

# Analysis of the efficacy and efficiency of carbon dioxide fractional laser cosmetic treatment of skin diseases

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## Abstract

This study evaluates the application value of carbon dioxide fractional laser cosmetology in the treatment of dermatological diseases, focusing on its therapeutic effects, scar remaining rate, pain scores, lesion counts, and wound granulation status. A total of 74 patients with dermatological disorders were randomly assigned to an experimental group and a control group from May 2023 to May 2024. The experimental group received carbon dioxide fractional laser treatment, while the control group was treated with conventional medication. The results indicated that the experimental group had higher therapeutic effects (97.30% vs. 78.38%,  $P < 0.05$ ), a lower scar remaining rate (2.70% vs. 24.32%,  $P < 0.05$ ), and significantly reduced pain scores post-treatment ( $P < 0.05$ ). Additionally, the experimental group showed a decrease in lesion counts and improved wound granulation status compared to the control group. The study concludes that carbon dioxide fractional laser treatment is an effective and less painful method for treating dermatological diseases, with advantages such as non-invasiveness, short recovery time, and minimal side effects. The technology's precision, ability to stimulate collagen production, and promote skin remodeling contribute to its efficacy in improving skin quality and treating skin diseases. The study supports the further development and optimization of carbon dioxide fractional laser technology for safer and more effective dermatological treatments.

Keywords: Carbon dioxide fractional laser, dermatological diseases, therapeutic effects, pain reduction, wound healing diseases; effect

In recent years, with the rapid development of medical technology, laser technology is widely used in the field of medicine, has a certain hemostatic effect, can quickly make the tissue carbonization, the operation of the convenience is high, can improve the level of treatment of patients, and in the process of dermatological treatment, carbon dioxide fractional laser cosmetic method can promote the patients to recover well, enhance the level of treatment. Based on this, this paper analyzes the application value of carbon dioxide fractional laser cosmetology in the treatment of dermatological diseases, and contributes to the improvement of the level of treatment.

## 1 Basic information and methodology

### Basic information

Seventy-four patients with dermatological disorders from May 2023 to May 2024 were selected and randomly divided into experimental and control groups, with 37 cases in each group.

Control group: age between 5 and 67 years, median index ( $45.55 \pm 2.33$ ) years, 18 males and 19 females.

Experimental group: age between 5 and 68 years, median index ( $45.56 \pm 2.34$ ) years, 17 males and 20 females.

Comparison of basic information did not show any difference,  $P > 0.05$ .

Inclusion criteria: meeting the diagnostic criteria for dermatologic conditions; informed consent for this study; no previous laser therapeutic method.

Exclusion criteria: psychiatric abnormalities; abnormal renal function.

### methodologies

Control group: conventional medication is used, the affected area is cleaned before the patient goes to bed every night, and after drying, 0.1% adapalene gel is applied once a night for half a month, and during the process of applying the medication, the skin around the affected area is comprehensively protected and not exposed to sunlight.

Experimental group: the use of carbon dioxide fractional laser cosmetic treatment method, the use of radiofrequency fractional carbon dioxide laser

therapeutic instrument equipment, one hour before the treatment of the patient's affected surface of anesthesia, make full use of bupivacaine hydrochloride gel paste, to reduce the burning pain in the treatment location, anesthesia one hour after the cleansing of the affected area, the use of cleansing milk cleaning and local disinfection, set to the pulse energy and fractional coverage, respectively, is 50 mJ with the 6.25% of the constituent area put shape and round part, according to the standard criteria for the treatment of skin damage location, uniform scanning scar or need to treat the location, the postoperative use of ice ice for half an hour, to reduce the thermal damage, reduce the burning pain in the treatment location, the use of mupirocin ointment application, the application of three to five days, applied two to three times a day, each time the interval between the application of the application of the time is four hours, six months avoiding the sun, the application of sunscreen and moisturizer. Apply sunscreen with moisturizer.

#### Observation indicators

(1) If there is no recurrence six months after completing the treatment and no complications and adverse reactions, it will be judged as effective; if more than 50% of the skin lesions of the patients disappear after the treatment and there are no complications and adverse reactions, it will be judged as effective; if the skin lesions of the patients do not disappear after the treatment and there are recurrences six months later, it will be judged as ineffective. (2) Record the number of cases of scar remnants and determine the rate of scar remnants. (3) Evaluate the degree of pain by using the VAS score method, the total score is 10 points, the higher the score proves the higher the degree of pain. (4) The number of cases of rashes, nodules, pustules, and cysts of the patients were recorded, and the index of the number of lesions was analyzed. (5) Use the camera to take photos of the trauma, observe and analyze the color condition and texture, for color, -1 point is obscure, 0 point is dark red, 1 point is bright red, for texture -1 point is no granulation, 0 point is mild edema, 1 point is dense and severe, the higher the score proves that the state of trauma granulation is better.

#### 1.4 Statistical analysis

The SPSS 23.0 software was used to calculate the data using the chi-square, % and  $\pm$  forms, and differences in data comparisons were expressed in the form of  $P < 0.05$ .

## 2 Results

### 2.1 Therapeutic effects

The experimental group was higher than the control group,  $P < 0.05$ , see Table 1 for details.

Table 1. treatment effects [n (%)]

groups	Number of persons (n)	produce an effect	validity	null	effect
experimental group	37	25 (67.57%)	11 (29.73%)	1 (2.70%)	36 (97.30%)
control subjects	37	20 (54.05%)	9 (24.32%)	8 (21.62%)	29 (78.38%)
X2					6.1983
P					0.0127

### 2.2 Scar Remaining Rate

The control group was higher than the experimental group,  $P < 0.05$ , see Table 2 for details.

Table 2. Scar Remaining Rates [n (%)]

groups	Number of persons (n)	hand down (next generation)	not behind	left rate	legacy
experimental group	37	1 (2.70%)	36 (97.30%)	1 (2.70%)	
control subjects	37	9 (24.32%)	38 (102.70%)	9 (24.32%)	
X2					5.9749

### 2.3 Pain scores before and after treatment

No difference was seen in the comparison of data before treatment,  $P > 0.05$ , and after treatment the experimental group was lower than the control group,  $P < 0.05$ , see Table 3 for details.

Table 3. Pain level scores before and after treatment ( $\bar{X} \pm S$ )

groups	Number of persons (n)	Pain level scores	
		pre-treatment	post-treatment
experimental group	37	$5.44 \pm 1.11$	$1.22 \pm 0.55$
control subjects	37	$5.55 \pm 1.12$	$2.44 \pm 0.99$
t		0.4243	6.5526
P		0.6726	0.0000

### 2.4 Number of lesions before and after treatment

Comparison of data values before treatment did not show any difference,  $P > 0.05$ , and after treatment the experimental group was lower than the control group,  $P < 0.05$ , see Table 4 for details.

Table 4. Number of skin lesions ( $\bar{X} \pm S$ )

groups	Number of persons (n)	a rash		Lumpy		pustule		cyst (med.)	
		Before treatment	After treatment						
experimental group	37	$9.22 \pm 1.11$	$3.11 \pm 0.55$	$4.11 \pm 1.11$	$0.8 \pm 0.05$	$8.22 \pm 1.12$	$1.28 \pm 0.22$	$2.77 \pm 0.44$	$0.55 \pm 0.02$

control subjects	37	9.23 ± 1.12	5.68 ± 0.98	4.12 ± 1.12	1.28 ± 0.09	8.23 ± 1.13	3.48 ± 0.97	2.78 ± 0.45	0.99 ± 0.09
t		0.038607	13.9186	0.036324	23.2	0.038543	13.466	0.0998	29.02
P		0.96930	0.00093	0.96000	0.006	0.96900	0.0033	0.920	0.000

### 2.5 Wound granulation status before and after treatment

There was no great difference in the comparison between the groups before treatment,  $P > 0.05$ , and the experimental group was better than the control group after treatment,  $P < 0.05$ , see Table 5 for details.

Table 5. status of trabecular granulation before and after treatment ( $\bar{X} \pm S$ )

groups	Number of persons (n)	color and luster		background (texture)	
		Before treatment	After treatment	Before treatment	After treatment
experimental group	37	0.11 ± 0.04	0.88 ± 0.11	0.13 ± 0.03	0.89 ± 0.12
control subjects	37	0.12 ± 0.03	0.15 ± 0.04	0.13 ± 0.03	0.22 ± 0.03
t		1.2166	37.9370	0.0000	32.9481
P		0.2277	0.0000	1.0000	0.0000

### 3 Discussion

Skin diseases are common in recent years, and genetic factors, immune factors, etc., vitiligo, ichthyosis and other skin diseases related to heredity, immune system abnormalities can lead to psoriasis, eczema and other skin diseases, climate, diet, living habits, etc., sunlight, ultraviolet rays, chemicals, etc., can be triggered by skin diseases, bacterial, viral, fungal and other infections can cause inflammatory diseases of the skin, long-term mental stress and emotional fluctuations also May lead to skin problems, a wide variety of skin diseases, each skin disease has its own unique

clinical manifestations and characteristics, skin diseases usually manifested as itching, pain, redness, swelling, flaking, blisters and other symptoms, part of the longer course of skin diseases, easy to recur, and some of them will be relieved or cured on their own, and at the same time, the onset and course of the skin disease is affected by a variety of factors, mainly heredity, the environment, diet, living habits and so on. Scientific and rational treatment is crucial.

Carbon dioxide fractional laser cosmetic treatment technology is the more advanced technology and advanced cosmetic treatment method, which has been widely researched and applied in recent years, mainly using high-energy laser beams to form tiny damage points on the skin surface, stimulating the skin's self-repairing mechanism, to achieve the cosmetic effect of tightening the skin, improving the wrinkles, fading pigmented spots, etc. At present, the research results about carbon dioxide fractional laser cosmetic treatment technology are abundant, and the research shows that the technology can effectively improve skin laxity, wrinkles, acne scars and other problems, and improve the quality of the skin, and the technology also has the advantages of non-invasive, short recovery time, and small side effects, which are welcomed by the majority of patients, with the deepening of the research, the safety and validity of the carbon dioxide fractional laser cosmetic treatment technology has been further verified, and the technology adopts a micro-traumatic way to stimulate the skin's self repair. The technology adopts a micro-trauma way to stimulate skin self-repair, less damage to surrounding tissues and short recovery time. At the same time, reasonable parameter setting and operation skills can effectively improve the treatment effect and reduce the incidence of complications. At the same time, the carbon dioxide fractional laser cosmetic treatment technology has been widely used in the clinic, not only in the cosmetic institutions, but also in the dermatology and plastic surgery departments of hospitals, etc., and the technology can be used alone or in conjunction with other cosmetic treatments to achieve a better therapeutic effect. With the continuous development of science and technology, carbon dioxide fractional laser cosmetic treatment technology

will be further improved and optimized, the future of the technology will be safer, more effective, the indications will also be more extensive, combined with other cosmetic treatment technology will provide patients with a more comprehensive, personalized cosmetic treatment plan[1] .

The above analysis of the efficacy of carbon dioxide fractional laser cosmetic treatment of dermatological diseases, the experimental group's effect is higher than that of the control group,  $P < 0.05$ . Adapalene gel is a retinoic acid drug, which has a significant effect on the treatment of dermatological diseases, adapalene gel can regulate the growth and differentiation of keratin-forming cells of the skin, which can help to remove the aging keratin, and promote the generation of new cells, thus improving the texture of the skin, adapalene gel It has an anti-inflammatory effect, which can reduce the inflammatory reaction of the skin and alleviate the symptoms of dermatological diseases, inhibit the growth and reproduction of Propionibacterium acnes, which has a significant effect on the treatment of acne and other bacterial infectious dermatological diseases, and promote the repair of skin damage, accelerate the regeneration of the skin tissues and recovery, which helps to improve the skin condition of patients with dermatological diseases. The action principle of carbon dioxide fractional laser cosmetic treatment of skin diseases is mainly to use high-energy laser beams to form tiny damage points on the skin surface, stimulate the skin self-repair mechanism, and achieve the purpose of improving the quality of the skin and treating skin diseases.[2] , Carbon dioxide fractional laser is able to act precisely on the skin surface, and make tiny traumas on the skin tissues through the laser energy. These micro traumas will activate the skin's self-repair mechanism, promoting collagen production and skin tissue remodeling. During the repair process, new collagen will fill the wrinkles and depressions on the skin surface, making the skin firmer and smoother. Fractional carbon dioxide laser is also capable of effectively removing the aged stratum corneum from the surface of the skin, and promoting the renewal and metabolism of the epidermal cells, so as to improve the texture of the skin and the problems of pigmentation and so on, and it has the features of non-invasiveness, short recovery time, and short recovery time. It has the

advantages of non-invasive, short recovery time, small side effects, etc., and can safely and effectively improve the symptoms of a variety of dermatological diseases[3] .

In this study, the experimental group had a pain score of  $(5.44 \pm 1.11)$  before treatment and  $(1.22 \pm 0.55)$  after treatment, while the control group had a pain score of  $(5.55 \pm 1.12)$  before treatment and  $(2.44 \pm 0.99)$  after treatment. Compared with the conventional drug treatment that requires oral intake or injection of medication, the fractional carbon dioxide laser treatment is a non-invasive treatment method that utilizes laser energy to act on the surface of the skin without penetrating the deeper tissues of the skin, thus causing relatively little irritation and damage to the skin and reducing pain. Laser energy acts on the surface of the skin without penetrating the deeper tissues of the skin, so the stimulation and damage to the skin is relatively small, reducing the sense of pain.[4] , carbon dioxide fractional laser treatment process can be in accordance with the patient's skin type and condition, precise control of the size and depth of the laser energy, precise control to ensure that the laser energy only acts on the area that needs to be treated, reducing the damage to the surrounding normal tissues, reducing the sense of pain, the treatment of the area before treatment, and the treatment of the area of the skin, reducing the pain, and the treatment of the skin. Before the treatment, local anesthesia or surface anesthesia is applied to the treatment area to ease the pain of the patients, and the anesthesia drugs can reduce the sensitivity of the skin to the laser energy, making the treatment process more comfortable[5] . At the same time, the recovery time after CO<sub>2</sub> fractional laser treatment is relatively short, and the skin repair process is faster, compared with the conventional medication that requires a longer time for recovery, patients can return to normal life faster and reduce the pain caused by the treatment. Therefore, the reason why CO<sub>2</sub> fractional laser cosmetic treatment of dermatological diseases is less painful than conventional drug treatment is mainly due to the non-invasive treatment mode, precise control of laser energy, local or surface anesthesia, and rapid recovery, etc. The factors work together to make the pain felt by patients in the treatment process relatively low[6] .

Rash ( $9.22 \pm 1.11$ ), nodules ( $4.11 \pm 1.11$ ), pustules ( $8.22 \pm 1.12$ ), cysts ( $2.77 \pm 0.44$ ) in terms of skin lesions in the experimental group of patients before the treatment, and rash ( $3.11 \pm 0.55$ ), nodules ( $0.88 \pm 0.05$ ), pustules ( $1.28 \pm 0.22$ ), cysts ( $0.55 \pm 0.02$ ) in the control group after treatment Rash ( $9.23 \pm 1.12$ ), nodules ( $4.12 \pm 1.12$ ), pustules ( $8.23 \pm 1.13$ ) and cysts ( $2.78 \pm 0.45$ ) before treatment, and rash ( $5.68 \pm 0.98$ ), nodules ( $1.28 \pm 0.09$ ), pustules ( $3.48 \pm 0.97$ ), and cysts ( $0.99 \pm 0.09$ ) after treatment, the carbon dioxide fractional laser was able to precisely Fractional carbon dioxide laser can precisely act on the skin surface, stimulate the skin to produce small traumas through laser energy, and activate the skin's self-repair mechanism. According to the patient's skin type and condition, it can precisely control the size and depth of laser energy to ensure that it only acts on the area that needs to be treated, and reduce the damage to the surrounding normal tissues, and the fractional carbon dioxide laser treatment can stimulate the production of collagen in the skin and the remodeling of skin tissues. During the repair process, new collagen will fill the wrinkles and depressions on the surface of the skin, making the skin firmer and smoother, and effectively improving the problems of skin laxity, wrinkles, scars and other skin lesions.[7] , Carbon dioxide fractional laser can remove the aged stratum corneum on the surface of the skin, and promote the renewal and metabolism of the epidermal cells, which can help to improve the texture of the skin and the pigmentation of the skin and other problems, so as to make the skin present a healthier and younger state, and the laser treatment can Stimulate the skin's immune response, enhance the skin's self-repair ability, the immune response helps to remove the abnormal cells and pathogens in the skin, and promote the recovery and health of the skin, CO2 fractional laser cosmetic treatment of dermatological skin lesions to improve the effect of the high is mainly due to the precise control of the laser energy, to promote the generation of collagen and skin remodeling, to remove the aging stratum corneum and promote the renewal of the epidermis, as well as to stimulate the skin's immune response, and other aspects of a comprehensive effect. The comprehensive effect of various aspects, such as the enhancement of treatment level[8] .

In the experimental group, the color ( $0.11 \pm 0.04$ ) and texture ( $0.13 \pm 0.03$ ) of traumatic granulation before treatment, and the color ( $0.88 \pm 0.11$ ) and texture ( $0.89 \pm 0.12$ ) of traumatic granulation after treatment, while in the control group, the color ( $0.12 \pm 0.03$ ) and texture ( $0.13 \pm 0.03$ ) of traumatic granulation before treatment, and the color ( $0.15 \pm 0.04$ ) and texture ( $0.22 \pm 0.03$ ) of traumatic granulation after treatment. ), texture ( $0.22 \pm 0.03$ ), carbon dioxide fractional laser can accurately control the laser energy and depth of action, so that the laser energy can accurately act on the traumatic granulation tissue, promote its repair and regeneration, reduce the damage to the surrounding normal tissues, so that the wound healing is more rapid. Fractional CO<sub>2</sub> laser can stimulate the proliferation of granulation tissue and promote the formation of new granulation tissue[9] . The stimulating effect can help fill the wound defects and make the wound more smooth, so as to improve the appearance of the wound. The laser treatment can promote the blood circulation and lymphatic reflux around the wound, increase the supply of nutrients and the excretion of metabolic products, which can help the healing and recovery of the wound, and the fractional carbon dioxide laser treatment can use its thermal effect to kill or inhibit the bacteria on the wound, so as to reduce the occurrence of infection, and the laser treatment can reduce the inflammatory reaction and reduce the redness of the wound. Laser treatment can reduce the inflammatory reaction, reduce the redness, swelling, pain and other symptoms of wounds, and help the healing of wounds. The reason why the CO<sub>2</sub> fractional laser cosmetic treatment of dermatological wounds with granulation improves the state better mainly includes the combined effect of the precise laser energy and the depth of action, stimulation of the proliferation of granulation tissues, promotion of the blood circulation and the lymphatic reflux, as well as reduction of infections and inflammatory reactions, which promotes the healing and recovery of wounds, so as to make the wound with granulation improve the state better. Better condition[10] .

#### References:

Weng, C. (2021). Effect of cosmetic treatment with carbon dioxide fractional laser on lesion counts and wound granulation status in patients with dermatologic

diseases. *Chinese Medical Science*, 11(7), 17-19, 24.

Li, R. (2021). Therapeutic effect of carbon dioxide fractional laser cosmetic treatment on dermatologic diseases. *Oriental Medicinal Cuisine*, (5), 46.

Zhao, J. (2023). Analysis of the effect of carbon dioxide fractional laser cosmetic treatment on patients with skin diseases. *Chinese Clinical Pharmacology and Therapeutics*, 28(3), 3.

Yang, J.-G., Liu, W., Sun, L., et al. (2021). Analyzing the therapeutic effect of carbon dioxide fractional laser on skin diseases. *Health and Wellness*, (28), 43.

Zhu, X. (2022). Clinical effect of carbon dioxide fractional laser aesthetic treatment of dermatologic diseases. *Medical Aesthetics and Cosmetology*, (9), 26-28.

Pall, Y., & Guo, J. (2021). Analyzing the therapeutic effect of carbon dioxide fractional laser aesthetics on skin diseases. *Special Health*, (3), 75.

Liu, A. J. (2021). Study on the clinical effect of carbon dioxide fractional laser cosmetic treatment of dermatologic diseases. *Kang Yi*, (9), 155.

Liu, J. (2023). Analysis of carbon dioxide fractional laser aesthetics combined with external application of drugs in dermatological diseases. *Self-care*, (13), 10-11.

Chen, Y.-J., Li, D.-H., & Chen, H.-Z. (2023). Progress in the application of carbon dioxide fractional laser in cosmetic dermatology. *Minimally Invasive Medicine*, 18(2), 229-232.

Deng, H., Li, X. Q., & Luo, B. B. (2022). Therapeutic effect of carbon dioxide fractional laser aesthetics in scarring and acne. *Medical Aesthetics and Cosmetology*,

(9), 29-32.