Clinical Observation of Silk Fibroin Composite Gel Combined with CO2 Lattice Laser in the Treatment of Facial Acne Depressed Scar

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Abstract: This study aims to observe the clinical effect and safety of silk fibroin composite gel combined with CO2 fractional laser in the treatment of facial atrophic acne scars. A total of 98 patients with facial atrophic acne scars were selected and randomly divided into a study group (n=49) and a control group (n=49). Both groups received CO2 fractional laser treatment. After the laser surgery, the control group used standard hyaluronic acid (HA) dressing, and the study group used silk fibroin composite gel (Siruimei Biotechnology). The clinical effect, ECCA scar score, patient satisfaction, and adverse reactions were compared between the two groups. The results showed that the total effective rate of the study group was 97.96% (48/49), which was significantly higher than 83.67% (41/49) of the control group (P<0.05). After treatment, the ECCA score of the study group (48.42 ± 6.35) was significantly lower than that of the control group (56.82 ± 7.12) (P<0.05). The total patient satisfaction rate in the study group (93.88%) was significantly higher than that in the control group (75.51%) (P<0.05). The incidence of adverse reactions in the study group was 8.16% (4/49), which was significantly lower than 24.48% (12/49) in the control group (x2 = 4.89, P<0.05). In conclusion, silk fibroin composite gel combined with CO2 fractional laser has a very good clinical effect on facial atrophic acne scars. It can improve the scar appearance, improve patient satisfaction, and reduce complications safely.

Keywords: Silk Fibroin Composite Gel; CO2 Fractional Laser; Atrophic Acne Scars; Wound Healing; ECCA Score

1. Introduction

Severe acne vulgaris is a very common skin disease in the clinic. If it is not treated in time, it will easily leave facial atrophic acne scars. These scars seriously affect the facial beauty of the patients. They also bring great psychological pressure to the patients in their daily life. At present, CO2 fractional laser is an effective method to treat atrophic acne scars. The principle of the laser is focal photothermolysis. It can produce many tiny heating treatment zones on the skin. This high temperature can stimulate the fibroblasts in the dermis and produce new collagen to fill the scars [1, 2]. However, the laser treatment will damage the normal skin barrier. The thermal energy will cause acute local inflammation. After the laser surgery, the skin of the patients will have redness, severe swelling, and scabs [3]. If the wound healing is slow, it will easily cause pigmentation and increase the recovery time of the patients.

In normal clinical work, doctors often use hyaluronic acid (HA) dressing to repair the skin barrier. HA can provide water to the skin and keep the wound moist. But HA is only a simple moisturizing material. It cannot actively reduce inflammation or provide a biological scaffold to promote skin cell growth [4]. Therefore, finding a better biological repair material is a research hotspot in recent years. Silk fibroin is a kind of natural protein material. It is extracted from silkworm cocoons. It has very good biocompatibility and safety. Its structure is very similar to the structural proteins of the human body [5]. Modern medical research shows that the special amino acids in silk fibroin can help cell migration, reduce oxidative stress, and promote wound healing quickly [6, 7].

Based on the above reasons, our hospital designed this study. We aim to observe the clinical effect and safety of silk fibroin composite gel combined with CO2 fractional laser for facial atrophic acne scars. We hope to provide a better method for clinical treatment

and skin repair [8].

2. Materials and Methods

2.1 General Data

We selected 98 patients with facial atrophic acne scars in our dermatology department. We used a random number table method to divide the patients into a study group (n = 49) and a control group (n = 49).

2.1.1 Inclusion criteria: (1) Diagnosed with facial atrophic acne scars; (2) Did not use any laser or chemical peeling treatments in the past 6 months.

2.1.2 Exclusion criteria: (1) Local skin infection or viral infection; (2) History of keloids or scar constitution; (3) Pregnant or lactating women.

We compared the general data (such as age, gender, and scar severity) between the two groups. The difference was not statistically significant (P>0.05). The two groups were comparable.

2.2 Treatment Methods

All patients received standard CO2 fractional laser treatment. The doctor adjusted the laser energy, density, and depth according to the patient's scar condition. After the laser surgery, the treatments were as follows:

2.2.1 Study Group: Applied silk fibroin composite gel (Siruimei Biotechnology (Zhejiang) Co., Ltd.; Registration No.: Zhe Xie Zhu Zhun 20242141765) immediately on the wound. Used it twice a day for 14 continuous days.

2.2.2 Control Group: Applied standard HA dressing immediately on the wound. Used it twice a day for 14 continuous days.

2.3 Observation Indicators

(1) Clinical Effect: Divided into Markedly Effective, Effective, and Ineffective according to the scar volume reduction. Total effective rate = (Markedly Effective + Effective) / Total cases × 100%.

(2) Scar Assessment: Used the ECCA (Echelle d'Evaluation Clinique des Cicatrices d'Acné) score to evaluate the scar severity before and after treatment.

(3) Patient Satisfaction: Divided into Very Satisfied, Satisfied, and Dissatisfied.

(4) Adverse Reactions: Recorded the occurrence of prolonged redness, severe edema, and pigmentation.

2.4 Statistical Analysis

SPSS 26.0 software was used for data analysis. Measurement data were expressed as mean ± standard deviation ($\bar{x} \pm s$) and analyzed by t-test. Count data were expressed as percentages (%) and analyzed by chi-square (x^2) test. P < 0.05 meant the difference had statistical significance.

3. Results

3.1 Comparison of Clinical Effect

The total effective rate in the study group was 97.96%, which was significantly higher than 83.67% in the control group. The difference had statistical significance (P<0.05). See Table 1.

Table 1. Comparison of Clinical Efficacy Between the Two Groups [n (%)]

Group	n	Markedly Effective	Effective	Ineffective	Total Effective Rate (%)
Study Group	49	28	20	1	48 (97.96)
Control Group	49	19	22	8	41 (83.67)
x^2value	-	-	-	-	4.346
P value	-	-	-	-	< 0.05

3.2 Comparison of ECCA Scores

Before treatment, the ECCA scores had no significant difference (P>0.05). After treatment, the ECCA score in the study group (48.42 ± 6.35) was significantly lower than the control group (56.82 ± 7.12) (P<0.05). See Table 2.

Table 2. Comparison of ECCA Scar Scores Before and After Treatment ($\bar{x}$±s, points)

Group	n	Before Treatment	After Treatment
Study Group	49	71.24±8.45	48.42±6.35
Control Group	49	70.89±8.21	56.82±7.12
t value	-	0.208	6.173
P value	-	> 0.05	< 0.05

3.3 Comparison of Patient Satisfaction

The total satisfaction rate in the study group (93.88%) was significantly higher than the

control group (75.51%) (P < 0.05). See Table 3.

Table 3. Comparison of Patient Satisfaction Between the Two Groups [n (%)]

Group	n	Very Satisfied	Satisfied	Dissatisfied	Total Satisfaction Rate (%)
Study Group	49	30	16	3	46 (93.88)
Control Group	49	20	17	12	37 (75.51)
x^2 value	-	-	-	-	6.38
P value	-	-	-	-	< 0.05

3.4 Comparison of Adverse Reactions

The incidence of adverse reactions in the study group was 8.16%, which was significantly lower than 24.48% in the control group. The difference had statistical significance (P < 0.05). See Table 4.

Table 4. Comparison of Adverse Reactions Between the Two Groups [n (%)]

Group	*n*	Prolonged Erythema	Severe Edema	Pigmentation	Total Incidence (%)
Study Group	49	2	1	1	4 (8.16)
Control Group	49	5	3	4	12 (24.48)
x2value	-	-	-	-	4.89
P value	-	-	-	-	< 0.05

4. Discussion

Facial atrophic acne scars are a difficult problem in dermatology. CO2 fractional laser is the standard treatment in the clinic. The laser uses heat to vaporize the scar tissue and stimulate new collagen growth. But the laser will destroy the stratum corneum of the skin. This will cause an acute inflammatory response. Therefore, it is very important to use an effective dressing to protect the wound and speed up healing. Traditional HA dressing can only keep the wound moist. It has no biological activity. It cannot help the repair of the extracellular matrix (ECM).

Compared with HA dressing, silk fibroin composite gel has many advantages. First, silk fibroin is a natural biological protein. It has many useful amino acids, such as glycine and alanine. Its structure is very similar to human skin. Therefore, it has good biocompatibility. When applied to the wound, it can act as a biological scaffold to help skin cells grow [6]. Second, the composite gel is a semi-solid material. Facial atrophic scars usually have an uneven surface. The gel can perfectly cover the uneven skin surface. It can continuously provide repair nutrition to the deep skin layer. The results of this study showed that the total effective rate of the study group (97.96%) was significantly higher than the control group. The ECCA score of the study group (48.42 ± 6.35) was significantly lower than the control group. This proves that silk fibroin composite gel has a very good repair effect on scars.

In addition, silk fibroin also has good anti-inflammatory ability. The laser thermal damage will produce many inflammatory factors and free radicals. Silk fibroin can reduce these harmful substances and reduce local oxidative stress [7]. By reducing the inflammation quickly, it can prevent prolonged redness and pigmentation. In our study, the adverse reaction rate of the study group was only 8.16%, which was significantly lower than 24.48% of the control group. Because the treatment effect is good and the side effects are small, the patient satisfaction of the study group reached 93.88%.

In conclusion, silk fibroin composite gel combined with CO2 fractional laser has a very good clinical effect for facial atrophic acne scars. It can improve the scar condition, speed up skin barrier repair, reduce adverse reactions, and improve patient satisfaction. It is worthy of wide application and promotion in clinical practice.

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