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Fractional CO_2 Laser Therapy for Effective Treatment of Facial Traumatic Hypertrophic Scar: A Case Report

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Data Collection B
Statistical Analysis C
Data Interpretation D
Manuscript Preparation E
Literature Search F
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Patient: Female, 57-year-old
Final Diagnosis: Hypertrophic rigid post-traumatic scar on the left side of patient's face following a car accident
Symptoms: Patient aesthetic discomfort and difficulty moving the jaw
Clinical Procedure: —
Specialty: Dermatology

Objective: Management of emergency care

Background: Hypertrophic scars occur when there is an excessive wound-healing response in the skin. Fractional, or fractionated, carbon dioxide (CO_2) laser therapy uses narrow shafts of light to smooth the skin surface and stimulate dermal collagen, which tightens the skin. This case report describes a 57-year-old woman with a traumatic hypertrophic scar of the face treated with fractional carbon dioxide laser therapy. The purpose of this case report was to highlight the role of fractional CO_2 laser therapy in treatment of a facial traumatic hypertrophic scar in a patient after a motor vehicle crash.

Case Report: A 57-year-old female patient presented with a hypertrophic, rigid, post-traumatic scar on the left side of her face following a motor vehicle crash. For the hypertrophic scar removal, the patient underwent 1 treatment session with fractional CO_2 laser using the μ-Scan DOT scanning system. After 1 laser treatment session, the photographic documentation, which permits monitoring the treatment's effectiveness in esthetic improvement, showed a significant improvement in scar texture and color. In addition, a significant reduction in scar height was observed following laser therapy. Fractional laser treatment with the device was very well tolerated by the patient, who reported no pain or discomfort, complications, or adverse effects either during treatment or in the follow-up period (3 months).

Conclusions: This report demonstrates the cosmetic application of fractional carbon dioxide laser therapy in a case of hypertrophic scar with the use of an effective therapeutic protocol that did not require the use of suturing.

Keywords: Laser Therapy • Lasers, Gas • Skin Manifestations

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Background

Complex trauma and burns on the skin occasionally result in abnormal skin healing, known as "hypertrophic scarring" [1]. Scarring is a common, serious, long-term complication of burn injuries or skin trauma [2]. Some systemic factors can increase the risk of hypertrophic scarring, such as infection, genetics [3], systemic inflammation after burns, or multiple episodes of trauma to the same area (such as wearing earrings or piercings) [4].

The inflammatory infiltrate maintains and enlarges very large bundles of collagen fibers in hypertrophic scars. Traumatic injuries (motor vehicle crashes or contact with asphalt, exploding substances, or pencil puncture wounds), and surgical and cosmetic procedures can cause pigmented hypertrophic scars [5,6]. The body's natural method of repairing and replacing lost or damaged skin is producing a scar. Scars can form anywhere on the body, and their anatomy is subject to variability. A scar can be painful or itchy, and it may have a lumpy, flat, sunken, or colored appearance. The final form of a scar is influenced by a number of variables, including the individual's age, nutritional status, skin type, where the injury occurred on the body, and direction of the wound. Scars typically fade with time [7].

Another kind of wound healing, the keloid scar, is frequently confused with hypertrophic scarring, but this is incorrect. The excess connective tissue formed in hypertrophic scarring remains within the original incision. However, the excess connective tissue formed in the keloid expands beyond the original lesion. The diagnosis is usually made clinically. However, if a hypertrophic scar or keloid continues to worsen or change, a biopsy may be necessary [4].

Certain dermatological techniques (eg, chemical peels, dermabrasion, cortisone injections) can help to reduce the appearance of some scars. Surgery combined with other adjunctive techniques such as intralesional steroids, radiotherapy, and pressure therapy results in a variety of outcomes [8]. Traditionally, compression therapy has been used in the management of burn wounds, but a meta-analysis found that compression therapy did not demonstrate effectiveness in altering the progression of hypertrophic scars. Targeting particular biochemical pathways may hold the key to the future of burn wound care. These include treatments targeting the RAS/MEK/ERK pathway, the Notch route, the TGF-beta pathway, the WNT/beta-catenin pathway, and the Sonic hedgehog pathway [4-10].

Laser therapy can be an effective treatment of hypertrophic scars, and it is often used to treat hypertrophic scars caused by burns. Laser therapy improves the color of the hypertrophic scar and can reduce the height of the scar and the tension on the scar.

Among these, CO_2 lasers generate more heat and cause higher coagulation of small blood vessels in the dermis than other lasers, such as the erbium-doped yttrium-aluminum-garnet laser, resulting in much less bleeding when a wide surface area is ablated [11]. Cosmetic indications for CO_2 laser resurfacing include prophylaxis and treatment of precancerous lesions and skin tumors of keratinocytes, cutaneous vascular lesions, treatment of photoaging, rhytides, and the reduction of the appearance of scars caused by acne, trauma, or surgical procedures [12,13]. However, there are a number of contraindications to CO_2 laser resurfacing. Many of the disadvantages of conventional laser resurfacing can be prevented by fractional CO_2 laser resurfacing.

Indeed, it has been demonstrated that burn scars, postsurgical scars, and atrophic acne scars can be successfully treated with fractional CO_2 laser resurfacing [14-19]. When using a fractional treatment, only a portion of the entire skin is treated, in a pixelated pattern, leaving the surrounding skin unaffected. This enables doctors to perform a much deeper procedure than with conventional laser resurfacing. Furthermore, the negative effects of the fractional technique are temporary and less severe than those of full skin resurfacing [20].

This case report describes a 57-year-old woman with a traumatic hypertrophic scar of the face treated with fractional carbon dioxide laser therapy.

Case Report

A 57-year-old woman presented with concern regarding a post-traumatic scar after a motor vehicle crash. She had a hypertrophic rigid scar on the left side of the face with uneven edges, that pulled the left corner of the mouth downwards, causing the patient aesthetic discomfort. The exclusion criteria were systemic dermatologic conditions (ie, eczema), autoimmune disorders, uncontrolled diabetes, pregnancy, and pigmentary disorders.

For the hypertrophic scar removal, the patient underwent 1 treatment session with a Glide CO_2 laser (DEKA M.E.L.A., Calenzano, Italy) using the µ-Scan DOT scanning system. Topical numbing cream with 24% lidocaine was used for anesthesia and was applied before each treatment session. The device can provide various laser emission modes, including 3 ultra-pulsed shapes: high peak pulse (HP), smart pulse (SP), and continuous pulse (CW) [21].

With the variety of available pulse modes, this technology allows for the induction of various tissue biological effects. In particular, the SP pulse mode causes more homogeneous coagulation of the surrounding tissues, so it is used for the hemostatic

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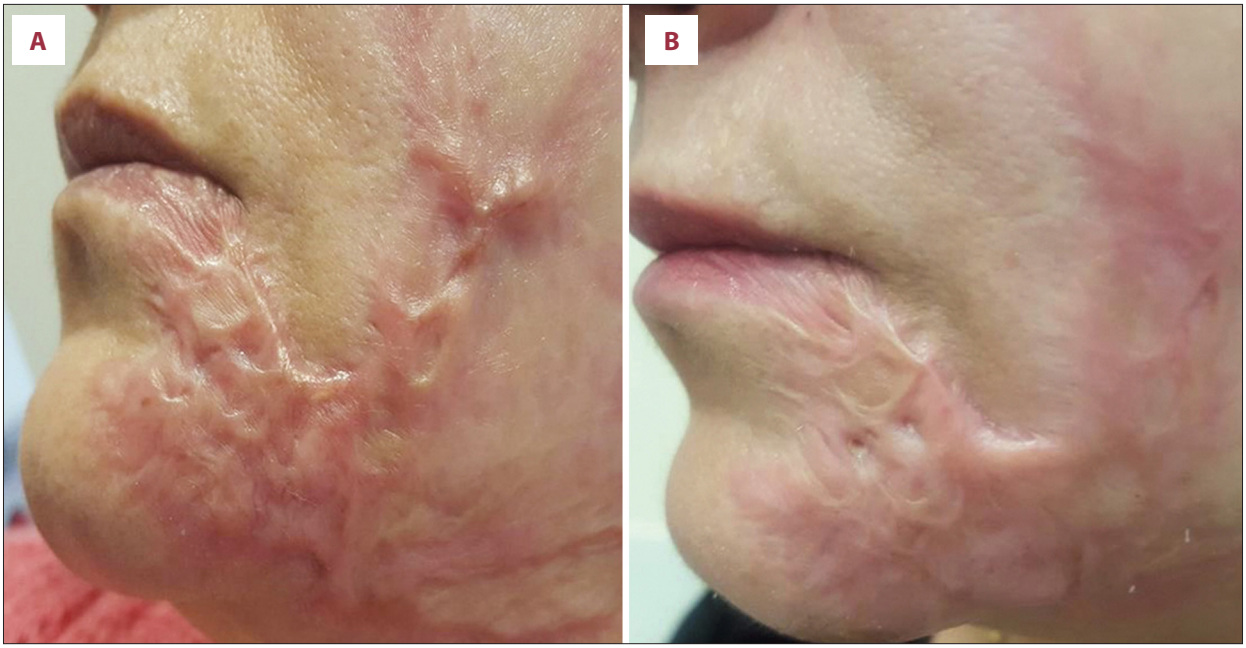


Figure 1. A woman with a traumatic hypertrophic scar on the left side of the face with uneven edges, before (**A**) and after 1 laser therapy session. (**B**) A noticeable improvement in skin texture and color, associated with a partial regression of the hypertrophic scar, was observed.

process. On the contrary, with the HP pulse, which has a higher power peak than the SP mode, it is possible to obtain a colder effect on the tissues and, if necessary, greater ablation. Laser therapy was applied according to the following setting parameters: HP pulse, Power of 15 W, Stack 2 and Spacing of 600 µm.

In this case report, the area was treated by scanning dots in random order. Developed to enhance post-treatment recovery, this scanning mode minimizes the risk of tissue overheating and avoids thermal damage.

For postoperative care, a thermal water-based lotion, cold compress, and sun protection were prescribed (sun exposure avoidance for at least 2 weeks). The use of moisturizing and emollient lotions helped to maintain a uniform and compact aspect of the new skin. Some possible adverse effects such as dyschromia, burning sensation, bleeding, and mild-to-moderate post-treatment erythema, itching, crusting, and edema were monitored. A photographic evaluation of the scar was made to monitor the treatment's effect on the patient's aesthetic improvement. After 1 laser treatment session, the photographic documentation showed a significant improvement in scar texture and color, as clearly shown in **Figure 1**. We found a significant reduction in scar height following laser therapy. Furthermore, the patient recovered mandibular mobility after just 1 laser treatment session.

The fractional laser treatment with the abovementioned device was very well tolerated by the patient, who reported no pain or discomfort, no complications, and no adverse effects during treatment or in the follow-up period (3 months). The patient provided informed consent regarding the risks, benefits, and treatment options, and the protocol used was according to the Helsinki Declaration's ethics guidelines.

Discussion

This study findings, as shown by clinical photographic evaluation, revealed that after just 1 laser treatment session, there was visible improvement in scar texture and color, with partial regression and a significant reduction in scar height. The patient experienced no pain or discomfort, problems, or negative effects during the treatment or throughout the entire follow-up period, indicating that the fractional laser treatment was very well tolerated.

Due to its potential to be painful, itchy, erythematous, raised, and esthetically unacceptable, hypertrophic scarring following trauma poses a serious concern for patients and a challenge for clinicians [22]. Hypertrophic scars generally appear raised, but rarely more than 4 mm above the skin. They tend to be hard, red or pink, and itchy. The fractional CO_2 laser is the primary laser used for hypertrophic scar treatment [23]. When CO_2 is used as a fractional laser, intracellular water is targeted and vaporized, leading to coagulation of surrounding extracellular proteins [24,25]. An increase in the ratio of type III collagen compared to type I collagen was noted in histology when a mature scar was treated with a fractional CO_2 laser [26].

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The previously published studies and case reports mentioned in the present report's introduction section showed similar results for the improvement of traumatic scars following use of fractional CO_2 lasers. Meynköhn et al [19] demonstrated that the ablative fractional carbon dioxide laser offers a safe and effective treatment for disfiguring facial scars, showing an improvement of scar appearance with a significant impact on a patient's life quality. Similar to our findings, good scar healing was achieved with just 1 laser treatment.

The effectiveness of the same study device in the treatment of postsurgical scars, keloids, and hypertrophic scars after laser therapy was previously demonstrated by Fiorentini et al and Andrade et al [16,17], in which good results were quickly achieved at the same follow-up time points and without any complications.

In the present report, use of fractional CO_2 laser in the early phase of wound healing showed excellent, clinically detectable improvement. We found that use of a fractional CO_2 laser had mostly positive effects, showing that the collagen remodeling in the treated scar closely resembled normal skin, as shown by the patient's clinical images.

Fractional CO_2 resurfacing treatment requires short recovery times, with a partial restructuring of the epidermis, tissue shrinkage, and formation of new collagen. Scanning systems that generate thermal effects in small areas (20%) surrounded by healthy tissues allow for faster healing with no adverse effects, which is why the patient tolerated the fractional resurfacing and only needed a short recovery time after each session. The scanner used in this case report had a small spot size (120 microns), which may be optimal for rapid epidermal wound healing by minimizing the keratinocyte migration path or period. The fractional approach combined with an optimal treatment coverage or spot density and pulse energy allows for a favorable ratio of viability to the treated tissue.

In addition, the presence of epidermal cooling has been proven to be a helpful adjuvant therapy to lessen adverse effects. Indeed, in our investigation, the study protocol included the use of a skin cooling system (SmartCryo) during all the laser sessions. Furthermore, the technology used during this investigation had the advantage that the laser's depth and density could be modified depending on the thickness of the scar.

Conclusions

This case report has demonstrated the cosmetic application of fractional carbon dioxide laser therapy to a hypertrophic scar with the use of an effective therapeutic protocol, which did not require the use of sutures and with good wound healing. The CO_2 laser treatment was well tolerated and avoided adverse effects and lengthy recovery time.

Declaration of Figures' Authenticity

All figures submitted have been created by the authors who confirm that the images are original with no duplication and have not been previously published in whole or in part.

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