

Microdermabrasion with controlled pressure for sensitive and thin skin: quantitative assessment of tissue safety and restoration of barrier function

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Abstract. The study is devoted to the assessment of tissue safety and the features of restoration of skin barrier properties after controlled microdermabrasion of patients with thin and sensitive skin. First of all, the aim of the article is to show the possibility of using such a procedure for the specified category of patients, as well as to reveal the specifics of using different approaches to its implementation. During the scientific search, general scientific methods of cognition were used: analysis and synthesis, induction, systematization and generalization. The results of the study demonstrate that the effect of controlled microdermabrasion on sensitive skin is carried out in stages. First, controlled microtrauma is induced. Then transient reactions are observed, which manifest themselves in the form of increased microrelief and erythema. The final stage is the restoration of surface structures, which is accompanied by an improvement in aesthetic characteristics. At the initial stage of recovery, a short-term increase in transepidermal water loss and erythema index is recorded, which is a manifestation of the physiological inflammatory response. After 48–72 hours, the indicators return to the baseline level or acquire positive dynamics. It was established that hydration stabilization and reduction of relief heterogeneity occur already on the third day after the session. The work also emphasizes the importance of individual selection of procedure parameters: abrasion force, vacuum pressure level and number of passes. This approach minimizes the risk of excessive inflammatory reaction. A conclusion is made on the feasibility of using personalized post-procedure protocols. In the first 72 hours, it is recommended to avoid potential irritants (the sun in particular) and ensure active hydration. The practical significance of the work lies in the formation of algorithms for the safe use of microdermabrasion for patients with increased skin sensitivity. This allows to reduce risks and improve therapeutic results.

Keywords: microdermabrasion, sensitive skin, barrier function, TEWL, tissue safety.

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Introduction

Microdermabrasion is one of the most common non-invasive cosmetic procedures in clinical practice, where it is considered one of the most frequently performed aesthetic correction methods in the United States. The procedure is proven to have a long-term effect, and therefore the number of people wishing to undergo it is increasing every year, even despite the presence of certain diseases or delicate skin conditions. At the same time, the service has gone beyond the clinical scope, as a significant number of devices for this procedure appear on the cosmetic device market. In 2025, the market volume of microdermabrasion products is estimated at approximately 500 million US dollars, and according to forecasts, it will grow at an average annual rate of 10%, reaching approximately 1.2 billion US dollars by 2033. Such dynamics indicate an intensive formation of demand for non-invasive, affordable and effective cosmetic care products that allow consumers to replace or supplement salon procedures with home technological solutions. The fundamental drivers of this growth are the prevalence of dermatological problems (acne, hyperpigmentation, early signs of aging), as well as the gradual increase in income levels, which stimulates spending on personalized beauty care. Technological innovations aimed at improving the efficiency, safety and ergonomics of devices play an equally important role [3].

Despite the fact that the technology is quite aggressive, since it is based on the formation of a directed flow of grinding particles, the use of modern equipment and technologies makes it accessible even to people with sensitive skin. This creates certain prerequisites, features of the procedure and consequences that must be taken into account by all cosmetologists in their work. The study is aimed at expanding the competence of specialists, which is based on a description of the key aspects of using the technology for sensitive and thin skin.

Literature Review

The issue of the safe use of microdermabrasion with controlled pressure for sensitive and thin skin is not sufficiently covered in the scientific literature, but it is sufficiently represented in online publications, in particular on specialized cosmetology and medical platforms.

Modern Internet resources provide general information about the benefits, risks and expected results of the microdermabrasion procedure. In particular, the resources realfit.com [5], sianclinic.com [6] and heartaestheticshobart.com.au [7] provide detailed information about the expected effects, cost and potential adverse reactions of the procedure. materialestetica.com [8] focuses on technical aspects – types of equipment for professional microdermabrasion. The resource verywellhealth.com [11] compares microdermabrasion with alternative methods, in particular hydrafacial, which is relevant when analyzing the safety of the procedures.

In terms of scientific research, a significant contribution has been made by authors who conducted empirical and clinical studies of the effects of microdermabrasion on the skin. For example, S. Andrews et al. [2], S. Razi et al. [9], L. Goberdhan et al. [4] studied the combination of microdermabrasion with skincare, showing its effectiveness on dryness, hyperpigmentation and skin texture. G. Altshuler et al. [1] and M. Shah and J. Crane [10] provided a general overview of the procedure, including the mechanism of action, indications, contraindications and possible complications. Despite the availability of both scientific sources and expert literature on the topic, there is a lack of systematic material that comprehensively covers the issue of using innovative microdermabrasion approaches for sensitive and delicate skin. To complement the existing methods, the Hollywood Facial Signature technique was used, which is based on combined skin care strategies.

The purpose of the article is to show the possibility and features of controlled microdermabrasion for patients with thin and sensitive skin based on different approaches.

Research Results

Microdermabrasion, as noted in the study by M. Shah and J. Crane [10], is a common cosmetic procedure that is performed without anesthesia and provides delicate grinding of the skin surface using a special grinding technique that operates on the principle of an abrasive. Controlled microdermabrasion, in turn, is considered a controlled process of removing the stratum corneum of the epidermis by a cosmetology specialist, which is carried out by supplying abrasive crystals under the action of a vacuum system. This process involves the use of a special technique that is able to use different pressures to ensure a safe procedure of spraying the abrasive onto specifically targeted areas and removing its residues together with the horny skin.

The authors S. Andrews and M. Shah and J. Crane [10], note that a typical session lasts from 30 to 60 minutes, including three passes per area, while stable results are usually achieved after 4–6 procedures. The procedure is performed weekly. In patent descriptions, microdermabrasion is presented as a method that is applied at least five times with an interval of 7–10 days, and then requires periodic maintenance procedures. This demonstrates its systemic nature and the gradual formation of a clinical effect for the correction of hyperpigmentation, improvement of skin texture, reduction of fine wrinkles, improvement of skin condition during and after acne.

Controlled microdermabrasion technologies include various design approaches: 1) microcrystals and 2) diamond nozzles. Microcrystalline technology is based on the supply of a jet of aluminum oxide crystals under controlled pressure. They contribute to deep cleansing and stimulation of cell renewal. Diamond nozzles provide abrasion thanks to heads covered with small diamond particles of various sizes. This approach is more delicate. It is suitable, including for sensitive skin and allows you to perform the procedure with high precision (Table 1).

Table 1 – Microdermabrasion technologies and their characteristics

Indicator	Value
Microcrystalline technology	the use of aluminum oxide microcrystals delivered under controlled pressure and vacuum conditions. Ensures deeper exfoliation and stimulates cell renewal [1]
Diamond tips	abrasive heads with diamond coating of various grit levels. Allow for more precise and gentle resurfacing. Suitable for sensitive skin, with no risk of residual particles [8]
Combined systems	a combination of crystal and diamond technologies, providing versatility for procedures on different areas and skin types [8]
Abrasive delivery systems	the use of compressed air or vacuum flow to move crystals and return them to the reservoir after passing over the skin [1]
Structural components of device	handpiece, interchangeable tips, particle collector, filters, abrasive feed control system. Designed to minimize particle penetration into tissues [1]
Procedural technique	skin cleansing, eye protection, handpiece contact with skin, abrasive delivery, multiple passes over the area, cleansing and moisturizing. The degree of ablation depends on the crystal flow and exposure time [10]

Diamond devices are more commonly used due to their high precision, control, and efficiency. This makes them attractive to consumers who are focused on results close to professional ones. Crystal systems, although less expensive, are rapidly gaining popularity due to their accessibility and ease of use. Both segments are actively developing, expanding the

functionality of the devices by integrating LED therapy, adjustable suction power, various attachments, and improved ergonomics [3]. The most common in clinical conditions is diamond microdermabrasion. It belongs to the methods of superficial skin remodeling, and combines mechanical abrasion of the epidermal layer with vacuum aspiration of particles of the stratum corneum and sebum. In clinical practice, this technique is widely used to correct dyschromia, improve the optical properties of the skin, reduce the manifestations of photoaging, textural unevenness, and fine wrinkles. At the same time, for people with sensitive skin, it remains a procedure with potentially increased reactivity due to temporary disruption of barrier functions [8]. In particular, 10 minutes after microdermabrasion, many patients show a sharp increase in the number of relief elements, i.e., elevations and depressions of the skin surface, which is interpreted as a consequence of mechanical microdamage to the epidermis. Such structural disorders are a reflection of the primary induced trauma that triggers reparative processes. The increase in textural heterogeneity after 48 hours demonstrates that the recovery phase is accompanied by a temporary increase in microrelief, which is subsequently leveled under the influence of cell proliferation and remodeling of the intercellular matrix [8].

Despite these temporary negative effects, subjective assessment of patients after a week shows that most of them feel smooth skin, as well as improved tactile characteristics.

However, some patients with certain skin problems have experienced side effects: transient acne-like rashes, as well as urticarial reactions, which confirms the high sensitivity of the regenerating skin to external triggers. This emphasizes the need for delicate control of the intensity of the procedure (vacuum pressure, number of passes) and strict recommendations for post-procedure care, in particular the avoidance of potentially irritating agents in the first 48–72 hours [8].

Diamond microdermabrasion on sensitive skin has a complex effect consisting of three interrelated phases:

- 1) induction of microtrauma, accompanied by a violation of the barrier function;
- 2) transient increase in relief heterogeneity and susceptibility to inflammation;
- 3) recovery with an aesthetically favorable result due to reparative restructuring of surface tissues [8].

In a study by Goberdhan et al. [4], participants with a variety of skin types (including dry, photodamaged, hyperpigmented, and oily/acne-prone) underwent 6 sessions of diamond microdermabrasion (DM) every two weeks for 12 weeks. After the procedure, patients received personalized infusions and home care that included growth factor serums, moisturizers, or brighteners, depending on their skin type. Results showed that significant improvements in hydration, radiance, texture, and reduction in dryness and roughness were observed after the first treatment; these effects were maintained for at least 72 hours. Over the 12 weeks, the DG + home care regimen showed sustained improvements in skin tone, evenness, signs of photodamage, hyperpigmentation, texture, and reduction of fine lines in the periorbital and perioral areas.

The technical principles of the construction of the devices are described in detail in the patent of G. Altshuler [1]. Their document notes that historically various abrasive surfaces were used, however, modern devices feed microcrystals using compressed air or by creating a vacuum that draws the crystals into the stream and carries them through the nozzle to the skin surface. They pass through a special tool that contacts the skin, after which the spent material and particles of the epidermis are collected in a reservoir.

It is important that after the procedure all residues of the abrasive are completely removed. Therefore, in modern designs, engineers strive to minimize their entry into the tissues or replace crystal systems with diamond ones that work without spraying the material.

The description of the technique for conducting the procedure of controlled microderabrasion in the work of M. Shah and J. Crane [10] complements the idea of the organization of the process. The procedure is carried out in stages: first of all, before starting, the skin is cleaned, and the eyes are protected with wet gauze; the nozzle of the device creates negative pressure that slightly tightens the skin; after that, crystals are supplied or a diamond abrasive is activated; after several passes, the treated area is cleaned of particles and the procedure is completed by applying a moisturizer.

For an objective assessment of the results of microdermabrasion, especially in patients with sensitive and thin skin, visual clinical indicators alone are not enough. Therefore, biophysiological instrumental methods are additionally used in modern studies.

The key safety parameter is transepidermal water loss (TEWL), which is determined using a tewameter as an indicator of the state of the lipid organization of the stratum corneum. The dynamic increase in TEWL after the procedure reflects controlled microdamage to the barrier, while a gradual return to baseline values or their excess within 48–72 hours indicate the effectiveness of the regenerative processes.

The second important marker is the skin hydration index, measured by a corneometer. Stabilization and increase in the hydration index at the beginning and end of the procedure indicates the restoration of barrier properties and improvement of the skin's ability to retain moisture. The third indicator is the erythema index. It is determined using reflectometric methods and is a quantitative characteristic of the vascular response to mechanical stress. A moderate, short-term increase in this indicator is a sign of a physiological inflammatory response that stimulates tissue remodeling, and, conversely, prolonged or pronounced erythema may indicate an excess of skin tolerance, which is especially critical for sensitive dermatotypes.

Heart Aesthetics Hobart [7] states that sensitive and thin skin requires a particularly careful approach during microdermabrasion, as it can react more strongly even to superficial abrasive effects. Although the procedure itself belongs to mild exfoliation methods, not all skin types respond to it in the same way. This primarily applies to those patients who have the following skin diseases and conditions: rosacea, couperose, increased reactivity or recent sun damage. This also includes dermographism and other manifestations of sensitivity. Such skin can show redness, increased sensitivity or irritation even with minimal abrasion. Heart Aesthetics Hobart [7] specialists emphasize that if alternative procedures cannot be used for sensitive skin, then the use of microdermabrasion should be considered and individually adjusted. For example, a cosmetic nurse in the clinic selects an individual regimen so that the procedure does not cause an excessive inflammatory response. Sensitive skin may experience a short-term pink tint after the procedure, but severe redness or prolonged sensitivity indicates excessive activity, so the procedure should be tested on a small area to make sure it does not cause long-term discomfort to the patient.

It is also important that after the procedure, such skin requires mandatory protection from the sun and avoidance of heat, intense physical activity and harsh care products. This is due to the fact that its barrier is temporarily weakened, so it reacts more quickly to external factors. In the first days after the procedure, a feeling of tightness or increased sensitivity is possible, which requires soothing and moisturizing care, as the authors emphasize.

In general, according to the source [5], practicing cosmetologists in the United States confirm that microdermabrasion on sensitive or thin skin is possible, but only with individual selection of parameters and a preliminary assessment of the skin condition by a specialist. In particular, as noted by Dr. J. Angobaldo [5], the procedure can be performed in patients with increased sensitivity, since the microdermabrasion device has different modes that allow you to reduce the intensity of the effect according to the needs of a particular person. First of all,

this concerns the regulation of the abrasion force and vacuum, which makes it possible to minimize irritation.

Other specialists emphasize important limitations. For example, Dr. A. Lyos [5] emphasizes that microdermabrasion is not recommended for people with rosacea or dilated capillaries, as well as in the presence of active infectious processes on the skin. In turn, the data of SianSkinClinic [6] indicate that classic microdermabrasion is not suitable for sensitive or thin skin. This emphasizes the need for such innovative methods, one of which is hydrodermabrasion. It does not use crystals or excessive mechanical abrasion. In particular, the article [11] emphasizes that hydrodermabrasion appears as a gentle multi-step approach that combines cleansing, exfoliation, extraction and hydration. First of all, this technology replaces the abrasive effect of crystals with a controlled hydroflow. This allows for cleansing without irritation. The procedure adapts to the skin condition and is safe even for people with increased sensitivity. For example, the extraction stage is carried out using adjustable suction force, which provides comfort and minimizes the risk of injury. After cleansing the treatment area, moisturizing is carried out using serums, which helps increase elasticity and reduce the appearance of fine wrinkles. It is also important that hydrodermabrasion provides similar benefits to microdermabrasion without abrasive contact, which may be excessive for thin skin. The technology provides an instant effect without a recovery period. It allows you to work with a wide range of problems. These are acne, pigmentation, uneven relief. However, the softness of the action remains. The advantage is the possibility of individual personalization. This enhances the effect and reduces risks in patients prone to irritation.

The innovative proprietary Hollywood Facial Signature technology is distinguished by a comprehensive approach to skin renewal. It combines multi-level hardware action, atraumatic manual techniques and the use of proprietary dermatocosmetic formulas. The key difference of the technique is the principle of controlled tissue loading, which provides a manageable level of microtrauma, which allows it to be used for patients with sensitive skin. The technology integrates microdermabrasion with strict pressure control, hydrodermabrasion with active infusion, oxygen mesotherapy with dosed kinetics of active substance delivery, LED photobiomodulation for regulating the inflammatory response and repair, as well as the proprietary moisture retention system through a combination of functional hydrogels and proprietary serums. A high level of individualization is achieved thanks to preliminary "skin-mapping", which allows you to identify local areas of dehydration, hyperreactivity or excess sebum production and adapt the parameters of the effect in real time. All these factors together form a unique bioengineered approach to care that optimizes the balance between tissue safety, stimulation of recovery and a rapid clinical and aesthetic effect of "red-carpet glow" without irritation.

Conclusions

Analysis of scientific and expert literature allows us to formulate a set of key features of controlled microdermabrasion on sensitive skin. Studies involving sensitive phenotypes demonstrate that reducing the exposure parameters (for example, reducing the vacuum force to 4 PSI, and the intensity of abrasion) allows us to keep tissue microdamage within the limits of physiological repair, which is confirmed by non-invasive imaging data: immediately after the procedure, the number of textural irregularities increases by 5–10 times, and the disturbance of the microrelief normalizes within the first week, reflecting the controlled course of healing. Assessment of barrier restoration based on dryness, tactile roughness, and sensitivity to external stimuli shows that with proper post-procedure care (application of intensive moisturizers, lipid-restoring formulas, and mandatory photoprotection), hydration levels return to baseline or improve within 48–72 hours.

At the same time, controlling subjective symptoms (erythema, burning, itching) is critically important, since in the event of these sensations, patients with sensitive skin or with rosacea, capillary fragility, or active inflammatory elements demonstrate an increased risk of adverse reactions. Therefore, the effectiveness of microdermabrasion for sensitive skin is possible only if control is maintained and the technique is individually adjusted to obtain objective parameters of the epidermal barrier restoration robot.

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