Clinical Observation of Silk Fibroin Dressing for Wound Healing after CO2 Fractional Laser Treatment

Xia Zheyi, Zhou Qiwen, Chen Bo, Zhang Shuai*
First People's Hospital of Yibing, Yibin, Sichuan, China
**Corresponding Author*

Abstract: To observe the clinical effect of silk fibroin dressing on wound healing and adverse reactions after CO2 fractional laser treatment. A total of 72 patients were randomly divided into an observation group (n=36) and a control group (n=36). Both groups received CO2 fractional laser therapy. After the surgery, the observation group used silk fibroin dressing (Fuxiang Sitai Medical Technology), and the control group used traditional ice compress. The results showed that at 30 minutes after treatment, the pain score (3.77 ± 0.78 vs 8.32 ± 0.57), burning score (1.67 ± 0.25 vs 2.89 ± 0.31), and redness and swelling score (1.74 ± 0.28 vs 2.43 ± 0.35) in the observation group were significantly lower than those in the control group (P < 0.05). At the same time, the scab formation time (1.93 ± 0.52 days vs 2.37 ± 0.48 days) and scab shedding time (6.74 ± 1.36 days vs 8.52 ± 1.41 days) in the observation group were significantly shorter (P < 0.05). At 28 days after treatment, the VISIA skin analysis showed that the percentile scores of erythema, texture, and brown spots in the observation group were significantly higher than the control group (P < 0.05), but there was no significant difference in porphyrins and pores (P > 0.05). In conclusion, the application of silk fibroin dressing after CO2 fractional laser can effectively reduce acute pain and inflammation, speed up skin healing, and repair the skin barrier.

Keywords: Silk Fibroin Dressing; CO_2 Fractional Laser; Wound Healing; VISIA Analysis; Post-Operative Care

1. Introduction

At present, CO2 fractional laser is widely used in clinical dermatology. It is a very important method to treat atrophic acne scars and skin aging. The laser uses focal photothermolysis to create microscopic treatment zones. It can destroy old tissue and stimulate dermal fibroblasts to produce new collagen [1].

However, the high thermal energy damages the normal stratum corneum and destroys the skin barrier. It brings a serious acute local inflammatory response. After the laser surgery, patients often feel severe pain, burning sensation, skin redness, swelling, and long-term scabs [2]. If the wound is not treated well, it easily causes transepidermal water loss (TEWL). This will delay skin healing and increase the risk of post-inflammatory hyperpigmentation (PIH).

Traditional post-operative care usually uses ice compress. Ice compress can cool the skin and lower the temperature. It can contract blood vessels and reduce pain temporarily. But ice compress is only a physical cooling method. It cannot provide a biological scaffold to help cell migration or rebuild the extracellular matrix (ECM) [3].

So, more and more researchers pay attention to new biological materials. Silk fibroin is a kind of natural protein extracted from silkworm cocoons. It has excellent biocompatibility and very low immunogenicity. Its structure is very similar to human collagen [4]. Recent studies show that silk fibroin can act as a bioactive dressing. It can promote fibroblast growth, keep the wound moist, and reduce inflammatory factors.

Based on the above, our study compares silk fibroin dressing with traditional ice compress. We aim to observe the clinical effect and safety of silk fibroin dressing for patients after CO2 fractional laser treatment. We use subjective symptom scores and VISIA skin analysis to evaluate the results.

2. Materials and Methods

2.1 General Information

We selected 72 patients who received CO2 fractional laser treatment in our hospital. We randomly divided them into an observation group (n=36) and a control group (n=36). The

age, gender, and disease condition of the two groups had no statistically significant differences (P > 0.05). The two groups were comparable.

2.1.1 Inclusion Criteria:

Patients who need CO2 fractional laser treatment;

Age between 18 and 50 years old;

Patients signed the informed consent form.

2.1.2 Exclusion Criteria:

History of keloids or scar constitution;

Local skin infection or viral infection on the face;

Severe systemic diseases or autoimmune diseases;

Pregnant or lactating women.

2.2 Treatment Methods

Both groups received standard ultra-pulsed CO2 fractional laser treatment.

Post-operative Care:

2.2.1 Observation Group: Applied Silk Fibroin Dressing (Fuxiang Sitai Medical Technology (Suzhou) Co., Ltd.; Registration No.: 20242142377) Immediately for 30 Minutes. Then Patients Used It Every Day for 5 Continuous Days.

2.2.2 Control Group: Used Traditional Ice Compress (ice Packs Wrapped in Sterile Gauze) Immediately for 30 Minutes. Then Patients Used It for 5 Continuous Days.

(Note: All patients were told not to touch water on the face during the early healing days).

2.3 Observation Indicators

2.3.1 Subjective Symptoms (at 30 Min after Treatment): Used the Visual Analog Scale (VAS, 0-10 Points) to Evaluate Pain. Burning Sensation and Redness/swelling Were Scored from 0 to 3 Points.

2.3.2 Wound Healing Time: Recorded the Scab Formation Time and Total Scab Shedding Time (days).

2.3.3 VISIA Skin Analysis (at 28 Days after Treatment): Used the VISIA System to Evaluate Erythema, Porphyrins, Pores, Texture, and Brown Spots. a Higher Percentile Score Means the Skin Condition Is Better.

2.4 Statistical Computations

SPSS 27.0 software was used for statistical analysis. Measurement data were expressed as mean ± standard deviation ($\bar{x}\pm s$) and analyzed by the t-test. $P < 0.05$ meant the difference was statistically significant.

3. Results

3.1 Comparison of Subjective Symptom Scores

At 30 minutes after treatment, the pain score, burning score, and redness & swelling score in the observation group were significantly lower than those in the control group. The differences were statistically significant ($P < 0.05$). See Table 1

Table 1. Comparison of Subjective Symptom Scores at 30 Minutes Post-Treatment (X ±s, Points)

Group	n	Pain Score	Burning Score	Redness & Swelling Score
Observation	36	**3.77 ± 0.78**	**1.67 ± 0.25**	**1.74 ± 0.28**
Control	36	**8.32 ± 0.57**	**2.89 ± 0.31**	**2.43 ± 0.35**
t value	-	28.324	18.406	9.255
P value	-	< 0.05	< 0.05	< 0.05

3.2 Comparison of Wound Scabbing and Shedding Times

The scab formation time and scab shedding time in the observation group were significantly shorter than those in the control group. The differences were statistically significant ($P < 0.05$). See Table 2.

Table 2. Comparison of Wound Scabbing and Shedding Times (X ±s, D)

Group	n	Scab Formation Time	Scab Shedding Time
Observation	36	**1.93 ± 0.52**	**6.74 ± 1.36**
Control	36	**2.37 ± 0.48**	**8.52 ± 1.41**
t value	-	3.731	5.456
P value	-	< 0.05	< 0.05

3.3 Comparison of VISIA Skin Analysis Results

At 28 days after treatment, the percentile scores of erythema, texture, and brown spots in the observation group were significantly higher than those in the control group ($P < 0.05$). Porphyrins and pores had no statistically significant differences between the two groups ($P > 0.05$). See Table 3.

Table 3. Comparison of VISIA Skin Analysis Percentiles at 28 Days Post-Treatment (X ±s, %)

Group	n	Erythema	Porphyrins	Pores	Texture	Brown Spots
Observation	36	**77.6 ± 9.1**	**22.6 ± 3.5**	**37.3 ± 6.2**	**66.6 ± 7.3**	**77.3 ± 7.3**
Control	36	**65.2 ± 7.7**	**19.8 ± 2.6**	**34.9 ± 4.5**	**47.1 ± 5.2**	**55.2 ± 6.8**
t value	-	6.235	3.842	1.884	13.06	13
P value	-	< 0.05	> 0.05	> 0.05	< 0.05	< 0.05

4. Discussion

Wound healing after laser surgery is a very complex process. It needs inflammatory cells, fibroblasts, and the extracellular matrix (ECM) to work together. CO2 fractional laser destroys the stratum corneum and causes tissue necrosis. This brings an acute inflammatory response [5]. Therefore, early wound care is very important. We must restore the skin barrier quickly to prevent post-inflammatory hyperpigmentation (PIH) and persistent skin redness.

Traditional ice compress only gives temporary physical cooling. It can relieve pain for a short time, but it cannot actively rebuild the ECM. Silk fibroin is a kind of bioactive dressing. It has many functional amino acids. It can create a moist and mildly acidic microenvironment. This microenvironment can inhibit bacterial growth and help tissue regeneration [6].

In our study, the pain score (3.77 ± 0.78) and burning score (1.67 ± 0.25) in the observation group were significantly reduced. This shows that silk fibroin can stick to the wound very fast. It acts as a biological shield to protect nerve endings from external stimulation.

At the same time, the scab formation time (1.93 ± 0.52 days) and scab shedding time (6.74 ± 1.36 days) in the observation group were significantly shorter. This means silk fibroin can speed up the transition from the inflammatory phase to the proliferative phase. It can help fibroblasts move and improve local blood circulation to speed up skin healing.

Long-term results from the VISIA skin analysis also proved this point. At 28 days, the observation group had better scores in erythema, texture, and brown spots. This proves that silk fibroin can reduce vascular reactivity and prevent abnormal melanin deposition [7]. Because the skin barrier is repaired quickly, the skin quality becomes much better.

5. Conclusion

In conclusion, the application of silk fibroin dressing after CO2 fractional laser treatment is better than traditional ice compress. It can effectively reduce acute post-operative pain and inflammation, speed up wound healing, and improve long-term skin quality. It has high clinical application value for post-laser wound management.

References

[1] Zhang J, Xu F, Lin H, et al. Efficacy of fractional CO2 laser therapy combined with hyaluronic acid dressing for treating facial atrophic acne scars: a systematic review and meta-analysis of randomized controlled trials[J]. Lasers in medical science, 2023, 38(1): 214.

[2] Kim H I, Kim H S, Yi H S, et al. Scar assessment after fractional CO2 laser resurfacing using a questionnaire[J]. Medical Lasers; Engineering, Basic Research, and Clinical Application, 2022, 11(3): 166-172.

[3] Tavakolizadeh M, Pourjavadi A, Ansari M, et al. An environmentally friendly wound dressing based on a self-healing, extensible and compressible antibacterial hydrogel[J]. Green Chemistry, 2021, 23(3): 1312-1329.

[4] Mazurek Ł, Szudzik M, Rybka M, et al. Silk fibroin biomaterials and their beneficial role in skin wound healing[J]. Biomolecules, 2022, 12(12): 1852.

[5] Li Z Q, Tian S Z, Yan H W. Progress in the application of ablative fractional lasers in chronic wounds[J]. Lasers in Medical Science, 2025, 40(1): 229.

[6] Liu J, Liu W, Zhang Y, et al. Injectable High-Adhesion Fibrinogen-Silk Fibroin Hydrogel Loaded with Curcumin Accelerates Pterygium Repair via Dual Anti-Inflammatory/Antiproliferative Mechanisms[J]. ACS Applied Materials & Interfaces, 2025, 17(37): 51805-51819.

[7] Kislevitz M, Lu K B, Wamsley C, et al. Novel use of non-invasive devices and microbiopsies to assess facial skin rejuvenation following laser treatment[J]. Lasers in Surgery and Medicine, 2020, 52(9): 822-830.

