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THE EVOLUTION OF CHEMICAL PEELS: SAFE SKIN RENEWAL THROUGH CONTROLLED BIOSTIMULATION

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Abstract

The article explores the development of chemical peels as a safe and effective method for skin renewal. It focuses on the mechanisms of controlled biostimulation that ensure the regeneration and improvement of the skin structure without risk of complications. The article analyzes modern formulas and peeling techniques that promote the activation of natural skin renewal processes, increasing their effectiveness and reducing the recovery period. It emphasizes the importance of a personalized approach and professional supervision of procedures to achieve optimal aesthetic results.

Keywords: *teenagers, chemical peels, controlled biostimulation, skin renewal, skin regeneration, safety of procedures, aesthetic dermatology, modern peels, skin restoration*

Introduction

Chemical peels are a popular procedure in aesthetic dermatology, aimed at skin renewal and rejuvenation. Over time, the method has undergone significant changes, from simple acid treatments to more complex technologies that provide safe and controlled results.

The effectiveness of modern chemical peels lies not only in the removal of the outer layers of the skin, but also in the activation of deeper regeneration processes through biostimulation. This improves skin quality, texture, and elasticity, without causing significant damage or a long recovery period.

Initially, chemical peels were primarily used to treat surface defects. However, with the development of scientific and cosmetic technologies, the range of applications has expanded, safety has increased, and the risk of complications has decreased. Controlled biostimulation is a crucial aspect of modern techniques, which triggers renewal processes at the cellular level, stimulates collagen and elastin synthesis, and improves microcirculation.

The evolution of chemical peels has led to a transition from simple surface treatments to more complex and deeply researched approaches to skin renewal. These methods combine effectiveness and safety, and provide

maximum benefits for patients with minimal risks. This article will provide an overview of the key stages in the development of chemical peels and the modern techniques that ensure their safe and effective use (Kubanova A. A., 2004).

Discussion

It should be noted that the history of chemical peel research dates back several centuries, reflecting the gradual accumulation of knowledge about the effects of chemicals on skin in order to rejuvenate and renew it.

The earliest attempts to use acids for skin improvement date back to ancient civilizations, such as Egypt, Greece, and Rome. Natural acids like citric and tartaric were used to remove upper skin layers and lighten pigmentation. However, scientific research and systematic study of chemical peels did not begin until the XX century.

In 1882, Augustin Bordeaux described the use of phenol for skin disease treatment, which marked the beginning of deep peel development. In the 1920s and 30s, Edwin Prandt and Meredith Cullen developed methods for targeted phenol application, allowing for controlled and deep skin regeneration with minimal complications.

In the 1950s, the French dermatologist Jean Carraud introduced the concept of chemical peels, where he described different levels of exposure – superficial, medium and deep – depending on the type of acid used and the depth of penetration.

At the same time, phenol and alpha-hydroxy acids (AHAs), such as glycolic and lactic acids, which have a milder effect, began to be gradually used, allowing for a wider range of patients and reduced risks. The development of technology in the late XX and early XXI centuries led to the emergence of new products and techniques that combined peeling effects with biostimulation, increasing the safety and efficacy of procedures.

An important milestone was the introduction of standardized protocols and strict patient selection criteria, making it possible to avoid complications and making the procedure more accessible to a wider audience (Minenok, T. A., 2015).

Table 1. *Hardware techniques for safe skin renewal (Hernandez E. I., Ponomarev I. V., Klyuchareva S. V.)*

No.	Methodology	Characteristic
1.	Laser therapy	Initially, ablative lasers (CO_2, Er: YAG) were quite aggressive, but over time, fractional lasers were developed that create microscopic damage zones while leaving the surrounding tissues intact. This allows for a significant reduction in rehabilitation time and risk, while stimulating active neo-collagenesis. Non-ablative lasers and IPL (intense pulsed light) have also been used to stimulate collagen production without damaging the epidermis.
2.	Radio Frequency Lifting (RF)	RF technologies are based on the controlled heating of the skin's dermis, which leads to a reduction in collagen fibers and the stimulation of new collagen production. Through the development of monopolar, bipolar, and multipolar RF systems, as well as microneedle RF technology, deep and precise effects have been achieved.
3.	Ultrasonic Lifting (HIFU)	High-intensity focused ultrasound has been adapted for cosmetology for spot heating of the deep layers of the skin and the musculoskeletal-aponeurotic system (SMAS), which leads to tightening and compaction of tissues.

It should also be noted that the safe renewal of the skin through controlled biostimulation is the result of many years of research and development in the fields of dermatology, cosmetology, and bioengineering. This approach aims to improve

skin quality by stimulating the natural processes of regeneration and rejuvenation in tissues, rather than aggressively removing layers.

A turning point in this approach was the realization that, for a true and long-term improvement of skin, it is necessary to act on deeper structures, such as the dermis, where collagen and elastin are produced. This led to the development of biostimulation, which involves stimulating skin cells (fibroblasts) to produce rejuvenating components on their own (Kuznetsova E. S., Reznikov K. M., 2013).

In the 1980 s and 1990 s, methods aimed at biostimulation began to develop actively. One of the first directions was the use of hyaluronic acid injections, not only to fill wrinkles but also to improve hydration and stimulate collagen production. At that time, mechanisms of action of various peptides and growth factors, which could trigger regenerative processes, were also actively studied.

A significant stage in the development of safe skin renewal was associated with the emergence and improvement of hardware techniques (Table 1).

In parallel with hardware methods, techniques aimed at biostimulation have also been developed.

Polylactic acid (PLLA) was first used as a biostimulant in the 1990 s. This material is completely biodegradable and stimulates fibroblasts to actively produce collagen.

Calcium hydroxyapatite (CaHA) also acts as a collagen-stimulating agent, providing immediate volume and long-term stimulation of collagen synthesis.

PRP (Platelet-Rich Plasma) and PRF (Platelet-Rich Fibrin) are two methods that use the patient's own blood, which is rich in platelets and growth factors. These methods have become popular because they naturally stimulate tissue regeneration and skin rejuvenation.

Mesotherapy and biorevitalization are two cosmetic procedures that aim to deeply moisturize and rejuvenate the skin. Biorevitalization, which literally means "biological revival," involves injecting thin needles into the skin with preparations based on hyaluronic acid. Hyaluronic acid is a naturally occurring substance in our skin that helps retain moisture. During the procedure, non-gel hyaluronic acid with a high degree of purity is often used, sometimes combined with individual amino acids, to quickly hydrate the skin, improve its tone, and give it a fresh appearance.

Injections of a cocktail of vitamins, amino acids, hyaluronic acid, and other bioactive substances are used to improve metabolism and stimulate skin cells.

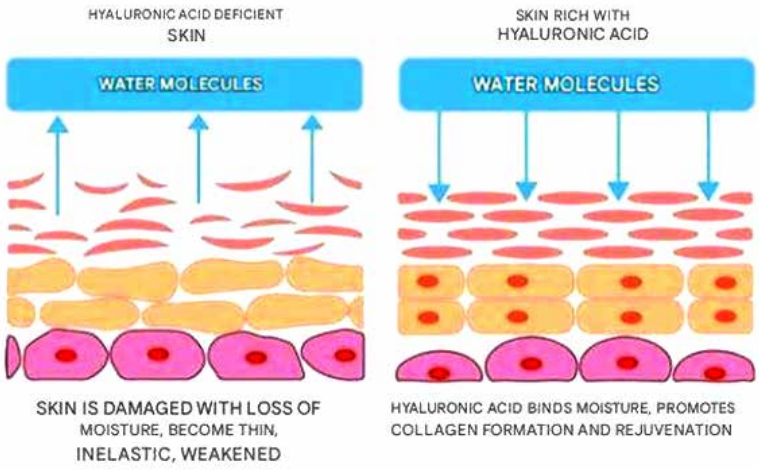
Results

Today, the concept of "skin renewal through controlled biostimulation" encompasses a wide range of treatments that are characterized by:

– Minimally invasive procedures with a short rehabilitation period, focusing on methods that require minimal recovery time.

– Precise control over exposure, allowing for the regulation of depth, intensity, and area to minimize risks while maximizing effectiveness.

Figure 1. *The effect of hyaluronic acid on skin condition*



– Stimulation of the body's own resources: activation of natural mechanisms of regeneration and synthesis of collagen, elastin, and hyaluronic acid. When hyaluronic acid enters the dermis, it begins to attract and retain water molecules, improving cell hydration, accelerating metabolism and microcirculation, and stimulating the synthesis of collagen and elastin. In simple terms, the skin receives powerful hydration from within, which immediately improves its appearance: it becomes firmer, smoother, and more radiant. The effect is often noticeable within a few days after the first injection – the face looks refreshed and rejuvenated. Biorevitalization is particularly effective in eliminating signs of skin dehydration, fine lines, and a dull complexion (Fig. 1).

– A combined approach: a combination of various hardware and injection techniques is often used to achieve the best results.

The future of this field is closely linked to the continued development of personalized medicine. This includes the creation of more precise bioactive substance delivery systems and the development of novel biocompatible materials that can selectively stimulate certain cells. Additionally, artificial intelligence will play a crucial role in optimizing treatment protocols and improving the safety of procedures.

Research in the field of cellular technology and gene therapy promises exciting new possibilities for skin rejuvenation and regeneration. Chemical peels, while still a popular method of skin renewal, have been around for a long time and continue to evolve. They use acids to carefully exfoliate damaged skin layers, stimulating regeneration. However, despite improvements in design, the use of chemical peels still presents certain challenges and potential risks that must be carefully considered.

1. Lack of Predictability and Control of Penetration Depth

One of the main challenges in using chemical agents is accurately controlling the depth of their penetration. The depth of peeling depends on several factors, including the type of acid (glycolic, salicylic, lactic, trichloroacetic acid, etc.), its concentration, pH of the solution, number of application layers, exposure time, patient's skin type and thickness, presence of preliminary preparations, and even fat content. An inaccurate calculation of these variables can lead to either insufficient effect (with a too superficial exposure), or, more seriously, excessively deep penetration causing burns, scarring, and prolonged hyperpigmentation. Even experienced specialists sometimes face situations where the skin reacts differently than expected.

2. The risk of post-peeling hyperpigmentation

Post-peeling hyperpigmentation, especially post-traumatic hyperpigmentation (PTH), is a common and unpleasant problem, especially for people with darker skin types (Fitzpatrick III and above). Any inflammation or damage to the skin from peeling can stimulate the production of excess melanin by melanocytes, leading to the appearance of dark spots. The risk of PTH is increased by using an incorrect acid concentration, overly aggressive exposure, lack of proper sun protection before and after the treatment, and if the person has a history of pigmentation problems. Treating PTH can be time-consuming and challenging.

3. Extended recovery period and social limitations

Especially for medium and deep peels, there is a significant period of recovery. After the procedure, the skin may become very red, swollen, and flaky, with crusts forming. This process can last from several days to several weeks, during which patients are advised to avoid contact with the outside world, follow a strict skincare routine, and avoid using makeup. This can cause significant social and psychological discomfort. Even superficial peels may cause slight peeling and redness, requiring some limitation of activity.

4. The possibility of adverse reactions and complications

In addition to hyperpigmentation, chemical peels may cause other complications, such as:

– Burns and scarring: If the acid is applied too deeply or unevenly, it can cause chemical burns, which may lead to the formation of atrophic or hypertrophic scars. This is especially true for sensitive areas and patients with a predisposition to scarring.

– Infections: The disruption of the skin's barrier after peeling leaves the skin vulner-

able to bacterial, viral, or fungal infections, such as an exacerbation of herpes.

– Allergic reactions: Although rare, allergic reactions to ingredients in the peeling solution can occur.

– Persistent redness: This may last for a long time after the treatment, especially for people with sensitive skin or those with rosacea.

– Exacerbation of chronic skin conditions: Peeling can trigger an exacerbation of skin conditions like rosacea, eczema, or psoriasis.

5. Importance of strict sun protection

It's crucial to protect your skin from the sun after a chemical peel, as the skin will be more sensitive and vulnerable.

The skin after chemical peeling is very sensitive to ultraviolet radiation. If patients do not follow strict sun protection rules (using high SPF creams, avoiding direct sunlight, and wearing wide-brimmed hats), the risk of hyperpigmentation and other skin damage increases significantly. This can be a challenge for patients who may not be able to strictly follow these guidelines.

6. Limitations for Certain Skin Conditions

Chemical peels have several contraindications and should not be performed in certain situations. These include active herpes, acute skin inflammation, open wounds or fresh scars, pregnancy or lactation, and when taking certain medications, such as systemic retinoids. Additionally, it is important to be cautious with patients who have dark skin, a tendency towards keloid scars, or who have thin, sensitive, or damaged skin.

7. Requirements for a Specialist

Chemical peels, particularly medium and deep peels, require a high level of qualification and expertise. A specialist should have a deep understanding of skin anatomy and physiology, as well as a thorough understanding of how acids work and how to respond to different skin reactions. Improper selection of a peel, incorrect application techniques, or improper post-peel care can lead to serious adverse consequences.

Conclusions

In conclusion, we would like to emphasize that modern chemical peels have a significant potential to improve skin condition. However, their use should be carefully assessed based on indications and contraindications. A balanced approach, strict adherence to protocols, and adequate post-treatment care by the patient are essential. Continuous improvement in formulas and techniques aims to minimize risks, although they cannot be completely eliminated.

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