

The effect of lymphatic massage and physical activity on delaying signs of skin aging: A literature review

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ABSTRACT

Skin aging (SA) is influenced by external (UV radiation, air pollution) and internal (genetics, hormones) factors. Aesthetic medicine has recently developed rapidly. This article examines natural methods that may slow SA and improve skin appearance, focusing on physical activity and lymphatic massage. The study evaluates their effects on skin condition and related biological processes, including oxidative stress, inflammaging, telomere shortening, and extracellular matrix degradation. It also considers physical activity's role in enhancing microcirculation, collagen production, and skin barrier quality. Lymphatic massage is discussed regarding tissue drainage, improved nourishment, toxin removal, and lifting effects, supported by imaging techniques such as three-dimensional computed tomography (3D-CT). Literature review and pilot data suggest that regular physical activity and manual lymphatic drainage are effective in SA prevention, supporting skin's structural and functional integrity safely.

Key words: Skin aging, Physical activity, Lymphatic massage, Lymphatic drainage, Anti - aging prevention

INTRODUCTION

Skin aging (SA) is a complex, multifactorial process involving both natural physiological mechanisms and external factors that accelerate these changes. Oxidative stress, chronic low - grade inflammation (inflammaging), and telomere shortening lead to the degradation of collagen fibers, loss of skin firmness and elasticity, which manifest as wrinkles, discoloration, and volume loss. The rapid development of aesthetic medicine and growing interest in natural skincare methods have drawn attention to interventions such as regular physical activity - which stimulates collagen production, improves microcirculation, and exhibits

antioxidant effects - and lymphatic massage, which enhances tissue drainage, reduces swelling, and affects the tension of fascial structures. The aim of this study is to analyze the impact of these two complementary strategies on slowing visible signs of SA, from an interdisciplinary perspective combining elements of cosmetology and physiotherapy.

METHODOLOGY

This study involved a review of scientific literature from the last ten years using databases such as PubMed, Scopus, and Web of Science. Included were experimental, clinical, and review studies investigating

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the effects of physical activity and lymphatic massage on the structure and function of the skin. The analyzed publications focused on molecular mechanisms of aging, the influence of physical exertion on the expression of extracellular matrix (ECM) - related genes, oxidative stress, microcirculation, and the use of three - dimensional computed tomography (3D - CT) imaging in patients undergoing facial massage.

The research section incorporated data from pilot observational studies on the effects of massage on facial tissue thickness and the tension of the superficial musculo - aponeurotic system (SMAS). Materials were selected based on clearly defined criteria: presence of measurable skin morphological indicators, use of objective assessment methods (such as computed tomography or profilometry), absence of surgical interventions, and the description of natural, non - invasive skincare methods. The results were compiled qualitatively and subjected to comparative analysis, considering the effectiveness and safety of the evaluated interventions.

THE AGING PROCESS OF THE SKIN: A BIOLOGICAL PERSPECTIVE

The skin functions as a barrier that separates the external environment from internal organs, protecting the body against water loss and microbial infections. However, like every cell in the human body, it is subject to the aging process. In light of this, the search for effective strategies to delay SA becomes particularly important. It should be emphasized, however, that we have a significant influence on the aging of the skin through a healthy lifestyle - including UV protection, stress reduction, and regular physical activity [1].

SA is a complex process that remains not fully understood. It results from numerous biological, biochemical, and physical interactions, as well as a gradual decline in the body's ability to regenerate and maintain homeostasis [2]. Moreover, external factors such as ultraviolet (UV) radiation, excessive alcohol consumption, smoking, air pollution, and environmental toxins significantly accelerate the senescence process. Aging affects each layer of the skin. In the epidermis, aging leads to thinning, reduced keratinocyte proliferation, and a loss of integrity in the intercellular junctions. In the dermis, the number of fibroblasts decreases, the quality of the extracellular matrix (ECM) deteriorates - manifesting

as disorganization, reduced synthesis, fragmentation, and loss of collagen fibers. In addition, the vascular network weakens, impairing tissue nourishment and oxygenation.

Cellular mechanisms accelerating the aging process include:

- Oxidative stress - excessive production of reactive oxygen species (ROS) leads to protein damage (e.g., oxidation of amino acid residues), protein aggregation, lipid peroxidation (e.g., destruction of cell membranes, formation of toxic aldehydes such as MDA - malondialdehyde), and DNA mutations [3];
- Telomere shortening - with each subsequent cell division, telomeres become shorter, eventually leading to replicative senescence of cells;
- Inflammaging - a chronic, low - grade inflammatory state associated with impaired mitochondrial function and the accumulation of damaged macromolecules. This process is driven, among other factors, by increased levels of pro - inflammatory cytokines interleukin 6 (IL - 6), Tumor Necrosis Factor alpha (TNF - α), which accelerate extracellular matrix (ECM) degradation and inhibit tissue regeneration.

Subcutaneous adipose tissue undergoes thinning as a result of various biological processes, such as aging mechanisms, lipolysis, and the redistribution of visceral fat. Similarly, muscle mass decreases over time - a process known as sarcopenia. All of these factors contribute to skin thinning, loss of firmness, and, ultimately, the formation of visible wrinkles and pigmentation disorders [4].

Facial aging also involves structural changes in the bones, adipose tissue, and muscles. Facial fat can be divided into two main categories - superficial and deep - depending on their anatomical location relative to the SMAS (superficial musculo - aponeurotic system). The superficial fat layer is mobile and responds to the activity of facial expression muscles, while the deep fat layer is relatively immobile, firmly attached to deeper structures, and provides structural support for the muscles and the overlying skin layers. With age, gradual atrophy of facial fat occurs, particularly in the forehead, periorbital, and perioral regions. This leads to hollowing of the cheeks, deepening of the tear trough, and pronounced nasolabial folds. Bone remodeling and a weakening of the supportive ligaments further contribute to the downward and

medial redistribution of facial fat, intensifying the aforementioned changes. Over time, involution of the facial mimic muscles also occurs. Combined with progressive subcutaneous fat loss and reduced skin elasticity, this results in characteristic morphological changes. Repetitive muscle contractions contribute to the fixation of dynamic wrinkles, while the diminished shock - absorbing capacity of soft tissues leads to the phenomenon of so - called “dynamic disproportionality.” This is particularly noticeable in the perioral area, where excessive activity of the orbicularis oris muscle, along with reduced structural support from connective tissue, results in narrowing of the vermilion border and deepening of the nasolabial folds [5].

The main differences between endogenous and exogenous skin aging are summarized in Table 1.

EFFECTS OF PHYSICAL ACTIVITY ON SKIN PHYSIOLOGY

The Role of Physical Activity in Reducing Oxidative Stress, Stimulating Collagen Production, and Improving ecm Structure

The skin is the largest organ in the human body, and its primary function is to protect the organism from external factors. It is worth noting that the skin also serves as an active component of the neuroendocrine system. This means that the skin not only responds to hormonal and neural signals but also produces and releases its own hormones (e.g., vitamin D₃, cortisol) and neurotransmitters (e.g., substance P, catecholamines), thereby modulating the response to both local and systemic stress.

Oxidative stress plays a crucial role in the SA process. Reactive oxygen species (ROS), generated as a result of various stimuli (e.g., UV radiation), cause damage to lipids, proteins, and DNA within cells. Fibroblasts are particularly sensitive to ROS. In response to oxidative stress, structural disruptions in collagen and disorganization of the extracellular matrix (ECM) occur. Moreover, ROS can stimulate the activity of matrix metalloproteinases (e.g., MMP - 1 and MMP - 3), enzymes responsible for collagen degradation, which in turn impairs fibroblast function.

Studies conducted on individuals performing aerobic training (AT) and resistance training (RT) have shown that physical activity has a significant impact on processes occurring in the skin. The analysis of the study demonstrated that both aerobic and resistance training significantly increase the expression of genes essential for the extracellular matrix (ECM), such as collagen genes COL1A2 and COL3A1, as well as proteoglycans. Moreover, physical activity positively influences fibroblast metabolism and stimulates collagen production through activation of MAPK and TGF - β signaling pathways, which support the biosynthesis of ECM components. These changes correlated with improved skin elasticity, an increase in the quantity and organization of collagen, and reduced degradation of the upper layers of the dermis typically observed with aging. In addition, moderate physical exercise reduces oxidative stress. This is attributed to elevated levels of antioxidant enzymes (e.g., superoxide dismutase [SOD], catalase, and glutathione), enhanced cellular resistance to oxidative damage, and a reduction in adipose tissue, which leads to decreased production of pro - inflammatory cytokines (e.g., IL - 1, IL - 6,

Table 1: Comparison of exogenous and endogenous SA [6]

Category	Endogenous aging	Exogenous aging	Common features
Main causes	- Genetics - Hormones - Reduction of stem cell activity	- Smoking tobacco - Unhealthy diet and lifestyle - UV radiation - Air pollution (PM2.5)	- Oxidative stress (ROS) - DNA damage - Accumulation of senescent cells
Molecular changes	- Telomere shortening, -Decreased fibroblast activity, - Reduced collagen synthesis (by approximately 1% annually after the age of 25) - Decreased IGF-1 synthesis	- Activation of matrix metalloproteinases (MMPs) - Solar elastosis - Skin microbiome dysbiosis	- ECM degradation caused by SASP* - Reduction in TGF-β/Smad** signaling pathway efficiency
Symptoms	- Thin, dry skin - Fine wrinkles - Decreased elasticity	- Deep wrinkles - Hyperpigmentation - Rough skin texture	- Reduction in dermal thickness - Flattening of the dermo-epidermal junction
Changes in the dermis	- Loss of fibroblasts in the papillary dermis	- Accumulation of degraded elastin fibers (elastosis)	- Reduced synthesis of type I and III collagen

*SASP (Senescence - Associated Secretory Phenotype) is a collection of biologically active substances secreted by senescent cells. These factors induce inflammation, damage surrounding tissues, and contribute to progressive SA.

**TGF - β/Smad signaling pathway is based on the action of Transforming Growth Factor Beta (TGF - β) and Smad proteins. It regulates collagen production by fibroblasts. With age, the pathway weakens, leading to reduced collagen synthesis and loss of skin elasticity

TNF - α) and increased levels of adiponectin, a hormone with anti-inflammatory properties. Cellular adaptation occurs through the expression of antioxidant genes in response to sustained exposure to low levels of ROS [7,8].

The Impact of Physical Exercise on Microcirculation and Tissue Oxygenation

Research findings highlight the benefits of regular physical activity, such as improved tissue nourishment, increased oxygen delivery, and enhanced blood flow through the microcirculation, all of which are essential for maintaining a healthy skin appearance. A combination of aerobic and resistance exercise improves blood vessel perfusion and accelerates the removal of accumulated toxins from cells [9].

Scientific evidence also indicates that aerobic training can improve endothelial function, as observed in individuals with coronary artery disease (CAD). This occurs through increased expression and phosphorylation of endothelial nitric oxide synthase (eNOS), leading to enhanced nitric oxide production - a key vasodilator. Additionally, improved vasodilation in response to acetylcholine has been noted [10].

The Effect of Physical Activity on the Skin Barrier

Sweating is a natural process during physical activity. Increased sweat production improves hydration of the stratum corneum, helping to maintain water balance and prevent dryness. Studies show that skin hydration levels can increase by up to 50% after moderate-intensity exercise. A temporary decrease in sebum production has also been observed, which may destabilize proper barrier function.

Moreover, excessive sweating raises the skin's pH level, disrupting its natural acidity and the balance of the skin microbiome. These changes are transient and typically resolve shortly after the exercise ends; however, proper post-workout skin care is crucial to restore the skin's natural environment [11].

The presented studies provide strong evidence supporting the importance of regular physical exercise in maintaining a youthful appearance. This description is particularly relevant in the context of developing non-invasive anti-aging strategies.

THE EFFECT OF LYMPHATIC MASSAGE ON THE SKIN

Lymphatic Massage as a Method Supporting the Delay of Aging Signs

The practice of massage, whether applied to the face or the body, has been shown to have a positive effect on both the appearance of the skin and the management of various medical conditions. The regular application of massage therapy has been demonstrated to engender a plethora of advantages, including enhanced blood circulation, augmented skin elasticity, and a reduction in muscle tension.

Specifically, facial massage has been demonstrated to stimulate collagen and elastin production, thereby contributing to the smoothing of wrinkles and the enhancement of skin firmness. Furthermore, massage techniques have been demonstrated to promote lymphatic drainage, thereby reducing swelling and enhancing facial contour.

From a therapeutic standpoint, body massage has been shown to alleviate muscle pain, improve range of motion, and support tissue regeneration. It has been demonstrated that regular massage sessions have the potential to contribute to a reduction in stress and an enhancement in psychological well-being.

In the context of the management of age-related changes, the practice of massage, whether applied to the face or the body, represents a valuable addition to conventional skincare regimens, providing both aesthetic and therapeutic benefits.

A pilot study was conducted to objectively assess the impact of facial massage on the structure of soft tissues. The efficacy of facial massage was substantiated through an objective analysis of morphological changes in facial structures, such as the cheeks and the superficial musculo-aponeurotic system (SMAS), employing modern computed tomography technology.

A significant correlation was observed between changes in cheek thickness and SMAS height, suggesting a lifting and tightening effect resulting from facial massage [12].

In a further study, also employing 3D-CT, the impact of facial massage on morphological changes was assessed. This study provides objective evidence that facial massage can lead to significant changes

in subcutaneous structures such as adipose tissue and mimic muscles, which is relevant in the context of delaying facial aging signs. A visual evaluation indicated substantial alterations in the nasolabial folds subsequent to facial massage. Observations revealed alterations in the lower, upper, and lateral regions of the cheek, as well as the lower eyelids, in more than half of the subjects. A 3D - CT analysis revealed significant FMCR (facial massage - induced change rate) changes in the paranasal regions, nasolabial folds, and upper jawline. Such changes are indicative of alterations in soft tissue and subcutaneous structures. Observations were made of changes in subcutaneous fat and mimic muscles, suggesting that facial massage may affect deeper tissue layers, not just the skin surface.

These changes have the potential to contribute to enhanced skin elasticity and tone, as well as a reduction in swelling and muscle tension, which is a crucial factor in the context of delaying the onset of facial aging [13].

Manual lymphatic drainage (MLD) constitutes a specialised therapeutic modality involving gentle, rhythmic movements with the objective of stimulating lymph flow within the body. The objective of MLD is to enhance lymphatic transport through the lymphatic vessels, thereby contributing to the reduction of oedema, the elimination of metabolic waste, and the enhancement of immune system functioning.

The mechanism of MLD is based on the use of both external forces, such as skeletal muscle contractions and respiratory movements, and internal forces, including spontaneous contractions of smooth muscle in lymphatic vessel walls and stimulation by the autonomic nervous system. Collectively, these mechanisms facilitate the flow of lymph from the interstitial spaces through the lymphatic vessels to the circulatory system, a process that is imperative for maintaining fluid homeostasis and ensuring effective immune responses.

In clinical practice, MLD is also used in the context of post - traumatic rehabilitation and in the treatment of postoperative oedema, with the objective of reducing pain, improving range of motion, and enhancing quality of life [14].

The Function of the Lymphatic System in Toxin Elimination and Skin Homeostasis Maintenance

The lymphatic system plays a pivotal role in preserving skin homeostasis by modulating fluid balance,

eliminating toxins, and fortifying immune responses. The skin is endowed with a complex network of lymphatic vessels that function to effectively drain excess fluids, proteins, and metabolic waste from interstitial spaces, thereby preventing swelling and supporting tissue health.

Lymphatic vessels, comprising capillaries, pre - collectors, and collectors, are responsible for the absorption and transportation of fluids and large molecules from the interstitial space. Lymphatic capillaries, distinguished by their distinctive structure comprising flat endothelial cells, facilitate the movement of interstitial fluid, proteins and other large molecules. The interstitial fluid absorption capacity of these structures is facilitated by the overlapping walls. Increased interstitial pressure has been demonstrated to promote fluid entry, a process that is further facilitated by anchoring filaments that connect capillaries to surrounding tissues. Lymphatic capillaries are anchored in the surrounding tissue by extensions of fibroblastic cells that form type VII collagen fibres.

Furthermore, the lymphatic system plays a pivotal role in supporting skin immune functions by facilitating the transportation of immune cells, such as Langerhans cells, to lymph nodes for antigen presentation and immune response initiation. In the event of skin damage or infection, lymphatic vessels undergo dilatation, thereby facilitating the expeditious removal of pathogens and inflammatory products, thus supporting the processes of healing and regeneration [15].

Aesthetic and Therapeutic Effects of Facial and Body Massage

It has also been demonstrated that manual lymphatic drainage (MLD) can function as an effective supportive therapy in improving skin condition after invasive procedures such as liposuction.

The reduction of swelling and the improvement of interstitial fluid drainage are key factors in the treatment process. The application of MLD resulted in a significant reduction in subcutaneous tissue thickness, with an average decrease of 15.38%, thereby indicating effective fluid removal. This approach may be significant in the reduction of facial puffiness, which is often perceived as a hallmark of advanced SA, particularly in regions such as the periorbital and jawline areas.

The following improvements have been observed in relation to microcirculation and tissue nourishment: improved lymphatic flow has been demonstrated to positively impact skin health, contributing to enhanced oxygenation and nourishment of skin cells. This, in turn, results in healthier skin tone and increased firmness.

The hypothesis that there is potential for improvement in skin elasticity is supported by the following evidence: the reduction of cellulite and tissue tension has been demonstrated to have a positive effect on skin tightness, albeit indirectly.

Manual lymphatic drainage (MLD) has been identified as a valuable tool in the management of mature skin. The reduction of swelling, enhancement of microcirculation, and provision of a relaxing effect contribute to the delay of the manifestations of SA by improving its overall appearance and condition [16].

The impact of manual lymphatic drainage on skin elasticity and suprafascial fluid accumulation was analysed in patients diagnosed with lymphedema following breast cancer treatment. Participants were randomly allocated to one of three groups: the intervention group received fluoroscopy - guided MLD, the first control group received traditional MLD, and the second control group received placebo MLD. All patients also underwent decongestive lymphatic therapy (DLT).

Despite the fact that the study focused on patients with pathological limb swelling, the results suggest that manual lymphatic drainage, when used in isolation, may have a limited impact on the mechanical properties of the skin, such as elasticity. This is particularly the case in the context of therapy aimed at reducing post - traumatic or postoperative swelling.

From an anti - aging perspective, these results underscore the necessity to integrate lymphatic massage with other skincare strategies, such as physical activity, anti - inflammatory diets, or collagen stimulation, to achieve enduring enhancements in skin quality [17].

Non - Invasive Lymphatic Massage Techniques for Skin Rejuvenation and Anti - aging Support

It is imperative to acknowledge the existence of other lymphatic massage techniques that merit discussion. One such technique is Kobido massage, which is

also referred to as the “Japanese face - lifting”. This technique is considered to be an advanced manual technique that combines elements of deep massage, lymphatic drainage, acupressure, and lifting. The objective of this method is twofold: firstly, to enhance the aesthetic appearance of the skin; and secondly, to improve its condition by stimulating blood and lymph circulation, thus retarding the progression of age - related processes.

A study was conducted to evaluate the effectiveness of Kobido massage elements in anti - aging prophylaxis and relaxation. The results demonstrated that regular utilisation of this technique resulted in enhanced skin appearance, facial muscle relaxation, reduced tension, and improved blood and lymph circulation in the head area. The most frequently observed effects included a reduction in tension, a smoothing of facial skin folds, and changes in facial contour. The results obtained were consistent with the expectations of the majority of participants, thus suggesting that Kobido massage may be an effective method for improving facial skin appearance and a safe alternative to surgical lifting.

The Kobido technique incorporates a range of movements, including stroking, rubbing, kneading, tapping, vibrations, and acupressure. Lymphatic drainage is of particular importance, and gentle movements are employed to support lymph flow and reduce swelling. This contributes to improved skin tightness and a healthy appearance. The initial phase of the procedure entails the clearance of the primary lymph nodes, subsequently followed by the stimulation of lymphatic flow towards the venous angles. The technique of rubbing is performed in a spiral motion on the axillary nodes, supraclavicular fossae, neck, and submandibular areas.

The regular practice of Kobido massage has been demonstrated to result in a number of notable benefits for the skin, including enhanced elasticity, a reduction in the appearance of wrinkles, and a lifting effect on the face. This suggests that it could present an appealing alternative to more invasive aesthetic procedures [18].

Lymphatic massage is also present in endermology, a non - invasive mechanical massage technique combining vacuum suction, mechanized rollers and/or flaps, and principles of mechanotransduction to stimulate the skin and subcutaneous tissues. Endermology has been demonstrated to induce a range of beneficial biological changes. The mechanism of action of this treatment

is through mechanostimulation, which activates fibroblasts, remodels the extracellular matrix, increases adipocyte sensitivity to fat release, and improves venous - lymphatic circulation. The aforementioned effects contribute to improved microcirculation, antifibrotic properties, increased skin elasticity, fluid drainage, and pain relief.

This technique has gained recognition as a non - invasive procedure that improves skin aesthetics and supports microcirculation and lymphatic drainage, directly affecting the appearance and condition of facial and body skin.

Regular tissue stimulation has been demonstrated to result in a number of beneficial effects for the skin, including improved tone and reduced swelling. In addition, it has been shown to enhance skin elasticity and to reduce muscle tension. These effects are of particular importance in the prevention of SA signs, as they help maintain firmness and a healthy appearance without the need for invasive procedures.

It can thus be posited that endermology should be regarded not solely as a constituent of medical therapy, for example in cases of lymphatic oedema, but also as a efficacious method of supporting anti - aging prophylaxis through natural skin activation and improvement of its biological functions. The potential for this therapy as an adjunctive treatment in various medical and surgical specialties, as well as its efficacy as an aesthetic procedure, is demonstrated [19].

Synergy of Physical Activity and Lymphatic Massage

The combination of facial massage and physical activity has been demonstrated to be an effective method for supporting a youthful appearance of the skin. The rationale underpinning this effect is that physical activity improves circulation and tissue elasticity, which in turn has a positive effect on the appearance of the skin [13].

The application of lymphatic massage in conjunction with judiciously selected physical activity has been demonstrated to markedly enhance regenerative processes and optimise the functionality of the lymphatic and circulatory systems. A study conducted on mixed martial arts (MMA) athletes demonstrated that the implementation of physical lymphatic drainage methods, including manual lymphatic drainage

(MLD), Bodyflow, and deep oscillation drainage, resulted in a substantial reduction in muscle fatigue, a decrease in muscle tension, and a decline in lactic acid levels following periods of strenuous physical exertion.

The underlying mechanism of this phenomenon involves the stimulation of lymph and blood flow in tissues, thereby facilitating the expeditious removal of metabolic by - products, toxins, and inflammatory mediators that are produced during periods of physical exertion. The enhanced lymphatic drainage process has been demonstrated to result in a reduction in swelling and decreased inflammation, thereby facilitating expedited regeneration of muscle microtraumas and diminished tension. Furthermore, lymphatic massage has been demonstrated to enhance the elasticity of the skin and subcutaneous tissue, a property that is crucial in the retardation of visible signs of aging.

Conversely, physical activity exerts a synergistic effect by augmenting the intrinsic muscle pump that facilitates lymphatic flow and enhances tissue perfusion. Regular exercise has also been demonstrated to contribute to the enhancement of cellular metabolism and the improvement of vascular condition, both of which are essential for effective body detoxification and the maintenance of healthy, firm skin.

A significant aspect pertains to the regularity and personalised adaptation of both physical activity and lymphatic massage treatments. The attainment of optimal results is contingent upon the systematic application of both methods, with a concomitant tailoring to the individual's needs, taking into account their health condition, activity level, and personal physiological responses.

In conclusion, the synergistic combination of lymphatic massage with physical activity constitutes an effective strategy in physioprophylaxis and cosmetology, supporting not only accelerated muscle regeneration and swelling reduction but also improving skin elasticity, tone, and overall well - being, thus contributing to the delay of aging signs [20].

Applications in the Clinical Field and Rehabilitation

A study was also conducted, which demonstrated that combining manual lymphatic drainage (MLD) with targeted rehabilitation provides significant benefits in restoring upper limb function in patients following

modified radical mastectomy. In comparison with the group that received only standard functional exercises, the group that received MLD in conjunction with rehabilitation therapies exhibited significant improvements in shoulder joint range of motion and a reduced drainage period of the chest wall.

The mechanism of MLD action is based on the stimulation of lymph flow, which contributes to the reduction of swelling, the elimination of toxins, and the improvement of circulation. Conversely, targeted physical activity has been shown to support natural muscle function, thereby enhancing lymph and blood flow and accelerating tissue regeneration. The combination of these two methods results in a more effective body detoxification process and an improvement in skin elasticity and tone.

In the context of physioprophyllaxis and cosmetology, regular use of MLD combined with individually tailored physical activity may be an effective strategy for delaying SA signs and improving overall well-being. It is imperative that interventions are adapted to the individual needs of patients in order to ensure optimal outcomes [21].

Limitations of Current Research

Despite the growing number of studies indicating the beneficial effects of physical activity and lymphatic massage on skin condition and anti-aging processes, the current state of knowledge has significant limitations. Many studies are based on small sample sizes, and there is a lack of long-term observations that would allow for an assessment of the durability of the obtained effects. Additionally, the heterogeneity of research protocols - including variations in exercise intensity, massage techniques, and diagnostic tools - hinders direct comparisons and the formulation of definitive conclusions. Further well-designed randomized controlled trials are needed to clearly determine the mechanisms of action and the effectiveness of these non-invasive strategies in supporting the delay of SA processes.

CONCLUSIONS

SA is a complex process involving both intrinsic and extrinsic factors. Regular physical activity and lymphatic massage have been shown to effectively delay signs of SA. Physical exercise improves microcirculation, stimulates collagen production, reduces oxidative stress

and enhances skin regeneration. Lymphatic massage promotes lymph flow, reduces edema and improves deep tissue tension, contributing to enhanced facial contour and skin firmness. The combination of these methods represents a valuable non-invasive approach for maintaining youthful skin appearance. These findings justify incorporating both physical activity and lymphatic massage into anti-aging skin care programs. However, further research is needed to better evaluate the long-term effects of these interventions.

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