammation.

1. **Asymptomatic course and insignificant severity:** a person does not notice inflammation
2. **Controllability:** when it is known that such inflammation is present in the body, it can be controlled or eliminated

3. **Non-pathologic in nature:** inflammation does not destroy tissues at the affected site
4. **Chronic course:** inflammation can last for years without any outward signs
5. **Presence of systemic inflammatory changes:** all are virtually invisible in daily life
6. **Positive effects on the body in the early stages of inflammation and adverse effects in the later stages of inflammation**

The immune system is the key player in inflammaging, leading to events that result in visible age-related changes.

This concept of inflammaging overlaps with one of the evolutionary theories of aging — antagonistic pleiotropy. In a nutshell, its essence is "delayed payback." What is beneficial for existence and survival at the beginning of our lives becomes detrimental at later stages and only accelerates aging by maintaining a "smoldering" inflammatory focus or multiple foci.

5.1.1. Causes of inflammaging and the competence of the skincare practitioner

Skin inflammation can develop against the background of chronic **somatic diseases** accompanied by inflammatory processes that, if untreated, eventually result in sluggish inflammation.

One of the causes of inflammation is **irrational nutrition** due to the overconsumption of high-calorie foods rich in carbohydrates and fats (Agrawal R. et al., 2023). This sets the stage for asymptomatic inflammation in the body, not only at the skin level (**Fig. II-5-3**).

Solar radiation also contributes to local inflammatory lesions in areas regularly exposed to the sun. These lesions can be visible but also hidden by a dark tan.

Regular **skin irritation**, such as allergies, mechanical friction, etc., can also lead to the emergence of a chronic inflammatory focus, which literally "undermines" the health of the skin and the entire body from within.

Frequent traumatic aesthetic procedures (usually chemical peeling) with breaks that are insufficient for full recovery can also lead to a state of prolonged sluggish inflammation that undermines skin health.

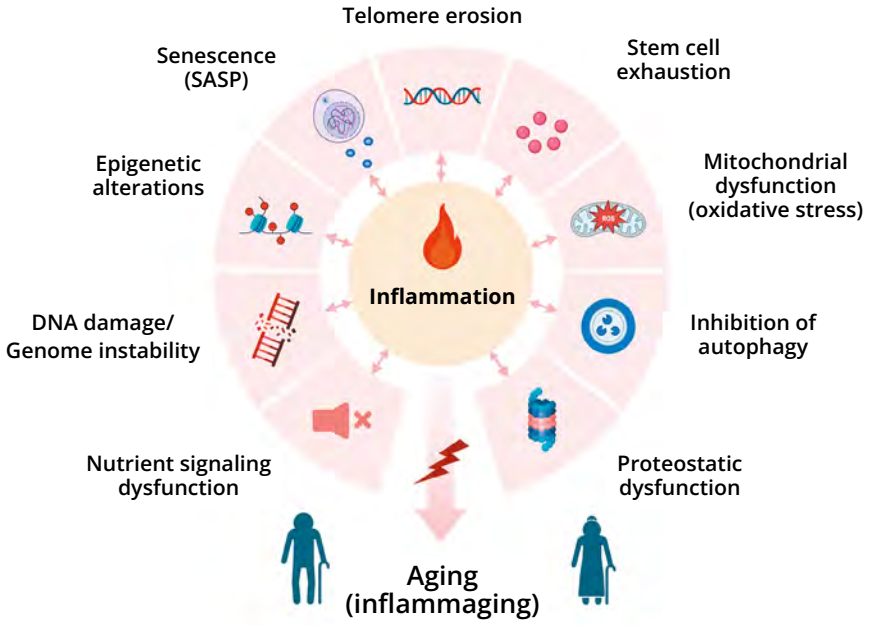

Figure II-5-3. Linking aging mechanisms and chronic inflammation (Agrawal R. et al., 2023)

The mechanisms thought to underlie the aging process include proteostatic dysfunction, inhibition of autophagy, mitochondrial dysfunction (which results in increased oxidative stress), stem cell exhaustion, telomere erosion, senescence (and the associated senescence-associated secretory program, or SASP), epigenetic alterations, DNA damage and genomic instability, and nutrient signaling dysfunction. These mechanisms often increase inflammation, which leads to inflammaging.

Which of these causes of inflammation can be addressed by an aesthetician?

Aestheticians can competently prescribe treatments with adequate recovery and appropriate "rest time." They can also recommend sufficient sun protection to reduce the amount of insolation on the skin. Finally, they can work with the skin manifestations of allergic reactions (to a certain extent), the effects of mechanical irritation, etc.

Although somatic pathologies and dietary recommendations are beyond the competence of estheticians, their expertise is sufficient to help many patients suffering from inflammation.

5.1.2. Factors contributing to inflammaging

Substances that set off inflammatory reactions in our body are called pro-inflammatory triggers. These include cytokines (IL-1, -4, -6, -10, -12, and -18, TNFα, INF-γ, TGF-β) and chemokines (IL-8, monocyte chemostatic factor 1 — MCP-1).

Under the influence of triggers, **inflammation markers** —hypoxia-inducible factor 1α (HIF-1α) and vascular endothelial growth factor (VEGF) — appear in the blood.

Inflammation also contributes to the development of inflammation:

- **Reactive oxygen species (ROS)** are chemical compounds in which oxygen has an unpaired electron in an outer orbital. Their levels vary with UV exposure and the presence of antioxidant enzymes (**Fig. II-5-4**). If excess ROS are not deactivated promptly, they damage lipids, proteins, and the cell genome through oxidation. UV radiation (especially its long-wavelength component — UVA) induces reactive oxygen species.
- **Tumor necrosis factor α (TNFα)** is a multifunctional pro-inflammatory cytokine synthesized mainly by monocytes and macrophages. It influences lipid metabolism, blood coagulation, and endothelial function. It also stimulates the production of IL-1, -6, -8, and INF-γ and activates leukocytes.
- **Interleukin-6** is a cytokine that can have both pro- and anti-inflammatory effects. Activated macrophages and T cells synthesize it.
- **Neutrophils** are granulocytic leukocytes that phagocytize relatively small foreign particles or cells. They subsequently usually die, releasing large amounts of biologically active substances that increase inflammation and activate the chemotaxis of immune cells into the nidus.
- **Matrix metalloproteinases (MMPs)** are a family of extracellular zinc-dependent endopeptidases capable of degrading all extracellular matrix proteins.
- The **complement system** is a complex of proteins constantly present in the blood. It is a cascade of proteolytic enzymes designed to defend the body against foreign agents and is involved in immune response.

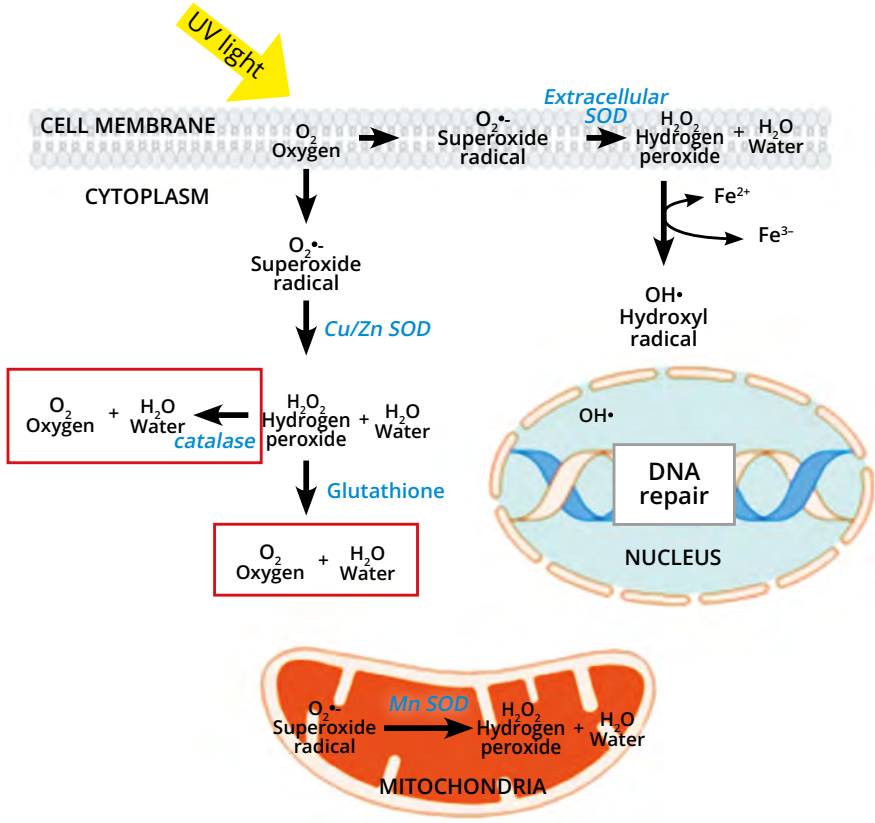

Figure II-5-4. Cellular antioxidant defenses (adapted from Amaro-Ortiz A. et al., 2014)

UV radiation induces the production of various ROS, which alter the molecular structure and damage lipids, proteins, and nucleic acids because of their chemical reactivity. Antioxidant enzymes mediate the removal of ROS, with different enzymes functioning in specific compartments (e.g., Mn SOD localized to mitochondria). ROS may react with DNA and other cell signal proteins, impairing their function if not removed. SOD — extracellular superoxide dismutase. Cu/Zn SOD — copper/zinc superoxide dismutase. Mn SOD — manganese superoxide dismutase.

- **Macrophages** are cells capable of actively capturing and digesting bacteria, remnants of dead cells, and other particles foreign or toxic to the body. The number of macrophages of monocytic origin increases sharply during inflammation and normalizes after its termination.

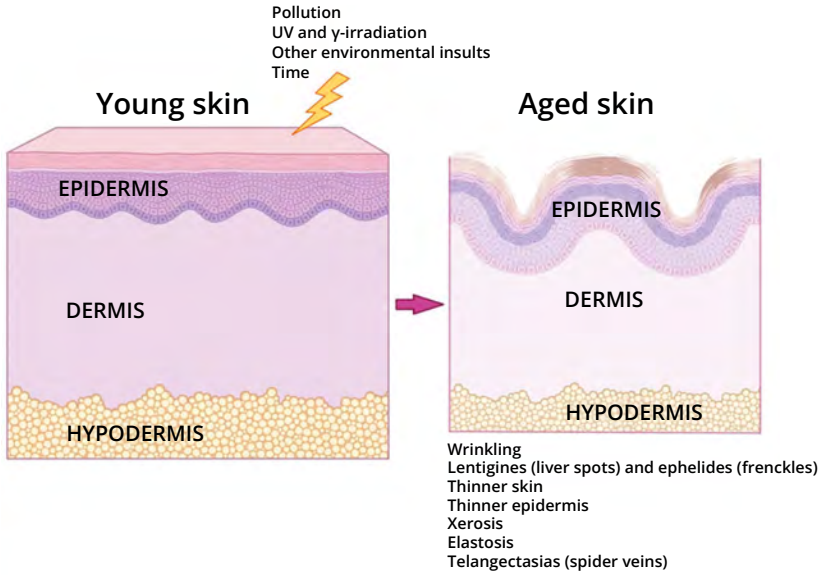

Figure II-5-5. Aging skin. Over time, aging skin undergoes several changes, leading to its dysfunction. Some unfavorable external factors can accelerate natural aging (adapted from Agrawal R. et al., 2023)

5.1.3. Skin inflammaging hallmarks

In addition to the biochemical signs of inflammaging, there are clinical hallmarks.

The skin's **roughness** and **dullness** are most often caused by the slowdown of epidermal cell renewal (**Fig. II-5-5**). This process occurs against the background of certain histological phenomena: spongiosis (intercellular edema), tissue acidification (decrease in pH), and hypoxia, which inhibit keratinocyte proliferation and differentiation.

Skin laxity and **deep wrinkles** may also be noticeable in patients with inflammaging — they are symptoms of more profound structural changes, including those to the dermal matrix. The underlying pathogenetic mechanisms are similar to the appearance of dull skin — spongiosis, tissue acidification, and hypoxia, against the background of which MMPs are activated, and the synthetic activity of fibroblasts is reduced.

Pigment disorders such as dyschromia and age spots may occur against the background of hypoxia and tissue acidification, which modify melanogenesis and pigment distribution.

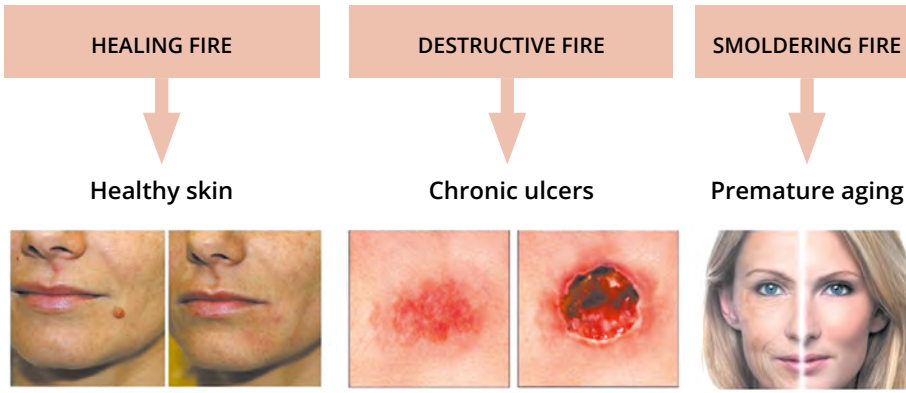

Figure II-5-6. Three types of inflammation

Lipoatrophy is also a clinical symptom of inflammation. Changes in the subcutaneous fatty tissue occur for the reasons mentioned above. An "inflammatory fire" that has not been extinguished in time causes the skin to age faster.

Inflammation can be "bad" as well as "good." Different types of inflammation can be compared to a healing fire, a destructive wildfire, or a smoldering bonfire. In the first case, inflammation promotes skin rejuvenation by eliminating or literally "burning out" the defect, after which healthy skin forms in its place. Inflammation benefits the skin and the entire body, resulting in a favorable outcome. A destructive wildfire is formed when uncontrolled inflammation leads to chronic ulcers and other defects. Finally, the smoldering bonfire of inflammation is something we don't notice in our daily lives, but it constantly, day after day, undermines our skin's resources, leading to premature aging — inflammaging (**Fig. II-5-6**).

5.1.4. Inflammaging monitoring

How do we identify hidden inflammation?

We have at least three objective tests at our disposal:

1. **Tewametry** for TEWL assessment
2. **Thermometry** for surface temperature assessment
3. **Mexametry** for erythema assessment

Tewametry records passive water transport through the *stratum corneum* to the external environment. When an inflammatory lesion occurs, the overlying skin gradually loses its barrier function, causing TEWL to increase.

Thermometry is also needed to look for localized inflammation because it is associated with a temperature increase.

Mexametry assesses the degree of erythema, which is very useful for tanned skin, where redness is challenging to see with the naked eye.

5.1.5. Anti-ageing care strategy for atopic skin

Continuous control of inflammation is a crucial part of anti-aging therapy and skincare. Its objectives are summarized below:

1. **Protection** against UV damage, excessive dryness, physical damage, etc. — sunscreens, emollients, moisturizers, etc.
2. **Inflammation management** — antioxidants, anti-inflammatory agents
3. **Itch reduction** — synthetic peptide Neurosensine™ (INCI: Acetyl Dipeptide-1 Cetyl Ester)
4. **Comprehensive post-treatment care to restore skin integrity** — physiological lipids (ceramides, cholesterol, free fatty acids), sebum-like substances (squalene, waxes, saturated fatty alcohols, etc.)

Sunscreens with a maximal sun protection factor (SPF) should not be used unless necessary. In the middle latitudes, SPF 10–20 is sufficient. Many day creams include a small amount of UV filters and thus provide adequate skin protection. To control inflammation, preparations containing antioxidants and anti-inflammatory agents can be used. Synthetic peptide Neurosensine™ can be applied to reduce itching, as it blocks neurogenic inflammation (i.e., its action is similar to strontium nitrate, which is rarely prescribed nowadays). By helping to eliminate the "consequences of destruction," we are effectively restoring the integrity of the skin.

The basic principles of anti-aging therapy as applied to inflammaging:

1. Use of anti-inflammatory agents to prevent and treat inflammation

2. Special preparation of the skin before traumatic procedures to strengthen its regenerative potential
3. Actively helping the damaged skin to repair to avoid acute inflammation from becoming chronic
4. Competent prescription of aesthetic treatment accompanied by inflammation — without "abusing" the possibilities of cosmetic dermatology

5.2. Peculiarities of aesthetic correction of atopic skin

The skin of women with AD ages faster (**Fig. II-5-7**) than that of their healthy counterparts. Therefore, the need for anti-aging care arises earlier, but high skin sensitivity often leads these women to avoid beauty salons. Peculiarities of care for atopic skin:

- Combining basic care for atopic skin (see Part II, ch. 3) with anti-age care
- Hypersensitivity to the agents used
- Delayed repair
- The dependence of care on the stage of the disease

Cosmetic procedures can be performed in the long-term absence of exacerbations and relapses. Aesthetic treatments that weaken the *stratum corneum* should be avoided. Some cosmetic products and procedures can lead to barrier failure, such as:

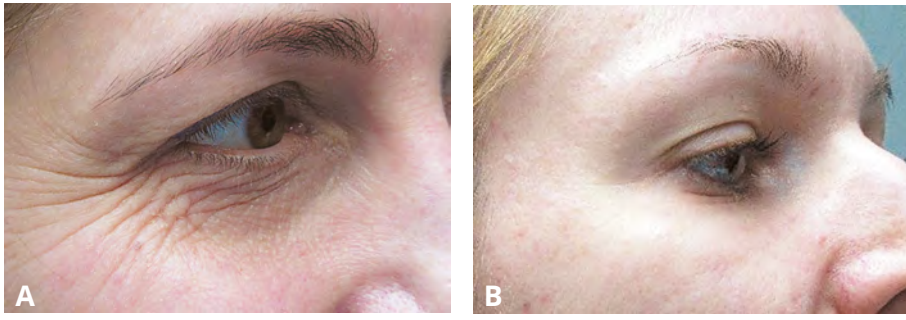

Figure II-5-7. Periorbital zone: A — a 38-year-old woman with AD, B — a 38-year-old healthy woman (photo provided by V.I. Albanova)

- Chemical peeling
- Retinol cosmetics
- Scrubs
- Microneedling
- Mechanical dermabrasion
- Laser dermabrasion
- Fractional ablative procedures such as radiofrequency (RF) microneedling, photothermolysis, plasma sublimation

Acute and chronic skin diseases also serve as general absolute contraindications for all types of hair removal.

As the above-mentioned means and methods damage the *stratum corneum*, they must be avoided or used with precautions. Let us examine the possibilities and limitations of aesthetic cosmetology methods in AD.

5.2.1. Chemical peeling

A chemical peel procedure involves the application of a chemical agent to the skin to cause controlled damage to the skin through chemical reactions between its structural elements and the chemical agent. The result is active exfoliation of the *stratum corneum* (**Fig. II-5-8**). Massive "shedding" of horny scales serves as a signal for basal keratinocytes to accelerate division to restore the skin barrier structures as soon as possible. Chemical peeling agents are preparations of intensive action that stimulate and accelerate the process of cell renewal in the epidermis (keratinocyte proliferation, migration, and differentiation) and the formation of barrier structures in the *stratum corneum* (keratinization and desquamation).

Any effect on the skin aimed at structural remodeling must rely on its ability to renew. The deeper the damage, the greater the strain on the skin's repair systems and the greater the chance that something in this repair process will go wrong. An inflammatory response can be an ally, but only if it is mild and disappears quickly. In contrast, the risk of complications increases if the inflammation is severe and chronic.

Midline and deep peels affect the epidermal living cells, so regeneration is needed. In atopic patients, genetically determined abnormalities of the epidermal barrier and immune dysregulation impede

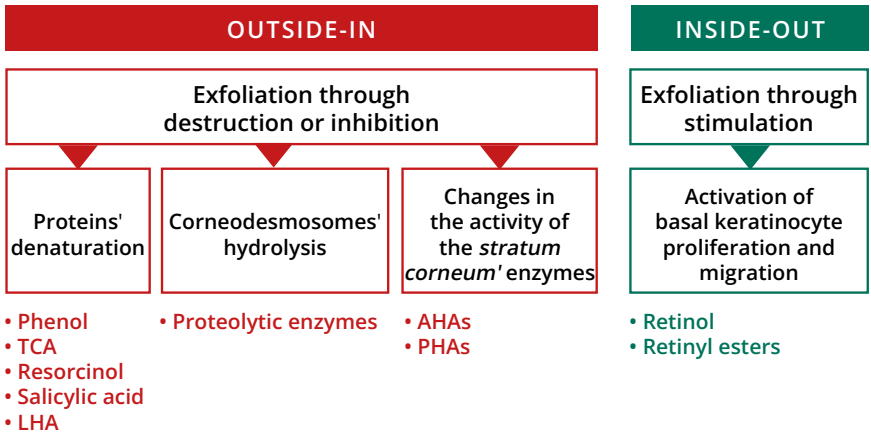

Figure II-5-8. "Outside-in" and "inside-out" peeling: principle of action and chemical agents

the normal course of the regeneration process. The increased permeability of the *stratum corneum* facilitates the permeation of the applied chemical agent and enhances the immune system's response. This creates the basis for more pronounced inflammation and increases the risk of complications. For this reason, AD serves as a contraindication to midline and deep peels.

Practitioners should also consider the peel agents' mechanism of action, which depends on their chemical nature.

Atopic skin is characterized by thinning *stratum corneum*, increased surface pH values, altered activity of proteolytic enzymes, and sebum deficiency.

Given its peculiarities, let's consider a probable scenario of peel impact on atopic skin.

Keratolytic peeling

Keratolytic substances include phenol, trichloroacetic acid (TCA), salicylic acid, and resorcinol. Due to their high toxicity, phenol and TCA are currently banned from inclusion in cosmetic products.

Keratolytic agents break disulfide bonds that maintain proteins' three-dimensional configuration, denaturing all protein structures, including keratin, cornified envelope proteins, corneodesmosomes,

proteolytic enzymes, and enzymes required for lipid barrier formation. This has a powerful destructive effect on the *stratum corneum*, which is already fragile and thinning in atopic patients, making such a pronounced keratolytic effect unwarranted and unnecessary.

Moreover, salicylic acid is a fat-soluble substance that quickly passes through the ducts of sebaceous glands, dissolves well in sebum, reaches sebocytes, and inhibits their synthetic activity. This leads to decreased sebum production and, consequently, reduced skin oiliness. However, as low sebum production is already a characteristic of AD, the influence of salicylic acid only aggravates the existing problem of sebum deficiency.

Therefore, **salicylic peeling should not be performed on patients with AD, even those in remission, to avoid exacerbating the disease**.

Enzymatic peeling

Enzymatic peels contain proteolytic enzymes of plant (bromelain, papain, ficin), microbiological (subtilisin), or synthetic (cross-papain) origin. Enzymatic peels are considered the mildest among chemical peels but have contraindications.

As mentioned earlier (see Part II, section 1.1.4), the surface pH of atopic skin is above the normal range. Against this background, the activity of protease inhibitors in the *stratum corneum* decreases, leading to an increase in protease activity that destroys the corneodesmosomes. As desquamation increases, the *stratum corneum* thins even more, weakening the epidermal barrier.

Enzymes are also proteins, and proteins are potential allergens. Given that immune dysfunction is involved in AD pathogenesis, the risks of an allergic reaction to a foreign protein are higher in AD patients than in healthy individuals.

Therefore, applying **enzymatic peels containing proteolytic enzymes that destroy the corneodesmosomes and enhance exfoliation is inappropriate.**

Retinol peeling

Retinol peeling —"inside-out" peeling — relies on retinol, the alcoholic form of vitamin A, as an active ingredient. Retinol is a fat-soluble substance that quickly passes through the *stratum corneum* without

directly damaging enzymes or other components. Its main targets are basal keratinocytes and sebocytes. By acting on the genetic apparatus of living cells through specific nuclear receptors, retinol regulates the activity of many genes of all types of skin cells, including:

1. Keratinocyte genes that control cell division, maturation, and migration
2. Sebocyte genes responsible for sebum production

Thus, retinol accelerates the epidermal cell renewal processes and suppresses sebum production.

Retinol peels aggravate the low-sebum condition in atopic skin, cause the lipid barrier disorder, and increase TEWL. For this reason, this type of chemical peel is not recommended for individuals suffering from AD.

Acid peeling

Alpha-hydroxy acids (AHAs) are not keratolytic because they do not break covalent bonds within or between protein molecules and do not damage proteins. Their effect on skin physiology is to change the pH of the aqueous environment (acidification), which in turn affects ionic interactions between organic molecules and enzymatic activity in the *stratum corneum*.

The following biological effects are observed at the cellular and tissue level:

- Increase in mitotic activity of basal keratinocytes
- Increase in the number of lamellar bodies in granular keratinocytes
- Acceleration of cellular renewal in the epidermis
- Thinning of the *stratum corneum*
- Strengthening of the barrier function

The clinical impact of superficial acid peels will be a slight exfoliation of the *stratum corneum*, smoothing of the microrelief, and brightening of the skin tone. The following formulations can be used for atopic skin:

- 20–30% AHA, pH 2–3 — for superficial peel treatment in the office
- 5–10% AHA, pH 4–5 — for pre-peeling preparation at home

The best AHA for atopic skin is lactic acid, an NMF component. When applied to the skin, lactic acid is absorbed by the *stratum corneum*. Since it is hygroscopic, it binds water, increasing the *stratum corneum* hydration. This moisturizing effect lasts until the lactic acid is exfoliated along with the corneocytes to which it is bound. Typically, lactic acid is introduced into the treatment program at week 4 to exfoliate superficial skin layers and treat hyperkeratosis without compromising the barrier function. The interaction of lactic acid with ceramides and its ability to bind water makes it an essential component of dry, low-sebum skin therapy.

Lactic acid slightly inhibits tyrosinase, which makes it well-suited for depigmentation therapy. Its use for four weeks has a double effect:

1. Positive impact on the psychological state of the patient because, even after one treatment, the skin becomes cleaner and lighter
2. Tyrosinase inhibition slows down melanogenesis and promotes the efficacy of other depigmenting products

After a surface peeling, emollients containing an equimolar mixture of ceramides, cholesterol, and free fatty acids at a 1:1:1 ratio can be applied for faster recovery.

In sum, superficial acid peeling is the only viable option that still allows gentle smoothing of atopic skin while cleansing it from accumulated conglomerates of horny masses, sebum, and impurities. Although the effect of AHA is gentle, given the hypersensitivity of atopic skin, it is necessary to test the peel product by applying a small amount to the elbow area before carrying out the procedure.

For more information about chemical peeling, see our *Chemical Peeling in Cosmetic Dermatology & Skincare Practice* book.