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Synergistic Sequential Emission of Fractional 1540 nm and 10 600 Lasers for Abdominal Postsurgical Scar Management: A Clinical Case Report

Authors' Contribution:
Study Design A
Data Collection B
Statistical Analysis C
Data Interpretation D
Manuscript Preparation E
Literature Search F
Funds Collection G

ABCD 1 Federica Fiorentini
DEF 2 Irene Fusco

1 Department of Dermatology and Aesthetic Medicine, Studio Medico Basoccu, Rome, Italy
2 Department of Clinical Research and Practice, El.En. Group, Calenzano, Italy

Corresponding Author: Irene Fusco, e-mail: i.fusco@deka.it
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Patient: Female, 45-year-old
Final Diagnosis: Improvement of scar
Symptoms: Noticeable extensive suprapubic following abdominoplasty
Medication: —
Clinical Procedure: —
Specialty: Dermatology

Objective: Rare coexistence of disease or pathology

Background: Abdominal scars can develop following abdominoplasty interventions and can cause severe functional and aesthetic disabilities. Surgery is almost no longer necessary thanks to the accessibility of more recent and sophisticated technology like lasers. Many ablative and non-ablative photothermolysis technologies and equipment have been developed, giving patients and medical professionals more alternatives but also complicating the system to be utilized and the methods to maximize the outcomes. The aim of the current study was to evaluate the volumetric action of 1540 wavelength and the efficacy and safety of the synergic sequential application of a new fractional ablative 10 600 nm CO_2 and non-ablative 1540 nm lasers on abdominal postsurgical scar management.

Case Report: We treated a female patient with an abdominal suprapubic scar following abdominoplasty. The patient underwent 3 treatment sessions (with a frequency of 1 session every 50 days) with 1 pass over the entire suprapubic area using 10 600 nm CO_2 fractional laser emission and 1540 fractional laser emission in simultaneous modality. A photographic evaluation was made to monitor the effect of the treatment on the aesthetic appearance of the patient's suprapubic scar. After 6 months, the photographic assessment showed a significant improvement in scar texture and color. No patient pain or adverse effects were detected.

Conclusions: This case report describes the possibility of effectively treating abdominal suprapubic scars following abdominoplasty surgery with simultaneous and combined irradiation of 10 600 nm and 1540 nm wavelengths.

Keywords: Abdominal Suprapubic Scar • Abdominoplasty • CO_2 Fractional Laser Emission • 1540 Fractional Laser Emission • Synergic Sequential Emissions

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Background

The number of abdominoplasty surgeries performed has been steadily rising during the past 10 years [1]. Abdominoplasty complications include hematoma, infection, seroma, skin necrosis, hypertrophic scars, neurological symptoms, suture extrusions, umbilical anomalies, pulmonary thromboembolism/deep venous thrombosis, respiratory disorders, and death [2]. Among these, depending on the degree of distortion, abdominal hypertrophic scars have a significant psychological and social impact [3]. Management strategies for abdominoplasty scars include punch grafts, postsurgical scar revision/excision, steroid applications/injections, and laser treatment. However, most of them, particularly surgery management, must be done under local anesthesia and with outpatient procedures resulting in a slow return to work. The availability of more recent and sophisticated technologies, such as lasers, has all but eliminated the need for surgery. With the introduction of more ablative and non-ablative photothermolysis technologies and apparatus, doctors and patients now have more alternatives, but the complexity of the system utilized and the methods to improve the outcomes have also increased [4,5]. By promoting collagen and fibroblasts, fractional ablative CO_2 lasers have been demonstrated to be a promising and prospective treatment for enhancing burn scar function/appearance and skin regeneration [6-9]. Moreover, 1540 nm non-ablative fractional lasers can be used to flatten the scar through the delivery of light in an array of narrow, focused micro-beams to create coagulation columns within the skin. This produces an improvement in the skin's appearance without the risk of inflammation [10-12]. Recent scientific findings demonstrated that the simultaneous combination of the CO_2 laser wavelengths of 10 600 nm and 1540 nm non-ablative laser is a valid treatment choice for skin remodeling. In addition, to reduce downtime and pain for patients during treatments, the combination of ablative and non-ablative fractional CO_2 lasers produced better skin remodeling results than either laser used alone [13-16]. Based on the existing literature, the purpose of the current study was to assess the volumetric action of the 1540 wavelength, and the efficacy and safety of the synergistic sequential application of a new fractional ablative 10 600 nm CO_2 and non-ablative 1540 nm lasers on abdominal postsurgical scar management.

Case Report

Our patient was a 45-year-old woman, in general good health, with a body mass index (BMI) of 22.3 Kg/m^2, a Fitzpatrick skin grade of III, and a history of abdominoplasty. Following surgery, the patient had a noticeable extensive suprapubic scar. She did not have any history of keloid formation following prior surgeries.

After 12 months, the scar was not healing, so the patient decided to undergo laser treatment. The following conditions were excluded in the patient: systemic dermatologic conditions (eg, eczema), autoimmune disorders, uncontrolled diabetes, pregnancy, and pigmentary disorders. Informed consent was obtained regarding the risks, advantages, and treatment options. For the abdominal scar removal, the patient underwent 3 treatment sessions with a dual-wavelength system (DuoGlide, DEKA M.e.l.a Srl, Florence, Italy). To work with the fractioned scanning units (μScan DOT), the system creates a multi-technology that includes a 10 600 nm CO_2 laser device (60 W) and a 1540 nm diode laser (10 W). A tunable balance between ablation and coagulation depths is possible, with the scanner able to deliver 1 or both wavelengths (1540 nm and 10 600 nm) in sequential emission mode on the same DOT, which is the area that includes both the microscopic ablative zones (MAZs) and microscopic thermal zones (MTZs) in the tissue. This enables the delivery of new and more effective treatments. Utilizing the 1540+CO_2 sequence, 1 pass across the whole suprapubic region is made, and both wavelengths simultaneously affect the skin. For the 10600 nm wavelength, power of 16 W, pulse width of 1 millisecond, and stack 2 and 500 μm of spacing were used, whereas for the 1540 wavelength, power of 3 W and pulse width of 5 milliseconds with stack 2 was used. The treatment sessions were performed once every 50 days. The protocol was in conformity with the ethics guidelines of the Helsinki Declaration (1975). A local cream and/or subcutaneous anesthesia were applied before each treatment session. A thermal water-based lotion, cold compression, and sun protection were used for postoperative care (sun exposure avoidance for at least 2 weeks). It is suggested to wait for 1 day before having a shower (hot water avoidance on the treated area until healing is complete). The use of moisturizing and emollient lotions is suggested without any time limitation, which helps to maintain a uniform and compact aspect of the new skin. We monitored for possible adverse effects such as dyschromia, burning sensation, bleeding, and mild to moderate post-treatment erythema, itching, crusting, and edema. Photographic evaluation of the suprapubic scar was performed to monitor the treatment's effect on aesthetic appearance. Sixty days after the last treatment session, the photographic assessment showed a significant improvement in scar texture and color, as clearly shown in **Figure 1**. The patient reported no pain or discomfort, and no complications or adverse effects were observed either during treatment or in the follow-up period.

Discussion

The literature reports neocollagenesis, epidermal thickening, and enhanced elastic fibers in various histological investigations employing non-ablative lasers [17]. However, ablative

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Figure 1. Aesthetic improvement of the patient's suprapubic abdominal scar before (**A**) and 60 days after the last treatment session (**B**) (6-month follow-up).

lasers have higher effectiveness than non-ablative ones. Since the therapeutic advantages (tissue coagulation and contraction effects) are synergistically enhanced by the particular sequential emission on the single DOT, precise wavelength selection is required. This also increases the safety profile by reducing post-treatment downtime.

Specifically, while the CO_2 laser acts fractionally, the second wavelength of 1540 nm, thanks to its special spatial shape, allows for homogeneous and contiguous non-coagulative heating over the entire scan area, reaching significant depths in the dermis (not gently reachable with the ablative laser alone without increasing the CO_2 energy), in a non-ablative way.

By adjusting the power and pulse duration (dwell time) parameters, the system emits a perfectly controlled energy/DOT. Lastly, the "DOT spacing", which defines the portion of the tissue that will not be exposed to CO_2 irradiation, can be selected.

The second wavelength of 1540 nm emits on the same axis as the DOT with a spot area in the order of 1000 µm, and the use of typical CO_2 spacing parameters (approximately 500 µm) used in the literature for dermatological applications [18,19]. The CO_2 and infrared wavelengths function in sequence, extending and enhancing the heat impact for more efficient tissue remodeling while always ensuring the healing timeframes of the fractionated emission modes.

Our study is one of the few available in the literature that reports the efficacy of this synergistic sequential emission of fractional 10 600 and 1540 nm lasers for the treatment of abdominal postsurgical scars.

The photographic evaluation clearly shows an improvement in the patient's abdominal scar 60 days after the last treatment session. This demonstrates that this new scanner system is a valid treatment option for remodeling deep scars, minimizing the risk of post-treatment hyper- and hypo-pigmentation thanks to the smaller spot size that generates greater depth of the action with reduced energy.

In terms of improved scar skin tone and texture, these fractional treatment results were visible immediately after the first session and continued to improve for 3-6 months, making

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the device a promising and valid therapeutic option for scar management.

Recent published studies [20,21] demonstrated the efficacy of low-energy fractional carbon dioxide laser therapy in management of postsurgical hypertrophic scars, emphasizing

that, otherwise, natural regression of all hypertrophic scars usually takes years. This has a severe psychological impact on patients and affects their social life. This study describes the possibility of effectively treating abdominal suprapubic scars following abdominoplasty surgery with a simultaneous and combined irradiation of the 2 wavelengths: 10 600 nm and 1540 nm.

Study limitations

Our future goal will be to increase the of number cases and make a scale with a significance score range for the evaluation of scars. Further studies involving more patients are needed to confirm the effectiveness of treatment.

Conclusions

This case report describes the possibility of effectively treating abdominal suprapubic scars following abdominoplasty surgery with a simultaneous and combined irradiation of the 2 wavelengths 10 600 nm and 1540 nm.

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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