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# Phonophoresis with hyaluronic acid and laser technologies in correction of skin involution

© ZH.YU. YUSOVA, E.L. BARANOVA, D.V. DEMIDION, L.S. KRUGLOVA

Central State Medical Academy of Administrative Directorate of the President of the Russian Federation, Moscow, Russia

**ABSTRACT**

**Objective.** To study fractional selective ablative laser in various modes and their combination with phonophoresis with hyaluronic acid in correction of skin involution.

**Material and methods.** The study included 68 patients with skin involution aged 39-59 years. Patients were divided into 2 groups: group A included 36 patients who received fractional $CO_2$ ablative exposure procedure once, group B — 32 patients who underwent 6 phonophoresis procedures with hyaluronic acid and subsequent fractional $CO_2$ ablative exposure procedure. The outcomes were evaluated after 2 and 6 months.

**Results.** Phonophoresis with hyaluronic acid combined with fractional $CO_2$ ablative exposure significantly improved skin texture, its qualitative characteristics and morphological parameters compared to laser monotherapy. Qualitative characteristics of skin after 6 months showed more stable results after combined correction of skin involution.

**Conclusion.** We revealed higher efficiency of combined method of phonophoresis with hyaluronic acid and fractional $CO_2$ ablative exposure compared to laser monotherapy regarding improving the morphological properties of skin.

***Keywords:*** *laser, phonophoresis, hyaluronic acid, skin involution.*

**INFORMATION ABOUT THE AUTHORS:**
Yusova Zh.Yu. — https://orcid.org/0000-0001-6452-2914; e-mail: zyusova@mail.ru
Baranova E.L. — https://orcid.org/0000-0002-6807-3850; e-mail: baranova@premium-a.ru
Demidion D.V. — https://orcid.org/0000-0002-5901-4250; e-mail: diana@premium-a.ru
Kruglova L.S. — https://orcid.org/0000-0002-5044-5265; e-mail: kruglovals@mail.ru
**Corresponding author:** Baranova E.L. — e-mail: baranova@premium-a.ru

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## Introduction

In modern aesthetic medicine, laser technologies are an integral part in correction of skin involution [1, 2]. Currently, technical solutions in laser technologies make it possible to obtain obvious clinical effect with minimal side effects [3–5]. Patients in aesthetic medicine desire a short-term rehabilitation and safe procedure, as well as stable and clear results. Laser ablation procedure is a destructive method of correction. This exposure is followed by rejuvenation of dermis, mainly superficial layers [6, 7]. Rejuvenation of cellular structures depends on aggressiveness of impact and regenerative potential of dermis. Skin dehydration is one of the key factors of recovery period, since intercellular interactions including restructuring interactions occur only in sufficient amount of hyaluronic acid [8, 9]. One can deliver hyaluronic acid using injections and phoresis without violation of skin integrity.

Ultrasonic factor is a distinctive feature of phonophoresis [10, 11]. There are several mechanisms of the impact of ultrasound on the body (mechanical, thermal, physicochemical, neuro-reflex) [12]. Ultrasound increases blood circulation and cellular metabolism. Thermal effect accelerates enzymatic activity inside tissues while thermal energy is more absorbed by structures depleted in blood flow and enriched by collagen fibers. In addition, lipid oxidation is accelerated; work of mitochondrial structures is improved. Physical and chemical processes in tissues are stimulated. All these processes accelerate tissue repair.

Combined methods are promising to minimize inflammatory component when using laser exposure and accelerate recovery process. Thus, phonophoresis with hyaluronic acid combined with laser ablation is aimed at improving the qualitative characteristics of superficial and deep layers of skin due to higher reparative properties of skin and faster recovery period.

The purpose of the study was to study fractional selective ablative laser in various modes and their combination with phonophoresis with hyaluronic acid in correction of skin involution.

## Material and methods

The study enrolled 68 patients aged 39–59 years with skin involution. All patients were divided into 2 groups depending on treatment strategy. Group A included 36 patients who received a single fractional $CO_2$-ablative treatment (wavelength 10.6 μm) via the AcuPulse laser system (Lumenis, Israel) using the AcuScan120 microscanner in Deep mode (laser beam focus spot size of 120 μm). Group B included 32 patients who underwent combined ther-

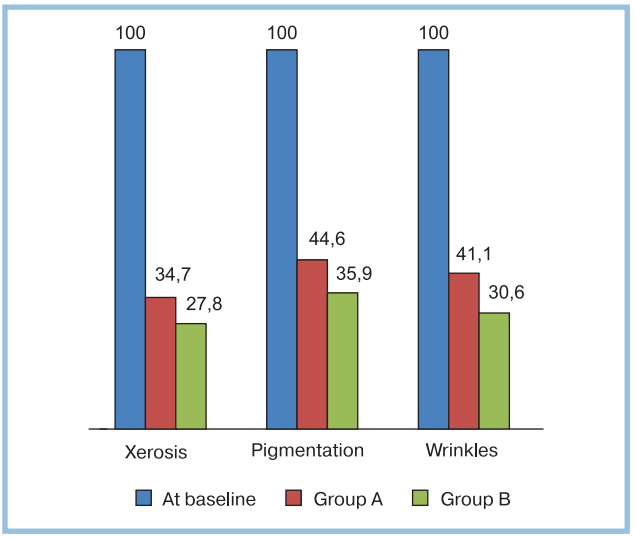



***Fig. 1.*** **Indicators of superficial epiluminescence dermatoscopy for 2 months after treatment.**

apy of 6 geneO+ phonophoresis procedures with a frequency of 1 MHz and a power of 0.2–0.4 W/cm$^2$ in labile continuous technique with a gel containing sodium hyaluronate 1% (molecular mass of 1550 kDa, pH 5.0–6.0). Phonophoresis was followed by fractional $CO_2$-ablative treatment.

To objectify scientific data, we used superficial epiluminescence dermatoscopy (FotoFinder and Antera 3D™ equipment) with image saving, as well as ultrasonic sonography to assess skin morphology (50 MHz transducer (central frequency)). We used mean indicator (right and left sides, symmetrical dots) obtained by using of ultrasonic scanner Dub Cutis 22–75 (TPM, Germany). The results were evaluated 2 and 6 months after treatment.

## Results and discussion

Fractional ablative photothermolysis ($CO_2$ laser system in a Deep mode) resulted positive changes after 2 months in all patients of group A. Indeed, xerosis decreased by 65.3%, pigmentation — by 55.4%, wrinkles — by 58.9%. Phonophoresis with hyaluronic acid combined with fractional ablative photothermolysis was followed by more pronounced clinical changes in group B after 2 months: xerosis decreased by 72.2%, pigmentation — by 64.1%, wrinkles — by 69.4% **(Fig. 1)**.

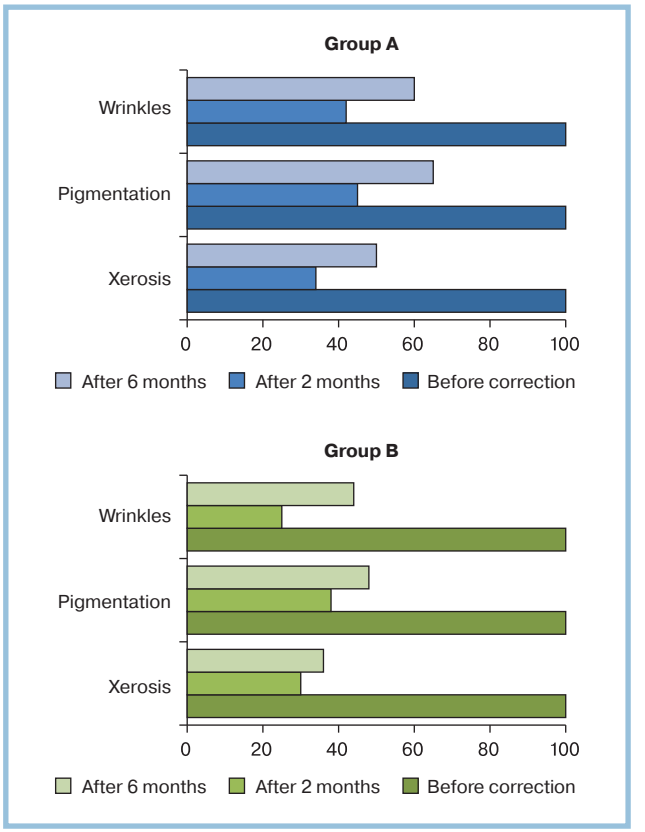



***Fig. 2.*** **Indicators of superficial epiluminescence dermatoscopy for 6 months after treatment.**

After 6 months, these indicators decreased in both groups. However, clinical results tended to be more obvious after combined correction **(Fig. 2)**.

Epidermal thickness reflects desquamation disorders and dyskeratosis phenomena (seborrheic keratoma, actinic keratosis) to a greater extent. There were no signs of abnormal hyperplasia of the growth zone (lower layers) before therapy. After 2 months, there was a positive trend in mean epidermal thickness in all groups. A more significant decrease in epidermal thickness was observed after phonophoresis with hyaluronic acid combined with laser therapy. These results may indicate restoration of functional parameters of epidermis. The last ones directly depend on restoration of qualitative characteristics of skin and functioning of dermis (trophic function).

Thickness of dermis increased by 5.7% in 2 months after laser therapy in Deep mode. Combined therapy (phonophoresis with hyaluronic acid and laser exposure)

**Ultrasound examination of skin**

| Group | Deformation coefficient | | Thickness of epidermis | | Thickness of dermis | | Ultrasonic dermis density | |
|---|---|---|---|---|---|---|---|---|
| | before correction | after correction | before correction | after correction | before correction | after correction | before correction | after correction |
| A | 1.046±0.01 | 1.032±0.013<br>***p*=0.0031** | 84.14±1.22 | 79.52±1.03<br>***p*=0.0050** | 1503.71±19.18 | 1589.86±18.15<br>*p*=0.1886 | 28.26±1.71 | 35.33±2.72<br>***p*=0.0001** |
| B | 1.043±0.017 | 1.033±0.024<br>***p*=0.0001** | 81.76±0.53 | 80.00±0.34<br>***p*=0.0211** | 1310.76±16.97 | 1402.38±12.67<br>*p*=0.7803 | 23.80±1.90 | 27.38±1.53<br>***p*=0.0140** |

*Note. p* — comparison with indicators before correction (Wilcoxon test); significant changes are highlighted at *p-value*<0.05.

increased thickness of dermis by 7.02%. Dynamics of deformation coefficient (2–4%) was comparable in both groups **(Table)**.

We analyzed skin texture before and after correction using the Antera 3D imaging device. Skin texture index before correction was taken as 100 units in all patients. The most pronounced result was obtained after combined treatment (improvement by 15.7% throughout 2 months after procedure). After monotherapy with laser exposure, improvement after 2 months was 8.2% **(Fig. 3)**.

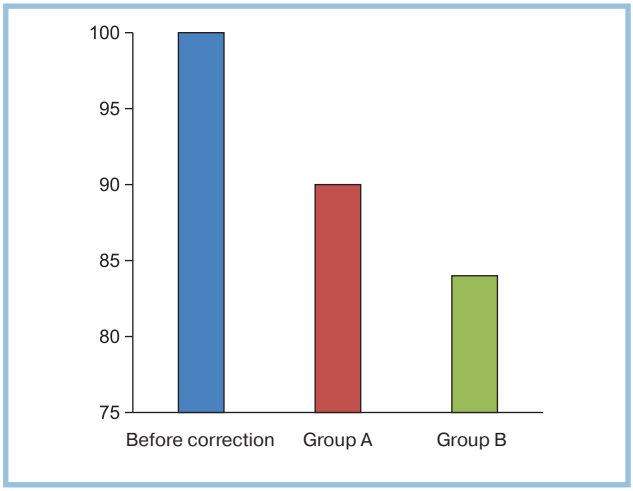



***Fig. 3.*** **Skin texture index in 2 months after treatment.**

## Conclusion

Our results revealed higher efficiency of combined therapy involving 6 procedures of phonophoresis with a gel containing 1% sodium hyaluronate and a single procedure of fractional $CO_2$-ablative treatment. Importantly, preparatory period combines not only delivery of hyaluronic acid to tissues, but also ultrasound therapy aimed at improving the trophic and metabolic functions of skin. This hich favorably affects recovery period after aggressive procedures and significantly improves clinical results in long-term follow-up period.

**No conflict of interests to declare.**

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