

The Combination Effect of CO₂ Laser and Topical Growth Factor Solution for Treatment of Atrophic Post-Burn Scar

Noor Taha Ismaeel^{1*}, Murtadha Al-janabi² and Ali Shukur Mahmood¹

¹*Institute of Laser for Postgraduate Studies, University of Baghdad*

²*Department of Dermatology, Faculty of Medicine, University of Kufa*

Burn scars are among the most disfiguring scars seen in clinical practice, and patients may experience physical and psychological problems due to them. Combining Fractional CO₂ Laser with Rejuvenating Complex solution (G.F.) provided an enhancement response for resurfacing therapy for post-burn scars. Treatment aimed to evaluate the response of post-burn scar for combination therapy. The sessions for each patient will be done monthly. The (G.F.) Rejuvenating Complex solution has been applied immediately after laser treatment. Thirty percent of the patients showed more than 75% improvement, 40% showed 51-75% improvement, 20% showed 25-50% improvement, and 10% showed less than 25% improvement. This line of treatment was safe and effective.

Keywords: CO₂ Laser; Topical Growth Factor; Atrophic Post-Burn Scar

I. INTRODUCTION

Both clinically and cosmetically, post-burn scars are a major issue in dermatology. The adverse effects and long treatment times associated with various therapeutic approaches for treating burn scars contribute to the patients' burden and severe morbidity (Brusselaers *et al.*, 2010). By ablating the majority of the tissue and triggering collagen remodelling and regenerative mechanisms, conventional ablative lasers, especially conventional erbium-doped yttrium aluminium garnet lasers, erbium YAG (Er: YAG), and conventional CO₂ lasers, have proven to be quite efficient in scar treatment (Tanzi & Alster, 2003). Fractional CO₂ laser therapy is now being utilized to treat a variety of scars, including burn scars, with minimal side effects and pleasing outcomes (Kauvar *et al.*, 2020; Seago *et al.*, 2020). The fractional photo-thermolysis idea allowed for considerably deep penetration, allowing for resurfacing by generating micro-columns of coagulated tissue that extend deep into the dermis while keeping the epidermis intact (Manstein *et al.*, 2004; Alster *et al.*, 2007). As a result of the injury, heat shock proteins, matrix metalloproteinases (MMPs),

transforming growth factor (TGF), and myofibroblasts are released, stimulating the production of cytokines that initiate the physiological wound healing process. The interactions of these cytokines result in appropriate scar reformation (Azzam *et al.*, 2016). Growth factor (GF) therapy has demonstrated some success in the treatment of resistant wounds such as chronic venous ulcers (Upton *et al.*, 2011), and diabetic foot ulcers (Uchi *et al.*, 2009) with favourable clinical outcomes.

This present study aimed to assess the efficacy of a combination of fractional ablative CO₂ lasers and growth factors in treating post-burn scars.

II. MATERIALS AND METHOD

This was a clinical therapeutic study conducted at the Institute of laser/ University of Baghdad during the period extending from October 2018 to October 2019. All patients agreed on written consent, after explaining the nature of the research, the nature of the disease, prognosis, treatment method, duration of follow-up, and the possible complications.

*Corresponding author's e-mail: noort1980@outlook.sa

Twelve patients were enrolled in the study; two were lost to follow-up. So, 10 patients with atrophic post-burn scar completed the study, 6 patients were females (60%), and 4 patients were males (40%). All patients with atrophic post-burn scar were treated with a CO₂ laser (Daeshin Enterprise Corp Ltd, Korea). A topical anaesthetic cream (lidocaine 2.5% and prilocaine 2.5%) was applied to the treated area for 30 minutes. The parameters of the CO₂ laser were Power 22 watt, point energy 22 mj, envil 25%, duration 1 millisecond, interval 1 millisecond. The sessions were monthly for 4 sessions. Immediately after the laser session, we applied growth factor solution (BENEV, USA) topically. The main ingredients of this solution are Epidermal Growth Factor, Fibroblast Growth Factor, Palmitoyl Tetrapeptide-7, Riboflavin, Chrysin & N-Hydroxysuccinimide. We instruct the patient to avoid sun exposure and use sunblock 2 weeks after the session.

A. Ethics

The Ethical Committee was approved by the Institute of Laser for Postgraduate Studies [No:5023].

B. Evaluation

Objectively: A photograph was taken of each scar before the treatment and at the end of the follow-up. Sony-Digital, high sensitivity, 8 megapixels, took photographs DSC-W30 still camera, at the same place, distance, and illumination. We evaluate the response 4 months after the last session by comparing the photos before starting the laser sessions and at the end of the follow-up period. We depend on comparing photos of the atrophic scars before and after the treatment, with two independent dermatologists. The response was assessed as the following:

Grade 1: improvement of less than 25%

Grade 2: 26-50% improvement

Grade 3: 51-75% improvement

Grade 4: more than 75% improvement

C. Subjectively

It was assessed by asking the patients about their satisfaction with treatment at the end of follow-up. It was

graded form (0), which means NO ANY Improvement, to (10), which means FULL improvement.

D. Statistical Analysis

This is an open-label trial; however, the statistician performing analyses is blinded for treatment assignment. Also, an investigator blinded for treatment allocation assesses radiological end-points.

III. RESULTS AND DISCUSSION

The study included 6 (60%) females and 4 (40%) males. Their ages ranged from 12 to 33 years, with a mean of 23.2 ± 6.368 years. The Fitzpatrick skin type ranged from III to IV. The cause of burns was hot liquids in 5 (50%) patients, while in 5 (50%) patients, the cause was direct fire. Generally, the trunk and the extremities are affected more. We have not recorded the scar's size or location in the results. The duration of the scar ranged from 1 to 5 years with a mean \pm SD of 2.5 ± 1.284 .

Three patients (30%) show more than 75% improvement, 4 patients (40%) show 51-75% improvement, 2 patients (20%) show 25-50% improvement and 1 patient (10%) show less than 25% improvement. The adverse effects including edema and erythema, were transient and mild. The downtime ranged from 7 – 9 days. Subjectively, 70% of the patients were satisfied with the treatment, while 30% were unsatisfied.





Figure 1. (A) Show post burn atrophic scar before the treatment; (B) Showing the response of the post burn scar to the combination of CO₂ laser and topical growth factor.

Burn scars are among the most disfiguring scars seen in clinical practice, and patients may experience physical and psychological problems due to them. There are currently just a few treatments available to improve the texture of burn scars, despite the clear need for innovative treatments that can rebuild skin texture and improve the look of burn scar tissue (Esselman *et al.*, 2006).

In the concept of lasers treatment, fractional resurfacing is a novel concept. By establishing columns of thermal damage, known as microthermal treatment zones (MTZ), the fractional approach creates a discrete thermal damage pattern and thermally modifies a part of the skin while leaving intervening sections of normal skin unaffected (Laubach *et al.*, 2006; Tannous, 2007; Ayyash & Mahmood, 2019).

A CO₂ fractional laser is an ablative laser that combines a CO₂ laser and a fractional photo-thermolysis system. The non-ablative erbium-doped 1550 nm fractional laser leaves healthy skin between the treatment zones, leading to a rapid recovery and fewer side effects (Manstein *et al.*, 2004).

The recovery time for the CO₂ fractional laser is usually longer than that for a non-ablative fractional laser, as about 7 days of crust formation can be expected (Cho *et al.*, 2010). Growth factors play a crucial role in wound healing and initiate skin repair (Figure 1) (Cho *et al.*, 2010; Penn *et al.*, 2012). Synergic interaction and communication between many growth factors determine the outcome of skin repair.

Examples include transforming growth factors involved in wound healing, including inflammation, stimulation of the following processes: angiogenesis, fibroblast proliferation, collagen production and deposition, and the new extracellular matrix remodelling (Penn *et al.*, 2012; Aust *et al.*, 2008). The crucial role of growth factors in wound healing is well established (Lee *et al.*, 2011).

Zhang *et al.* (2016) reported that the addition of growth factors significantly improved scarring and enhanced wound healing in burn scars. Also, Akita *et al.* concluded a more significant improvement in scar pliability on the growth factor treated side (Akita *et al.*, 2006).

CO₂ laser with topical growth factor may result in a synergetic effect on wound healing and scar improvement.

IV. CONCLUSION

The combination effect of CO₂ laser and topical growth factor solution seems effective and safe for treating atrophic post-burn scar.

Limitations of the study include no control group to compare the effect of combination therapy versus CO₂ laser alone for atrophic burn scar.

V. REFERENCES

- Akita, S, Akino, K, Imaizumi, T, Tanaka, K, Anraku, K, Yano, H & Hirano, A 2006, 'The quality of pediatric burn scars is improved by early administration of basic fibroblast growth factor', *Journal of Burn Care & Research: Official Publication of the American Burn Association*, vol. 27, no. 3, pp. 333–338.
- Alster, TS, Tanzi, EL & Lazarus, M 2007, 'The use of fractional laser photothermolysis for the treatment of atrophic scars', *Dermatologic Surgery: Official Publication for American Society for Dermatologic Surgery*, vol.33, no. 3, pp. 295–299.
- Aust, MC, Fernandes, D, Kolokythas, P, Kaplan, HM & Vogt, PM 2008, 'Percutaneous collagen induction therapy: an alternative treatment for scars, wrinkles, and skin laxity', *Plastic and Reconstructive Surgery*, vol. 121, no. 4, pp. 1421–1429.
- Azzam, OA, Bassiouny, DA, El-Hawary, MS, El Maadawi, Z M, Sobhi, RM & El-Mesidy, MS 2016, 'Treatment of hypertrophic scars and keloids by fractional carbon dioxide laser: a clinical, histological, and immunohistochemical study', *Lasers in Medical Science*, vol. 31, no. 1, pp. 9–18.
- Brusselaers, N, Pirayesh, A, Hoeksema, H, Verbelen, J, Blot, S & Monstrey, S 2010, 'Burn scar assessment: a systematic review of different scar scales', *The Journal of Surgical Research*, vol. 164, no. 1, pp. e115–e123.
- Cho, SB, Lee, SJ, Cho, S, Oh, SH, Chung, WS, Kang, JM, Kim, YK & Kim, DH 2010, 'Non-ablative 1550-nm erbium-glass and ablative 10 600-nm carbon dioxide fractional lasers for acne scars: a randomized split-face study with blinded response evaluation', *Journal of the European Academy of Dermatology and Venereology: JEADV*, vol. 24, no. 8, pp. 921–925.
- Esselman, PC, Thombs, BD, Magyar-Russell, G & Fauerbach, JA 2006, 'Burn rehabilitation: state of the science', *American Journal of Physical Medicine & Rehabilitation*, vol. 85, no. 4, pp. 383–413.
- Kauvar, A, Kubicki, SL, Suggs, AK & Friedman, PM 2020, 'Laser therapy of traumatic and surgical scars and an algorithm for their treatment', *Lasers in Surgery and Medicine*, vol. 52, no. 2, pp. 125–136.
- Laubach, HJ, Tannous, Z, Anderson, RR & Manstein, D 2006, 'Skin responses to fractional photothermolysis', *Lasers in Surgery and Medicine*, vol. 38, no. 2, pp. 142–149.
- Lee, MJ, Kim, J, Lee, KI, Shin, JM, Chae, JI & Chung, HM 2011, 'Enhancement of wound healing by secretory factors of endothelial precursor cells derived from human embryonic stem cells', *Cytotherapy*, vol. 13, no. 2, pp. 165–178.
- Manstein, D, Herron, GS, Sink, RK, Tanner, H & Anderson, RR 2004, 'Fractional photothermolysis: a new concept for cutaneous remodeling using microscopic patterns of thermal injury', *Lasers in Surgery and Medicine*, vol. 34, no. 5, pp.426–438.
- Mazin H Ayyash, Ali S Mahmood 2019, 'Fractional CO₂ Laser Treatment of Mild Periorbital Wrinkles in Iraqi Patients', *Iraqi Journal of Laser*, vol. 18, no. 2, pp. 21–26.
- Penn, JW, Grobbelaar, AO & Rolfe, KJ 2012, 'The role of the TGF- β family in wound healing, burns and scarring: a review', *International Journal of Burns and Trauma*, vol. 2, no. 1, pp. 18–28.
- Seago, M, Shumaker, PR, Spring, LK, Alam, M, Al-Niaimi, F, Rox Anderson, R, Artzi, O, Bayat, A, Cassuto, D, Chan, H H, Dierickx, C, Donelan, M, Gauglitz, GG, Leo Goo, B, Goodman, GJ, Gurtner, G, Haedersdal, M, Krakowski, A C, Manuskiatti, W, Norbury, WB & Waibel, J 2020, 'Laser Treatment of Traumatic Scars and Contractures: 2020 International Consensus Recommendations', *Lasers in Surgery and Medicine*, vol. 52, no. 2, pp. 96–116.
- Tannous, Z 2007, 'Fractional resurfacing', *Clin Derm*, vol. 25, no. 5, pp. 480–486.
- Tanzi, EL & Alster, TS 2003, 'Single-pass carbon dioxide versus multiple-pass Er:YAG laser skin resurfacing: a comparison of postoperative wound healing and side-effect rates', *Dermatologic Surgery: Official Publication for American Society for Dermatologic Surgery*, vol. 29, no. 1, pp. 80–84.
- Uchi, H, Igarashi, A, Urabe, K, Koga, T, Nakayama, J, Kawamori, R, Tamaki, K, Hirakata, H, Ohura, T & Furue, M 2009, 'Clinical efficacy of basic fibroblast growth factor (bFGF) for diabetic ulcer', *European Journal of Dermatology: EJD*, vol. 19, no. 5, pp. 461–468.
- Upton, Z, Wallace, HJ, Shooter, GK, van Lonkhuyzen, DR, Yeoh-Ellerton, S, Rayment, EA, Fleming, JM, Broszczak, D, Queen, D, Sibbald, RG, Leavesley, DI & Stacey, MC 2011, 'Human pilot studies reveal the potential of a vitronectin: growth factor complex as a treatment for chronic wounds',

International Wound Journal, vol. 8, no. 5, pp. 522–532.

Zhang, Y, Wang, T, He, J & Dong, J 2016, 'Growth factor therapy in patients with partial-thickness burns: a systematic review and meta-analysis', International Wound Journal, vol. 13, no. 3, pp. 354–366.