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Case Study

Application of Non-Injection Redermalization in Cosmetic Procedures for Aging Facial Skin and Effects on Human Well-Being

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ABSTRACT

Skin aging not only affects physical appearance but also causes psychological stress, which affects human well-being. Therefore, many anti-aging strategies have been developed and proposed, especially in recent times, as the importance of aesthetics, interest in maintaining a youthful skin appearance, and the growth of the elderly population are driving the demand for skin regeneration and rejuvenation products and services. One of the fast-growing antiaging cosmetic procedures is redermalization, which can be defined as the rejuvenation, restoration or regeneration of aging skin, which is supported by the acids used during redermalization procedures (a combination of hyaluronic acid and succinic acid), which activate fibroblasts responsible for collagen fiber synthesis and the production of growth factors such as TGF-β, improve microcirculation, and stimulate skin renewal and tissue reconstruction processes. The study is conducted to determine the effect of non-injection redermalization cosmetic procedures on aging skin and human well-being, based on a specific case study. In the research, the aging skin problem of the study participants was defined and considered a separate case, studied to develop a comprehensive, holistic understanding of the specific phenomenon in the given context. The study results showed improvement in the specific participant's facial skin aging issues, with decreased dehydration and wrinkle depth, and an overall improvement in the condition and appearance of the facial skin. The research participant felt rested, positive, and self-satisfied. Social characteristics also changed; the research participant felt able to control her time and achieve her goals, which improved communication with work colleagues, friends, and family. Non-injectable redermalization cosmetic procedures, based on a single, specific case study, have a positive effect on aging skin and human well-being.

INTRODUCTION

Skin aging is a process caused by both internal (chronological) and external (environmental) factors (1). It involves the loss of collagen and elastic fibers in the dermis, as well as fibroblast dysfunction, resulting in thinning of the epidermis. These changes impair skin integrity, skin moisture retention, wound healing, and sensory and immune function (2, 3). According to the authors' systematic analysis, external skin aging (photoaging), which is primarily influenced by external factors (80% of which are caused by UV radiation, smoking, and pollution), is the primary indicator of skin cancer risk factors. According to the authors, exposure to UV radiation can disrupt local and systemic human homeostasis (1). UV radiation (especially UVA and UVB) is the main source of photoaging, which is also one of the factors that regulate the skin's neuroendocrine system (1).

A healthy epidermis involves communication with the central nervous and endocrine systems in regulating local and systemic homeostasis (4, 5). The entire neuroendocrine system has a profound effect on psychological state – hormonal changes can affect mood, emotions, and behavior (6). Stress increases inflammation in the skin, and inflammation in the skin leads to underlying mental or neurological conditions such as depression, anxiety disorders, etc. (7). The synergy between physical and mental health creates a strong sense of self-confidence, and a healthy appearance not only increases self-esteem but also improves social interactions (8). The relationship between psychological stress (hormone imbalance) and skin aging is often discussed in the literature (9). Skin aging causes stigma, which can further increase psychological burden, creating a vicious circle of psychological stress; stress affects skin aging, while aging skin causes psychological stress (5). Overall, skin aging is a complex process that significantly affects not only physical appearance but also overall health and well-being (10, 11).

Studies of psychotherapy focused on stress reduction, such as mindfulness-based art therapy, mindfulness meditation, and cognitive behavioral therapy, have been shown to reduce cortisol levels, a stress hormone (12). A study by Rogerson et al. found that mindfulness and relaxation interventions were most effective in changing cortisol levels (13). Patients use cosmetic procedures not only to improve their physical appearance, but also to improve their self-esteem and self-confidence, which overall improves their quality of life (14). Skin health is considered one of the primary factors influencing people's well-being and health awareness, and therefore, many anti-aging strategies have been developed and proposed (15). According to the authors, especially in modern times, the importance of aesthetics, interest in maintaining a youthful appearance of the skin, and the growth of the elderly population are driving the demand for skin regeneration and rejuvenation products and services. Although aging is a natural, genetically determined phenomenon, various authors highlight the main cosmetic aspects to improve the condition of skin affected by stress and aging (2, 15, 16):

- SPF filters that protect against UV rays;
- Antioxidants (polyphenols, peptides, vitamins (especially C and E));
- Hardware (lasers, radio frequency, HIFU, LED, microneedle therapy);
- Retinoids;
- Exosomes, mesenchymal stem cells;
- Hyaluronic acid and Botox injections;
- Chemical peeling (glycol, amber, milk, trichloroacetic acid peels).

In the context of regenerative procedures and skin rejuvenation, the goal of anti-aging therapies is to eliminate or slow down the signs of skin aging, including wrinkles, loss of elasticity, pigmentation changes, and skin thinning, by restoring damaged skin through the stimulation of collagen fiber production (15). Collagen fibers are densely arranged in the dermal layer and are produced by the main cells in the dermis – fibroblasts (17). Fibroblast activity and collagen synthesis decrease with age. When hyaluronic acid enters the dermis of aging skin, nearby fibroblasts morphologically stretch and activate extracellular matrix components, including new collagen (18) and fibroblast-produced signaling molecules, such as TGF-β, whose expression induces tissue reconstruction (19). In 2008, Kerscher proposed the term “skin-boosting” to emphasize that hyaluronic acid injection into the dermis focuses on stimulating the natural regenerative processes of the skin and improving and restoring skin quality (18). Hyaluronic acid directly activates fibroblasts via receptor-mediated mechanisms, promoting their migration and proliferation, stimulating the production of type I and III collagen, and participating in tissue repair, thereby effectively improving skin hydration and texture (2, 15, 20).

One of the rapidly growing anti-aging cosmetic procedures is redermalization, a procedure in which a special solution containing a combination of hyaluronic acid and succinic acid (in cosmetics most commonly used as sodium succinate) is injected into the skin (21). Succinic acid is a strong biological antioxidant (20, 22, 23), which also contributes to the activation of anabolic processes in the skin, including the synthesis of structural skin proteins (collagen and elastin) and ATP, as well as normalization of microcirculation in the skin (19, 21). Combinations of hyaluronic and succinic acids have solid scientific support, confirming good tolerance and their anti-aging properties. They accelerate skin renewal, help restore normal skin hydration, normalize pigment formation, stimulate fibroblast proliferation, enhance the synthesis of collagen and elastin fibers, and improve microcirculation (24-26).

In a study by Dynnyk and colleagues, the effects of three redermalization treatments on dermal thickness and elasticity were evaluated in seven participants. The results showed that dermal thickness remained unchanged after the treatments, while dermal elasticity significantly increased (22). Romashkina et al. described the process of skin restoration in atopic dermatitis, where a course of three redermalization procedures was performed every 2 weeks, observing skin regeneration in atrophic scar areas, improved skin turgor and elasticity, and reduced severity of hyperpigmentation (20). Later research by the same group demonstrated

positive effects during remission in patients with rosacea, accelerating regeneration and restoring normal hydration and microcirculation (26). Kachuk conducted a course of eight body micro-needle redermalization procedures every ten days, reporting clinically significant improvements in all patients, including increased skin elasticity, hydration, and a visible reduction in the number of stretch marks (27). Snarskaya et al. reported that a transdermal course of four micro-needle therapy redermalization procedures, administered at four-week intervals, was highly effective and safe for treating atrophic acne scars of varying severity (28). In the study by Ponomarenko and Kovalenko, a 2–6-week course of redermalization was administered for neurotrophic ulcer defects, resulting in complete defect healing in all 25 cases (19). No scientific literature was found on the effects of non-injectable redermalization.

The term "redermalization" is rarely analyzed in the scientific literature. The prefix "Re-" comes from Latin, meaning "again", "back" or " repeated", signifying repetition or the recurrence of a process (29). The root "Derma" is a Greek word meaning "skin" (30). The suffix "-lization / -ization" is an English verb or process suffix, denoting an action, state, or process (31). Based on the etymology of the term and previously analyzed authors concerning skin processes, redermalization can be defined as the rejuvenation, restoration or regeneration of aging skin, which is supported by the acids used during redermalization procedures, which activate fibroblasts responsible for collagen fiber synthesis and the production of growth factors such as TGF-β, improve microcirculation, and stimulate skin renewal and tissue reconstruction processes (2, 15, 17-25).

MATERIALS AND METHODS

The study was conducted to determine the effect of non-injection redermalization cosmetic procedures on aging skin and human well-being, based on a specific case study. The method of criterion selection was employed to select subjects suitable for the research problem, in accordance with the criteria established by the researcher (32). In the research, the subject's aging skin problem was defined and considered a separate case, studied to develop a comprehensive, holistic understanding of the specific phenomenon in the given context (33). Other case studies have shown the importance of similar studies (34, 35). Thus, due to the individuality of specific cosmetic procedures, one research participant (n=1) was selected according to the following criteria: gender: female; age: 44 years; skin type: dry; phototype: II; skin condition: dehydrated.

Study participant: 44-year-old woman who works at a computer, spends leisure time outdoors, walking in the park or by the sea, and riding a bicycle. She reports no health complaints but states that stressful situations at work occur frequently. She feels tired and has a reduced desire to communicate with colleagues during breaks, and also notices a change in her skin condition – increased skin dryness and deepening wrinkles. In her daily home care routine, she uses a moisturizing cleanser, a day cream containing grape seed and avocado oil, and a night cream with grape seed and evening primrose oil. Grapeseed oil is rich in unsaturated fatty acids, antioxidants, and anti-inflammatory substances, which is why products containing this active ingredient improve skin hydration, reduce inflammation, and provide a protective effect against environmental factors (36). It has been proven that all oils, in general, are occlusive ingredients in cosmetics, resulting in a reduction in transepidermal water loss (TEWL) and an increase in the moisture content of the epidermis (37).

According to the manufacturer's protocol, a course of 4 non-injection redermalization procedures is recommended every 10-14 days. Before each procedure, skin condition parameters (moisture and sebum level, wrinkle depth) were measured with a diagnostic device. Each procedure is performed in stages - at the beginning, the skin is prepared by cleansing with a foaming facial wash, toning with a product that removes excess sebum, enhancing the penetration of subsequently applied active ingredients; a non-injection redermalization complex, which consists of 8% glycol, 5% amber, 5% mandelic acids and 3% L-arginine, is kept for 3-6 minutes (exposure time increased by 1 minute during each subsequent session) and washed off

with water; neutralization of acids with a special product; application of a concentrate with hyaluronic acid, d-panthenol and acerola bioenzyme; completion of the procedure with a restorative cream. After each treatment, the study participant used her regular skin care routine at home to obtain the most accurate results of a course of non-injectable redermalization procedures. According to various authors (8, 38, 39), after a course of procedures, the research participant was asked three questions related to changes in skin condition and psychological well-being:

1. Have you noticed changes in the condition of your skin after a course of procedures? If yes, which ones?
2. Do you feel changes in your emotional state after the course of procedures? If yes, which ones?
3. Have your social qualities improved, such as self-confidence, desire to communicate, etc.?

Often, people first pay attention to the condition of their skin, which is based on their self-confidence (39). The condition of the skin has an impact on a person's self-esteem and interpersonal relationships (38).

RESULTS

The study results are based on a single-case analysis, with the aim of developing a comprehensive and holistic understanding of a specific phenomenon in a given context. To determine the effect of non-injection redermalization cosmetic procedures on aging skin and human well-being, a course of four procedures is performed every 10-14 days.

The first procedure begins with collecting data on the use of cosmetics at home, lifestyle, and health status. After the oral survey, the condition of the skin is assessed based on the data from the skin diagnostic device. Before the first procedure, the skin type of the research participant is determined as dry by evaluating the level of skin sebum in the T and U zones. Skin phototype according to the Fitzpatrick scale – II. The moisture level of the skin in the T and U zones was assessed as dehydrated (respectively in the T zone 35%, in the U zone 43%), when according to the scale of the diagnostic device, the skin moisture level is evaluated as very dehydrated when it's $\leq 33\%$, dehydrated when it's $33\% < x \geq 66\%$ and normal humidity level when it's $66\% < x$. The condition of wrinkles is assessed as thin wrinkles at 26%, when, according to the scale of the diagnostic device, the condition of skin wrinkles is evaluated as thin wrinkles when it's $\leq 33\%$, medium when it's $33\% < x \geq 66\%$ and deep wrinkles when it's $66\% < x$. After the assessment of the skin condition, the procedure is performed according to the protocol.

Before the third procedure, the condition of the skin is re-evaluated using the data from the skin diagnostic device to evaluate the condition of the skin after two procedures. The moisture level of the skin in the T zone was assessed as dehydrated at 40%, while in the U zone, it was estimated at 55%. Wrinkle condition is rated as thin wrinkles at 25%. We noticed that after two non-injectable redermalization procedures, the skin's condition has improved, with a 5% increase in moisture level in the T zone and a 12% increase in the U zone. The depth of wrinkles has decreased by 1%. After the assessment of the skin condition, the procedure is performed according to the protocol.

One week after the course of four procedures, the condition of the research participant's skin was evaluated using data from the skin diagnostic device. This period was chosen because re-epithelialization occurs within 7-10 days (40). The moisture level of the skin in the T zone was considered dehydrated at 59%, but in the U zone, the moisture level reached the normal level at 74%. Wrinkle condition is rated as thin wrinkles at 23%. During the study, facial skin moisture indicators were measured in the T and U zones, and the changes in these measurements are presented in Fig. 1.

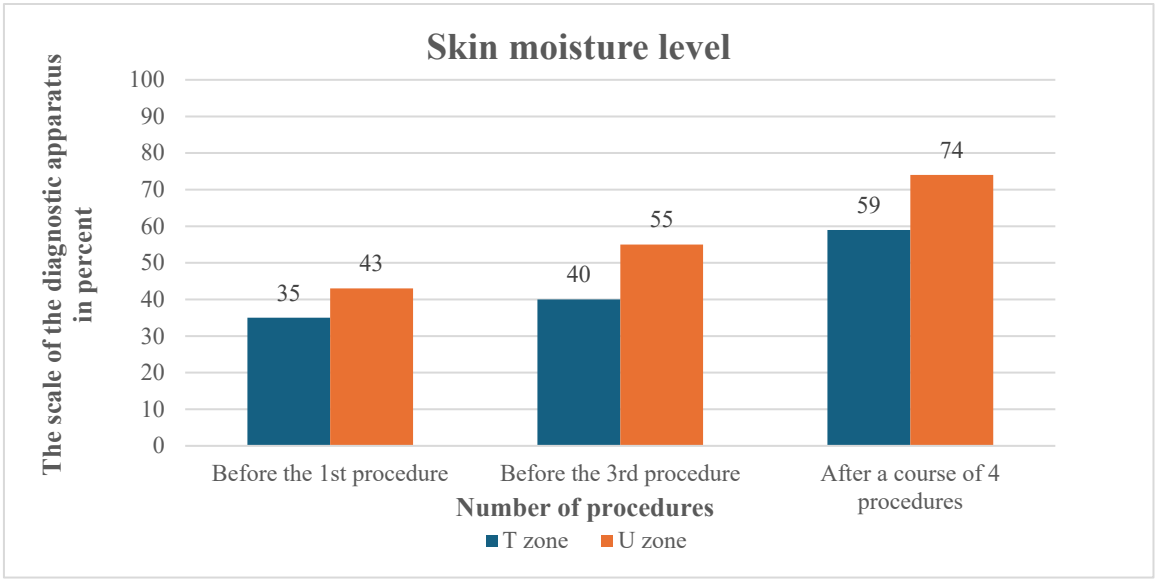

Fig. 1. *Changes in facial skin moisture levels.*
Source: compiled by the author based on the data from the diagnostic device

The level of facial skin hydration significantly increased with each procedure. It was determined that, following a course of four non-injectable redermalization treatments, facial skin hydration levels improved compared to those measured before the treatment course. Specifically, in the T-zone, hydration increased by 24%, rising from 35% to 59%. In the U-zone, skin hydration improved from a dehydrated state to normal, increasing by 31% from 43% to 74%.

The measures of facial skin wrinkles were also assessed during the study, with the changes illustrated in Fig. 2. When measuring changes in wrinkle depth, it is important to note that the lower the parameter, the better the results.

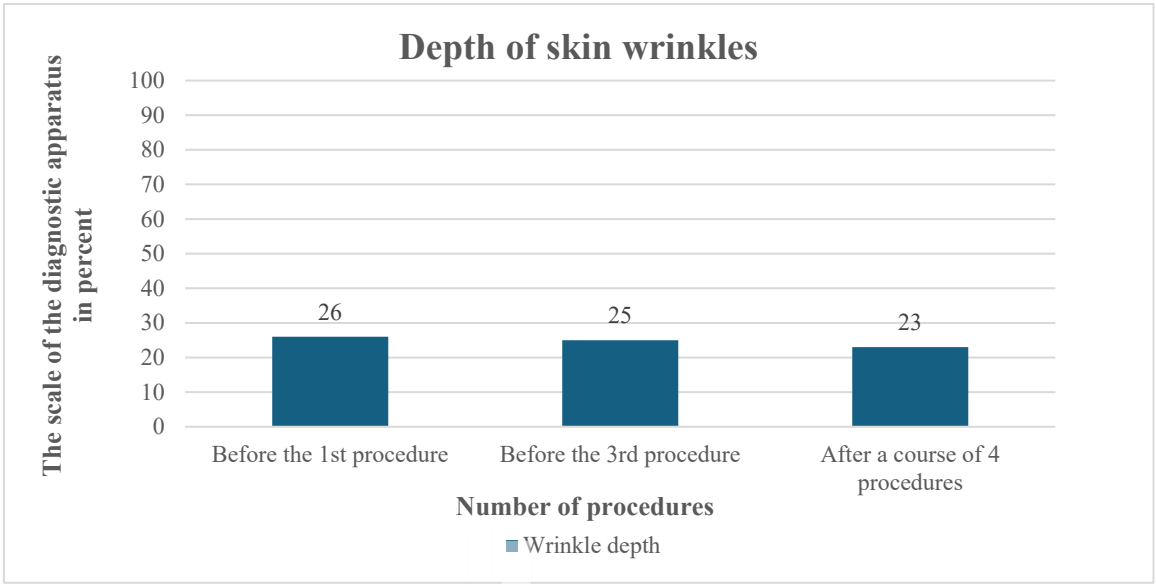

Fig. 2. *Changes in the depth of wrinkles in facial skin.*
Source: compiled by the author based on the data from the diagnostic device

The depth of facial wrinkles decreased significantly with each procedure. It was found that following a course of four non-injectable redermalization treatments, the depth of wrinkles improved by 3% compared to the depth measured before the treatment course.

This evidence demonstrates the positive effects of non-injectable redermalization on both skin hydration and wrinkle reduction, contributing to overall skin rejuvenation and improved appearance. After the procedure course, the research participant was asked three questions to determine how she evaluates changes in her skin condition and psychological well-being. The answers received are presented in Table I.

Table I. *Questionnaire after the course of procedures.*

Questions	**Answers**
Have you noticed changes in the condition of your skin after a course of procedures? If yes, which ones?	After three procedures, I noticed that the skin became clearer, with an impression of freshness and saturation with moisture. After the entire course of the procedure, the moisture saturation remained, the wrinkles at the outer corners of my eyes looked visually smaller, I needed less cream, and absorption was better.
Do you experience changes in your emotional state after undergoing these procedures? If yes, which ones?	After the treatments, I felt rested and positive, knowing I had taken time for myself, which gave me self-satisfaction.
Have your social qualities improved, such as self-confidence and desire to communicate?	After making time for myself, undergoing the procedures, and being able to plan work and rest time, I felt that I could control the actions for which I am responsible. A conscious choice of priorities determines not only a good feeling, but also the achievement of set goals. As a result, I can communicate well with colleagues at work and with friends and family when I can properly plan my rest and work time.

Source: compiled by the author based on the responses received

The study participant positively evaluated changes in skin condition and overall well-being following the course of procedures, noting both visible and psychological improvements. The skin appeared brighter, hydration levels increased, and wrinkle depth was visually reduced. After completing the treatment course, the participant reported feeling more rested and expressed satisfaction with the self-care and personal time dedicated to herself. Consequently, there was an increased willingness to engage socially and plan time for herself and others. These findings represent a single case study and are applicable on an individual basis.

DISCUSSION

The aging of the world population is one of the most important medical and socio-demographic problems globally (41). Nowadays, more public attention is being paid to healthy aging, which involves maintaining both physical and mental health as people age (42). Psychological stress is linked to oxidative stress, which damages skin cells and accelerates the aging process. Specifically, the production of collagen and elastin fibers decreases, resulting in less resistant and firmer skin, impaired immune function, and a decrease in the ability to retain moisture (1). One of the recommended anti-aging procedures is redermalization, which activates the skin regeneration, restoration, and repair process using a combination of hyaluronic and succinic acids (2, 15, 17-25). In the scientific literature, as described by the authors, the concept of redermalization is not widely

analyzed; the articles mostly explain it as a procedure rather than a process. Therefore, the presented concept of redermalization serves as a supplement to the existing theory.

A case study demonstrated that a course of non-injection dermal procedures improved the aging issues of the facial skin in a specific case, resulting in reduced dehydration and wrinkle depth, as well as a visually improved skin texture and appearance. The changes in skin condition were influenced by the non-injection redermalization procedure, which utilizes active ingredients including amber, glycolic, mandelic, and hyaluronic acids. The research participant positively evaluated the changes in her skin condition after the course of procedures: the skin was clearer, more moisturized, and "fresh", and the visual depth of wrinkles at the corners of her eyes had decreased. According to the manufacturer's recommendations, to further increase skin moisture, reduce the depth of wrinkles, and stimulate skin regeneration, the study participant was advised to extend the course with maintenance procedures once a month.

According to the authors Jarden and Roache (43), one of the most commonly cited definitions of well-being is: "Well-being can be understood as how people feel and how they function both on personal and social levels, and how they evaluate their lives as a whole." Summarizing the results of the questionnaire submitted during the study, it can be stated that after undergoing non-injectable redermalization procedures, the participant in the specific case study felt rested, her positivity and self-satisfaction increased, and she was happy to have time for herself. Social characteristics also changed - the research participant felt able to control her time and achieve her goals, resulting in improved communication with work colleagues, friends, and family.

Limitations

The study conducted is limited to a single study participant, whose skin aging issue is defined and considered a single case, studied to develop a comprehensive, holistic understanding of the specific phenomenon in the given context. The effectiveness of regenerative procedures may vary significantly depending on factors such as the severity of the patients' skin condition, individual genetic background, and general health status (15). The practical results of this study confirm that the effects of cosmetic procedures are individual and can be tailored to each case personally; however, it is recommended that future studies of non-injectable redermalization include a larger number of participants, considering each participant’s lifestyle, environmental, and other factors influencing the results to enable a systematic evaluation. It is also necessary to explain the concept of redermalization in more detail from a theoretical perspective and to continue studies that would demonstrate the process of dermal renewal as a redermalization process.

Despite several studies confirming that patients seek cosmetic procedures to improve psychological and emotional well-being, there is little direct evidence to show the extent to which cosmetic procedures improve these aspects (14). Currently, studies have shown the effects of injectable procedures and plastic surgery on skin condition and human well-being (44-46), but the effects of non-invasive cosmetic procedures remain underexplored. Further research is recommended to analyze the effects of non-injectable cosmetic procedures on human psychological state.

CONCLUSION

The analysis of scientific sources confirms that aging is an inevitable process in every person's life. It often increases stress and lowers self-confidence, but cosmetic procedures can be one of the reasons for improving self-view, increasing positivity, and well-being. Non-injection redermalization cosmetic procedures, based on a single, specific case study, have a positive effect on aging skin and human well-being. During the study, it was found that after the course of procedures, the moisture level of the research participant increased, the depth of wrinkles decreased, and the skin became clearer. In addition to skin changes, positive changes in emotional

state and social interactions were identified. The research participant noticed an increase in her positivity, pride in taking time for herself, improved ability to manage time, and a desire to communicate with family, friends, and colleagues at work. The conclusions obtained in the study are exploratory, specific to a single case, and therefore not generalizable.

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