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Effect of Low Energy Far-Infrared Irradiation on Facial Skin for Healthy People

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Abstract

Objective: Utilizing VISIA skin tester to quantitatively evaluate the effect of low energy far-infrared irradiation on healthy people's facial skin. **Methods**: 60 volunteers were selected in hospital from September 2019 to June 2020, and the total score of face, skin spots, texture, wrinkles and pores were observed before and after low energy far-infrared irradiation treatment with VISIA skin tester. **Results**: After 2 weeks of low energy far-infrared irradiation treatment, the total skin score of volunteers increased significantly ($P < 0.01$). In the itemized statistics, the moisture value, stain value and wrinkle value increased significantly ($P < 0.05$). **Conclusion**: Low energy far-infrared irradiation can significantly improve the facial skin quality of healthy people.

Keywords

Low Energy Far-Infrared Face Irradiation, Skin Quality Improvement

1. Introduction

As the main barrier between the internal and external environment of human body, human skin is not only the largest organ of human body, but also the main organ of visible aging changes of human body. Its physiological characteristics and pathological changes often involve the influence of age, light, health status and other factors [1]. It is the public's unremitting pursuit to have a healthy, whitening skin that is commensurate with the physiological age. The study of skin texture has important aesthetic and clinical significance.

In recent years, with the rapid development of medical science and technology, the research on the improvement of skin texture by phototherapy becomes the center point. A certain band of the far-infrared light component can produce biological effects such as photothermal effect, promoting the remodeling of col-

lagen fibers, superficial spots, skin metabolism, and skin texture, therefore achieving the effect of brightening skin color [2].

In this study, we used low energy far-infrared light to irradiate human facial skin, and introduced advanced VISIA skin tester [3] to detect and analyze facial skin, and accurately evaluate the efficacy.

2. Materials and methods

2.1. General Information

60 volunteers from September 2019 to June 2020 were selected. Half of them are male and half are female, aged from 24 to 45 years old. The average age of male was 34.2 ± 3.7 years old, and the average age of female was 31.6 ± 4.2 years old. These volunteers were divided into three groups: Group A: low energy far-infrared radiation with mask; Group B: low energy far-infrared radiation without mask; Group C work as a control group, participants clean their face with water without any other interventions.

According to the comparison on the differences of ages and the states of facial skin of three groups of subjects, the differences had no statistical significance ($P > 0.05$), showing that the baselines of three groups of subjects were balanced and had comparability.

The ethical permission for this study has been approved by the Hospital Health Research Ethics Committee.

2.2. Exclusion Criteria

Patients with severe skin diseases on the face or undergoing other treatments; patients sensitive to light or taking photosensitive drugs in the past six months; patients with severe endocrine diseases or chronic diseases affecting their skin conditions (such as anemia, systemic lupus erythematosus, etc.); pregnant or lactating women.

2.3. Instruments and Materials

Graphene F.I.R heating facial mask (A new product from Grahope New Materials Technologies Inc. Hereinafter referred to as G-MASK), which can emit low-energy far-infrared light to irradiate human skin; VISIA skin tester (Shenzhen Yiyuan Intelligent Technology Co., Ltd.), which can use advanced optical imaging and software technology to detecte and analysis of epidermal spots, pores, wrinkles and skin texture, subcutaneous vascular and pigmented lesions, etc.; Medical facial mask (Guangzhou Chuang Er biotechnology Co., Ltd., batch number 1180716A).

2.4. Method

1) Before using the G-MASK, the volunteers removed all the cosmetics on their face, cleaned their face with clean water, wiped out the water and kept quiet for about 5 minutes. After the faces were clean and dry, volunteers used the vi-

sion skin detector to test the skin. During the detection, the room temperature was kept at about 22˚C and the relative humidity was about 50%. The facial image information (spots, wrinkles, texture, pores, etc) of the volunteers were obtained and analyzed.

2) The participants used G-MASK daily with the following steps: a) Routine cleansing of the patient for 5 minutes, wipe out the skin until the water became invisible; b) Lay on supine position, wear G-MASK (treatment group A should apply the facial mask beforehand); c) Turn on the G-MASK at mid-level for 20 minutes; d) After treatment, turn off the G-MASK (treatment group A should remove the facial mask beforehand), then massage the face and eye rim around gently for 2-3 minutes; e) Repeat the steps once a day, every 14 days will count as one treatment, after the treatment, the VISIA skin tester will detecte the skin status in the following 20 days.

3) Attention during the use of G-MASK: a) Clean the face with warm water at about 30˚C without soap, facial cleanser, shower gel and other irritant substances, and wash gently to avoid rough massage; b) Avoid spicy and irritant food, alcohol and tobacco; c) Participants need to keep a regular healthy schedule, do not stay up late; d) Pay attention to sunscreen and moisturizing.

4) Evaluate the use effect based on the result of VISIA skin tester.

5) Statistical analysis: SPSS 19.0 was used to analyze the data, and paired t-test was used for the observation indexes, $P < 0.05$ was considered as statistically significant.

3. Results and Analysis

3.1. The Improvement of Skin Appearance in Each Group before and after the Treatment

Self-evaluation or others' evaluation was used to observe the improvement of skin appearance before and after the experience. The results are shown in Table 1.

Regardless of self-evaluation group or evaluation by others group, the improvement rates of two G-MASK groups (a, b) were better than the control group (c). In addition, there were males in the G-MASK group whose skin color improved from dull to natural skin color, but none in the other groups. The test of G-MASK shows a good trend of skin improvement, which is mainly reflected in that the skin color of the test becomes ruddy and fair, and the wrinkles are reduced.

Table 1. The improvement of skin appearance in each group before and after the treatment (the third week after 2 weeks of treatment).

evaluation group	Self-evaluation		Evaluation by others	
	Feel better	No improvement	Feel better	No improvement
A	14	5	14	5
B	12	7	13	6
C	3	17	2	18

3.2. Evaluation of Curative Effect before and after Treatment

The facial values of volunteers in each group were measured by VISIA skin tester to evaluate the use effect. The results are shown in Table 2.

According to the test results of VISIA skin tester, there was no significant change in the total skin score after 2 weeks of treatment. However, compared with the initial value in the same group, the measured value on the 21st day after treatment in group A1 and group B1 improved significantly, and the difference was statistically significant ($P < 0.01$). Group B1 and group B2 also improved, the difference was statistically significant ($P < 0.05$). There was no change in control group C ($P > 0.05$). The difference between A1 and B1, A2 and B2 was statistically significant ($P < 0.05$). The improvement degree of group A was better than that of group B.

It was suggested that the skin quality of group A and group B treated by G-MASK low energy radiation group were significantly improved compared with those of blank control group on the 21st day after treatment, and group A(low energy far-infrared radiation plus mask group) improved better than group B (low energy far-infrared radiation group).

The facial parameters in the skin image, moisture, stains, wrinkles, etc. were all improved after 35 days of treatment, and the difference was significant; there was no obvious change in UV stains.

3.3. Occurrence of Adverse Reactions

There were 3 volunteers with slight burning sensation on their faces during use, 2 volunteers quit and 1 volunteer continued. No blister, burn, pigmentation, depigmentation and other adverse reactions were found during the test.

One case in group B1 (simple G-MASK, male group) had more acne spots; one case in group B2 (simple G-MASK, female group) had worse complexion.

4. Discussion

Generally speaking, the factors of skin aging can be divided into endogenous factors and exogenous factors. Endogenous factors include genetic genes, free radicals, immunity and other factors [4]. Exogenous factors include ultraviolet radiation, smoking, air pollution, etc [5]. Among them, photoaging caused by

Table 2. Test results of vision skin tester after two weeks of using G-MASK ($\overline{x} \pm s$).

score \ group	A		B		C	
	A1 (male)	A2 (female)	B1 (male)	B2 (female)	C1 (male)	C2 (female)
Before treatment	43.2 ± 2.2	58.3 ± 2.7	42.1 ± 3.4	57.3 ± 1.9	44.1 ± 2.8	56.2 ± 3.6
After 2 weeks of treatment	45.1 ± 3.1	59.1 ± 1.9	44.3 ± 2.7	59.7 ± 2.8	43.6 ± 3.3	57.1 ± 2.6
On the 21st day after 2 weeks of treatment	51.2 ± 3.5**Δ	68.6 ± 3.8**Δ	48.2 ± 3.8*	64.2 ± 2.4*	45.2 ± 3.4	58.6 ± 3.3

Note 1: There was 1 case quit in each of group A1 and group B1. Note 2: The measured values were compared with the initial values of each group, **means $P < 0.01$, *means < 0.05. Δ means A1 compared with B1, A2 compared with B2, $P < 0.05$.

ultraviolet radiation is an important cause for skin aging [6].

VISIA skin tester is a good tool used to quantify the state of different layers of skin through the absorption and refraction of different wavelength light sources, which can objectively reflect the face state of patients. It can be used as a quantitative measurement standard of the curative effect of light, and has certain significance for diagnosis, guiding treatment methods and evaluating curative effect [7] [8] [9] [10].

In this paper, 40 volunteers were treated with facial irradiation by G-MASK. The results of VISIA skin test showed that after a course of treatment (2 weeks), there was no statistical improvement in the total skin score. But in the follow-up test on the 21st day, the score of the G-MASK group (A, B group) improved significantly. The main reason was that the regeneration cycle of human skin was generally 28 days, and the observed repair effect was delayed.

Totally, the test of the G-MASK, whether from the self-evaluation, the evaluation by others, or the change of the total score of the test, showed that the G-MASK group had a good skin improvement effect, and better than the blank control groups. All this may be related to the low energy far-infrared emitted by graphene material, which can promote facial blood circulation and promote the absorption of facial mask emulsion. In addition, there was no obvious discomfort during the use of the G-MASK. In the process of mass use in the future, the safety is guaranted except for the people with sensitive skin.

Pure graphene material has low starting voltage (3 - 5 V), and can emit low energy far-infrared ray. The peak of wavelength is about 9 μ m, which is easy to produce resonance effect with human body. The far-infrared band in this range can effectively block the transmission of red visible light, ultraviolet light, etc., and eliminate the possible human skin damage caused by other spectral bands. When far-infrared rays act on the skin, a series of biological effects are produced. For example, it can cause the vibration of water molecules inside and outside the cells of the body, turn the large molecular water mass (easy to cause human aging) into small molecular water mass; activate the protein in the body, activate the cells; it can make the microvascular dilation, accelerate the blood flow, improve the microcirculation disorder; it can improve the blood and oxygen supply of the cell tissue, accelerate the absorption and dissipation of inflammatory exudates; it can improve the metabolism, and improve the skin health [11] [12] [13].

In conclusion, low energy far-infrared irradiation of the G-MASK has a good effect on improving the facial skin of healthy people. We observed the skin improvement of the face after 2 weeks of pure graphene low energy far-infrared irradiation accurately through the VISIA skin tester. From the total score changes of volunteers before and after test, as well as the sub effect, such as evaluation of spots, wrinkles, textures, pores and other aspects, etc. we can provide better feedback to doctors and patients, and improve the treatment compliance and trust from patients.

On the other hand, this experiment was small randomized controlled trial. The sample size was small, thus the power of test was limit, thereby affecting the intensity of argumentation on the true result. It is expected to be improved in the subsequent research.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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