

**MODERN METHODS OF ACNE TREATMENT: FROM RETINOIDS TO LASER
THERAPY AND MICRONEEDLING**

Kokand university, Andijan branch

Faculty of Medicine, General Medicine

Mansurjonova Yasminabonu Mansurjon qizi

Scientific Instructor: **Turgunova Dildora Ziyafovna**

amansurzanova@gmail.com

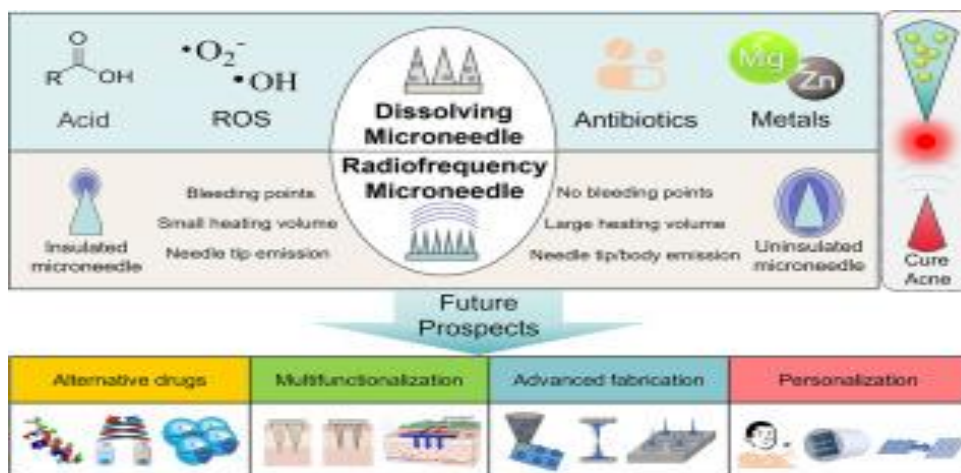
Abstract: Acne vulgaris is one of the most common dermatological conditions affecting both adolescents and adults. In recent decades, significant advances have been made in the treatment of acne due to the development of new pharmacological agents and the implementation of modern device-based therapies. This article reviews current treatment strategies, including the use of topical and systemic retinoids, antibiotics, hormonal therapy, as well as laser and photodynamic therapies. Special attention is given to the importance of a comprehensive and personalized approach based on the severity of the condition, skin type, and the patient's overall health. Additionally, the paper explores emerging trends in acne management such as the role of the skin microbiome, probiotics, and targeted molecular therapies.

Keywords. acne, acne treatment, retinoids, isotretinoin, laser therapy, photodynamic therapy, hormonal therapy, skin microbiome, dermatocosmetology, post-acne

Introduction. The skin is one of the largest organs of the human body. It performs many vital functions and serves as an indicator of numerous internal diseases. The skin protects against environmental influences, controls moisture evaporation, retains heat, prevents overheating, provides tactile sensation, withstands impacts and stretching, removes certain harmful substances from the body, and more.

Acne is a condition associated with increased sebum production and the enlargement and blockage of sebaceous glands. In areas where sebaceous glands become clogged, *Propionibacterium acnes* bacteria begin to multiply. These bacteria cause inflammation, leading to the formation of pimples.

The disease most commonly affects the skin of the face, upper back, and chest, and less frequently the shoulders and forearms. Acne is especially prevalent during adolescence, appearing as red inflamed papules, pustules, blackheads, and sometimes cysts. However, more and more adults are also affected by acne today. It is also frequently observed in athletes who use steroid-based substances.



Causes of acne:

- **Genetics.** A predisposition to acne can be inherited from close or distant relatives. That is why some people, even without skincare, are not affected by acne.
- **Endocrine system disorders.** When the glands produce excess sebum and the skin's keratinization process is intensified, it leads to clogged pores and the formation of acne.
- **Infection.** *Propionibacterium acnes* (*P. acnes*) naturally inhabits the skin surface but contributes to inflammation in blocked sebaceous glands.
- **Improper skincare.** It is very important to choose proper basic skincare products. Washing the face with soap or other alkaline cleansers should be avoided, as soap dries out the skin, dehydrates it, and removes natural oils. In response, the skin tries to protect and restore its barrier by producing even more sebum, worsening the condition. Similarly, frequent use of alcohol-based cleansers and lotions also leads to increased oil production and aggravation of acne symptoms.

Microneedle - is a revolutionary transdermal drug delivery system that creates painless and minimally invasive pathways through the stratum corneum of the skin, effectively bypassing the first-pass effect and enabling sustained drug release. This technique allows for precise control over drug dosage, release rate, and therapeutic efficacy through meticulous design and formulation. Microneedles can be categorized into solid, coated, hollow, dissolving, and hydrogel types, with materials ranging from polymers to inorganic biomaterials including biometals and bioceramics. The manufacturing techniques for microneedles are also diverse, including laser cutting, photo-lithography, etching, and 3D printing. Clinical trials have demonstrated that microneedle technology possesses good tolerability, usability, and acceptability, and has been successfully applied to vaccine administration, drug delivery, and the treatment of various skin conditions. Despite challenges such as limitations on drug dosage and the dissolution requirements for poorly soluble drugs, the potential of microneedle technology is vast with technological advancements.

Modern acne treatment involves a comprehensive, step-by-step approach aimed at addressing all major pathogenic mechanisms of the disease. Medical tactics are selected individually, depending on the severity of acne, the patient's age, skin type, hormonal status, and the presence of any accompanying conditions.

At the initial stages, in mild to moderate forms of acne, topical therapy is predominantly used. The most effective agents are retinoids, such as adapalene, tretinoin, and tazarotene. These normalize the process of epithelial renewal, prevent the formation of comedones, and reduce sebaceous gland activity. However, these medications may cause skin irritation, so they are usually introduced gradually, starting with low concentrations. Another widely used agent is benzoyl peroxide, which has pronounced antimicrobial activity against *Propionibacterium acnes*. Since it does not induce bacterial resistance, it is often used in combination therapy. Topical antibiotics, such as clindamycin or erythromycin, are prescribed only for short-term use to avoid the development of resistance. Azelaic acid-based products are also effective, as they exhibit both antimicrobial and depigmenting properties, which is especially important in cases of post-inflammatory hyperpigmentation.

For more pronounced inflammatory forms of acne, systemic therapy is required. The most effective drug in such cases is isotretinoin — a systemic retinoid used to treat severe, nodular, or recurrent forms of acne. It targets all key pathogenic factors: it reduces sebum production, decreases sebaceous gland size, and has anti-inflammatory and comedolytic effects. However, treatment with isotretinoin requires close medical supervision due to the risk of serious side effects, including dryness of the skin and mucous membranes, lipid metabolism disorders, and most importantly, teratogenicity. In women of childbearing age, the drug is prescribed only under strict contraceptive control.

In cases of active inflammation, systemic antibiotics such as doxycycline or minocycline may be used. These medications have strong anti-inflammatory effects but are prescribed for a limited period — no longer than 8 to 12 weeks — and always in combination with topical treatments to minimize the risk of bacterial resistance. In women, especially those with menstrual irregularities or signs of hyperandrogenism, hormonal therapy can be highly effective. Combined oral contraceptives with anti-androgenic properties are used, as well as spironolactone, which blocks androgen receptors and reduces sebaceous gland activity.

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