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MODERN FOUNDATIONS OF QUANTUM THERAPY IN THE TREATMENT OF PSORIASIS AND OTHER DERMATOSES

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ABSTRACT

Psoriasis and other chronic dermatoses remain among the most significant problems in modern dermatology because of their recurrent course, complex pathogenesis, and considerable impact on patients’ quality of life. Conventional pharmacological therapies are often associated with systemic adverse effects, limited efficacy, and the development of resistance during long-term treatment. In recent decades, quantum therapy has emerged as a promising therapeutic direction in dermatology. Quantum therapy includes the medical application of low-intensity laser radiation, ultraviolet phototherapy, photobiomodulation, excimer laser technology, infrared radiation, and photodynamic therapy. These modalities influence cellular metabolism, immune responses, inflammatory mediators, and regenerative processes through electromagnetic energy interactions with biological tissues. Modern studies demonstrate that quantum therapy can reduce keratinocyte hyperproliferation, normalize cytokine activity, suppress chronic inflammation, and stimulate tissue repair. In psoriasis, narrow-band UVB therapy and excimer laser treatment have shown particularly high clinical effectiveness and prolonged remission rates. Quantum therapy has also demonstrated positive outcomes in atopic dermatitis, vitiligo, acne vulgaris, lichen planus, alopecia areata, and other inflammatory skin diseases. The present article reviews the modern scientific foundations of quantum therapy, its biological mechanisms, clinical applications, advantages, limitations, and future prospects in the treatment of psoriasis and other dermatoses. Special attention is paid to immunomodulatory effects, molecular mechanisms of photobiomodulation, and innovative technological developments in dermatological practice.

Keywords: psoriasis, dermatoses, quantum therapy, phototherapy, laser therapy, photobiomodulation, excimer laser, ultraviolet radiation, dermatology, immunomodulation.

INTRODUCTION

Chronic inflammatory skin diseases represent a major global health burden affecting millions of individuals worldwide. Among them, psoriasis occupies a special place due to its high prevalence, recurrent nature, psychosocial impact, and association with systemic comorbidities. Psoriasis is now recognized not merely as a skin disorder but as a complex immune-mediated systemic disease involving chronic inflammation and dysregulation of multiple biological pathways.

The prevalence of psoriasis ranges from 1% to 3% in the global population. The disease may occur at any age and significantly impairs quality of life through persistent itching, pain, cosmetic disfigurement, sleep disturbances, anxiety, depression, and social stigmatization. Furthermore, psoriasis is frequently associated with metabolic syndrome, cardiovascular diseases, obesity, diabetes mellitus, and psoriatic arthritis.

The pathogenesis of psoriasis involves genetic predisposition, immune dysfunction, abnormal keratinocyte proliferation, angiogenesis, oxidative stress, and environmental triggers. Modern molecular studies have demonstrated the central role of T-helper lymphocytes, especially Th1 and

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Th17 cells, as well as pro-inflammatory cytokines including tumor necrosis factor-alpha (TNF-α), interleukin-17 (IL-17), and interleukin-23 (IL-23).

Traditional therapeutic approaches include topical corticosteroids, vitamin D analogues, systemic immunosuppressive agents, retinoids, methotrexate, cyclosporine, and biologic therapies. Although these treatments can provide clinical improvement, many patients experience adverse effects, incomplete remission, relapse, or reduced effectiveness during prolonged therapy.

In this context, physical therapeutic methods have gained considerable attention. Quantum therapy represents one of the most innovative and rapidly developing areas in dermatology. It is based on the controlled medical application of electromagnetic radiation with specific wavelengths and intensities to achieve biological and therapeutic effects.

Quantum therapy includes several modalities such as:

Narrow-band ultraviolet B phototherapy,PUVA therapy,Low-level laser therapy,Excimer laser therapy,Infrared radiation,Photodynamic therapy.

These technologies act at the cellular and molecular levels, influencing inflammatory processes, mitochondrial activity, tissue regeneration, and immune responses. Due to their non-invasive nature and relatively favorable safety profile, quantum therapy techniques are increasingly integrated into modern dermatological practice.

The purpose of this article is to analyze the modern scientific foundations of quantum therapy in psoriasis and other dermatoses, summarize current clinical evidence, and evaluate future perspectives for the development of these innovative treatment approaches.

Pathogenesis of Psoriasis

Psoriasis is a multifactorial disease characterized by chronic immune-mediated inflammation and excessive epidermal proliferation. The exact etiology remains incompletely understood; however, numerous studies indicate a strong interaction between genetic, immunological, and environmental factors.

Genetic Factors

Genetic predisposition plays a crucial role in the development of psoriasis. Several susceptibility loci have been identified, particularly PSORS1 located within the major histocompatibility complex on chromosome 6. The HLA-Cw6 allele is strongly associated with early-onset psoriasis and severe disease manifestations.

Other genes involved in immune regulation, cytokine signaling, and skin barrier function also contribute to disease susceptibility. These include genes associated with IL-23, NF-κB signaling pathways, and T-cell activation.

Immunological Mechanisms

Modern understanding of psoriasis emphasizes the importance of immune dysregulation. The disease is characterized by abnormal activation of dendritic cells and T lymphocytes.

Activated dendritic cells release cytokines such as:

TNF-α;

IL-12;

IL-23.

These cytokines stimulate differentiation and activation of Th1 and Th17 lymphocytes. In turn, Th17 cells produce IL-17 and IL-22, which promote keratinocyte proliferation and inflammatory responses.

The inflammatory cascade results in:

Hyperproliferation of epidermal cells,Increased angiogenesis,Infiltration of inflammatory cells,Formation of characteristic psoriatic plaques.

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Oxidative Stress

Oxidative stress contributes significantly to psoriasis pathogenesis. Increased production of reactive oxygen species damages cellular structures and enhances inflammatory signaling pathways. Antioxidant defense mechanisms are frequently impaired in patients with chronic psoriasis.

Keratinocyte Dysfunction

In healthy skin, epidermal cell turnover requires approximately 28 days. In psoriasis, this process accelerates dramatically to only 3–5 days. As a result, immature keratinocytes accumulate on the skin surface, forming thick scales and plaques.

Understanding these molecular and cellular mechanisms is essential for the development of targeted therapeutic approaches such as quantum therapy.

Concept and Physical Foundations of Quantum Therapy

Quantum therapy refers to the therapeutic application of electromagnetic radiation for medical purposes. It is based on the interaction between photons and biological tissues at molecular and cellular levels.

The therapeutic effects depend on several physical parameters:

Wavelength,Energy density,Pulse duration,Frequency,Radiation intensity,Penetration depth.

Different wavelengths penetrate tissues to varying degrees and produce distinct biological effects.

Main Types of Quantum Therapy

1. Narrow-Band UVB Therapy

Uses ultraviolet radiation with wavelengths of 311–313 nm.

2. PUVA Therapy

Combines psoralen photosensitizers with UVA radiation.

3. Low-Level Laser Therapy

Employs low-intensity red or infrared laser radiation.

4. Excimer Laser Therapy

Uses monochromatic UVB radiation at 308 nm.

5. Photodynamic Therapy

Combines photosensitizing agents with visible light exposure.

6. Infrared Quantum Therapy

Applies infrared electromagnetic radiation to improve circulation and tissue metabolism.

Each modality possesses unique biological mechanisms and clinical indications.

Mechanisms of Photobiomodulation

Photobiomodulation is one of the central biological mechanisms underlying quantum therapy. It refers to the ability of light energy to modify cellular metabolism and physiological processes.

The primary intracellular target of photobiomodulation is believed to be cytochrome c oxidase within mitochondria. Absorption of photons stimulates mitochondrial respiration and ATP production.

As a result:

Cellular energy metabolism improves,Oxidative stress decreases,Tissue regeneration accelerates,Microcirculation improves,Inflammatory mediator production declines.

Low-level laser radiation also influences nitric oxide metabolism, promoting vasodilation and enhanced oxygen delivery to tissues.

Immunomodulatory Effects

Photobiomodulation can modulate immune responses through:

Reduction of pro-inflammatory cytokines;

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Suppression of T-cell hyperactivity;

Activation of anti-inflammatory pathways;

Regulation of macrophage function.

These mechanisms are particularly important in chronic inflammatory dermatoses such as psoriasis and atopic dermatitis.

Narrow-Band UVB Therapy

Narrow-band UVB phototherapy is currently considered one of the most effective physical treatments for psoriasis.

The therapeutic wavelength of 311–313 nm provides maximal clinical efficacy with relatively minimal adverse effects compared to broadband UV radiation.

Mechanisms of Action

UVB radiation exerts several biological effects:

Induction of T-cell apoptosis;

Suppression of inflammatory cytokines,Inhibition of keratinocyte proliferation,Reduction of epidermal hyperplasia,Immunomodulation.

UVB exposure also decreases antigen-presenting activity in the skin and reduces infiltration of inflammatory cells.

Clinical Applications

Narrow-band UVB therapy is effective in:

Plaque psoriasis,Guttate psoriasis,Palmoplantar psoriasis,Pediatric psoriasis.

Treatment protocols usually involve 2–3 sessions per week over several months.

Advantages

High clinical efficacy,Long-term remission,Non-invasive treatment,Minimal systemic toxicity.

Adverse Effects

Possible side effects include:

Erythema,Dry skin,Hyperpigmentation,Premature skin aging.

Long-term excessive exposure may increase the risk of photocarcinogenesis; therefore, careful dose monitoring is essential.

PUVA Therapy

PUVA therapy combines psoralen administration with UVA irradiation. Psoralens intercalate into DNA and become activated upon exposure to UVA light.

Biological Effects

PUVA therapy:

Inhibits DNA synthesis,Suppresses keratinocyte proliferation,Reduces T-cell activity,Produces immunosuppressive effects.

Indications

PUVA is particularly effective in:

Severe psoriasis,Extensive plaque psoriasis,Palmoplantar psoriasis,Vitiligo,Cutaneous T-cell lymphoma.

Limitations

Despite its effectiveness, PUVA therapy carries several risks:

Phototoxic reactions,Nausea,Cataract formation,Increased skin cancer risk with prolonged treatment.

For this reason, modern dermatology increasingly favors narrow-band UVB therapy when appropriate.

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Excimer Laser Therapy

Excimer laser technology represents one of the most advanced forms of targeted phototherapy.

The excimer laser emits monochromatic UVB radiation at 308 nm directly to diseased skin while sparing healthy tissue.

Therapeutic Mechanisms

The excimer laser:

Induces apoptosis of pathogenic T lymphocytes;

Reduces inflammatory infiltrates;

Suppresses keratinocyte proliferation;

Enhances local immunoregulation.

Clinical Effectiveness

Studies demonstrate significant improvement after 10–15 treatment sessions. The therapy is especially effective for localized lesions resistant to conventional therapy.

Indications

Localized plaque psoriasis,Scalp psoriasis,Elbow and knee lesions,Vitiligo,Atopic dermatitis.

Advantages

High precision,Rapid clinical improvement,Reduced total UV exposure,Minimal damage to healthy skin.

Low-Level Laser Therapy

Low-level laser therapy (LLLT) utilizes low-intensity red or infrared light to stimulate biological processes without causing thermal tissue damage.

Biological Effects

LLLT promotes:

ATP synthesis,Fibroblast proliferation,Collagen production,Angiogenesis,Anti-inflammatory responses.

Applications in Dermatology

Low-level laser therapy has demonstrated beneficial effects in:

Psoriasis,Atopic dermatitis,Chronic ulcers,Acne vulgaris,Seborrheic dermatitis,Alopecia areata.

Effects in Psoriasis

In psoriasis patients, LLLT can:

Reduce itching;

Decrease plaque infiltration;

Accelerate healing;

Improve skin elasticity.

Combination therapy with topical agents often enhances therapeutic outcomes.

Photodynamic Therapy

Photodynamic therapy (PDT) combines a photosensitizing compound with light irradiation to selectively destroy pathological cells.

Upon activation by light, photosensitizers generate reactive oxygen species that induce cellular destruction.

Mechanisms of Action

PDT causes:

Oxidative damage;

Cellular apoptosis;

Vascular destruction;

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Immunological activation.

Dermatological Indications

Photodynamic therapy is widely used in:

Actinic keratosis;

Basal cell carcinoma;

Acne vulgaris;

Viral skin lesions;

Selected inflammatory dermatoses.

Advantages

Selective targeting;

Minimal invasiveness;

Favorable cosmetic results.

Limitations

Pain during treatment;

Photosensitivity reactions;

High cost.

Quantum Therapy in Other Dermatoses

Atopic Dermatitis

Atopic dermatitis is a chronic inflammatory skin disease characterized by itching and epidermal barrier dysfunction.

Quantum therapy can:

Reduce pruritus;

Modulate immune responses;

Improve skin barrier function;

Decrease inflammation.

Narrow-band UVB therapy is particularly effective in chronic moderate-to-severe atopic dermatitis.

Vitiligo

Vitiligo involves autoimmune destruction of melanocytes leading to depigmented skin lesions.

Excimer laser and UVB therapy stimulate melanocyte migration and repigmentation.

Acne Vulgaris

Blue and red light therapies reduce Propionibacterium acnes colonization and suppress sebaceous gland activity.

Lichen Planus

Laser therapy promotes epithelial healing and decreases inflammation in erosive lesions.

Alopecia Areata

Low-level laser therapy stimulates hair follicle metabolism and may enhance hair regrowth.

Immunomodulatory Effects of Quantum Therapy

One of the most important properties of quantum therapy is its ability to regulate immune system activity.

Therapeutic light exposure influences:

Cytokine production;

T-cell differentiation;

Macrophage activation;

Oxidative stress pathways.

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Quantum therapy can decrease levels of:

TNF-α;

IL-17;

IL-23.

Simultaneously, anti-inflammatory mediators may increase, contributing to restoration of immune balance.

These effects explain the growing role of quantum therapy in autoimmune and inflammatory dermatoses.

Advantages and Limitations of Quantum Therapy

Advantages

Quantum therapy offers several important benefits:

Non-invasive treatment;

Minimal systemic toxicity;

Good patient tolerance;

Reduced medication dependence;

Long-term remission;

Targeted therapeutic effects.

Limitations

Despite numerous advantages, certain limitations remain:

High equipment costs;

Requirement for specialized training;

Variable patient responses;

Need for repeated sessions;

Potential long-term photodamage.

Therefore, individualized treatment planning remains essential.

Future Perspectives

Modern technological progress continues to improve quantum therapy methods in dermatology.

Future developments may include:

Artificial intelligence-assisted phototherapy;

Personalized dosimetry systems;

Combined biologic and phototherapy approaches;

Nanotechnology-enhanced photodynamic therapy;

Advanced wearable phototherapy devices.

Molecular research is expected to further clarify the mechanisms of photobiomodulation and optimize therapeutic protocols.

The integration of precision medicine with quantum therapeutic technologies may significantly improve outcomes in chronic dermatoses.

CONCLUSION

Quantum therapy represents a highly promising direction in modern dermatology. Through the therapeutic application of electromagnetic radiation, these technologies exert significant anti-inflammatory, immunomodulatory, regenerative, and antiproliferative effects.

Current evidence demonstrates that narrow-band UVB therapy, excimer laser treatment, low-level laser therapy, and photodynamic therapy are effective in the management of psoriasis and various other dermatoses.

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Compared with traditional pharmacological approaches, quantum therapy offers several important advantages, including lower systemic toxicity, improved safety, targeted action, and prolonged remission.

However, further large-scale clinical studies are necessary to optimize treatment protocols, evaluate long-term safety, and establish standardized therapeutic guidelines.

The future of dermatological treatment is increasingly connected with innovative physical methods, and quantum therapy is likely to become an integral component of personalized medicine in dermatology.

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