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*Letter to the Editor*

# Scar Prevention by Laser-Assisted Scar Healing (LASH): A Pilot Study Using an 810-nm Diode-Laser System

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Normal wound healing of the skin results in a flat and flexible scar. The ideal end point would be total regeneration, with the new tissue having the same structural, aesthetic, and functional attributes as the original uninjured skin. Scars are often considered trivial, but they can be disfiguring and aesthetically unpleasant and cause severe itching, tenderness, pain, sleep disturbance, anxiety, and depression [1].

Cosmetic results obtained after skin surgery are a key component of patient satisfaction. Surgical skin scars are a type of scar that can benefit from laser therapy. Redness and telangiectasia developing in such scars usually spontaneously remit, but often slowly and incompletely. Laser can not only accelerate this decolorizing process, it can also advance the end point closer to the complete absence of redness with improvement in scar texture and pliability with minimal side effects [2]. Recently, Capon et al. [3] showed the ability of a 815-nm diode-laser system to assist wound closure leading to an acceleration and an improvement of wound healing with indiscernible resulting scar in hairless rats.

The purpose of this study was to improve the appearance of scars, by improving through a thermal action the wound healing process. This thermal action was generated by an 810-nm laser source. This specific wavelength choice ensured a minimal epidermal damage as neither blood nor water can absorb at this wavelength. This pilot study aimed at evaluating the 810-nm diode-laser system to accelerate and improve the healing process in surgical scars, immediately after skin closure, of patients with Fitzpatrick skin type I–IV.

Five patients (five females) with Fitzpatrick skin types I–IV and fresh surgical scars of greater than 2 cm (i.e., horizontal scars from abdominoplasty) were enrolled in this prospective pilot study (Table 1). This clinical trial has been approved by the Ethics Committee (Comité Consultatif de Protection des Personnes en Recherche Biomédicale (CCPPRB) de la région Nord Pas-de-Calais). Patients under 18 years of age, with dark skin (phototypes V or VI), pregnant women, and patients with a history of malignant tumor skin disease, bacterial or viral infectious skin disease, immunosuppression and treated by a long-term corticosteroids treatment were excluded. Patients were treated with fluence comprised between 80 and 120 J/cm$^2$, in order to evaluate safety and performance of the 810-nm diode-laser system.

Each surgical incision was divided into two fields, with 8 cm receiving an 810-nm diode-laser treatment (4 mm diameter beam, continuous wave, total exposure duration: 3–4 seconds). The other part was not treated. Treated and untreated portions were selected randomly. Scars were evaluated for pigmentation, vascularity, pliability, and height by surgeon and patient at 10 days, 3 months, and 12 months. A comparative scar evaluation based on cosmetic appearance using a visual analog scale from −5 (worst) to 5 (best) was performed by surgeon and patients. Overall appearance ratings ranging from an optimum of 1 to a minimum of 4 (1 = excellent, 2 = good,

**TABLE 1. Patients' Characteristics (Age, Sex, and Skin Types), Treated Sites and Fluences Used**

| Patient | Age | Sex | Skin type | Location | Fluence (J/cm$^2$) | Side effects |
|---|---|---|---|---|---|---|
| 1 | 35 | F | III | Breast | 93 | 0 |
| 2 | 47 | F | II | Abdomen | 104 | Superficial burn |
| 3 | 48 | F | II | Abdomen | 87 | 0 |
| 4 | 49 | F | III | Abdomen | 116 | Superficial burn |
| 5 | 53 | F | II | Abdomen | 87 | 0 |

Fitzpatrick skin types.

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**TABLE 2. Overall Appearance Ratings Estimated by the Surgeon and the Patients (at 10 Days, 3 Months, and 12 Months)**

| | Appearance ratings treated/control portions 10 days | | Appearance ratings treated/control portions 3 months | | Appearance ratings treated/control portions 12 months | |
|---|---|---|---|---|---|---|
| Patient | Surgeon | Patient | Surgeon | Patient | Surgeon | Patient |
| 1 | Good/Good | Good/Good | Good/Good | Good/Good | Excellent/Good | Excellent/Good |
| 2 | Good/Good | Good/Good | NA | NA | Excellent/Good | Good/Fair |
| 3 | NA | NA | NA | NA | Excellent/Good | Excellent/Good |
| 4 | Good/Good | Good/Good | Good/Good | Good/Good | Excellent/Good | Excellent/Good |
| 5 | Good/Good | Good/Good | Fair/Good | Fair/Good | Good/Good | Good/Good |

Overall appearance ratings ranging from an optimum of 1 to a minimum of 4 (1 = excellent, 2 = good, 3 = fair, 4 = poor) were also assigned to each segment at each time point.
NA, not assessed.

3 = fair, 4 = poor) were also assigned to each segment at each time point. Each treatment and control scar or scar segment was photographed under standard lighting conditions with the same pair of digital cameras immediately before laser treatment and at each follow-up visit.

The results showed that there were no significant differences in scar appearance between the control and treated scar portions at 10-day and 2–3-month follow-ups. At the final scar analysis (12 months), the treated portion scored significantly better for the surgeon and for patients compared with the controls (Table 2). After laser treatment, treated scar portions demonstrated better quality as measured either by the surgeon or patients as compared with untreated scar portions, with average score of 3.0 and 3.8 respectively (Photos 1 and 2) (Figs. 1 and 2). Patients reported greater satisfaction than the surgeon in the treated scar portions (Table 3).

No significant complications occurred during the course of this study. Two patients experienced superficial burn on the treated portion of the scar, which resolved in about 5–7 days.

More recent studies looked at the treatment of scars starting on the day of suture removal. Nouri et al., [4] using a 585 nm laser, found a beneficial effect with three laser treatments. Conologue and Norwood [5] showed a significant improvement of 60% in laser treated scars with a 595-nm pulsed dye laser compared with the controls of −3%. The recent study of Alam et al. [2] reported both improvement with time of surgical scars, with a single pulsed dye laser not providing any additional benefit. Other studies suggested that the initiation of laser treatment within the first few weeks after injury may prevent adverse scar proliferation [6,7].

This study reports for the first time the possibility to improve the appearance of scars, by altering through a thermal stress the wound healing process. Souil et al. [8] reported a markedly induction of hsp70 in skin structures examined after an 815-nm diode-laser exposure. Although not yet fully understood, thermal stress by stimulating hsp70 production, transforming growth factor (TGFβ) modulation and finally the collagen proliferation may result in cutaneous scarring [8,9].

**TABLE 3. Comparative Scar Assessment Estimated by the Surgeon and the Patients (at 10 Days, 3 Months, and 12 Months)**

| | Comparative scar assessment 10 days | | Comparative scar assessment 3 months | | Comparative scar assessment 12 months | |
|---|---|---|---|---|---|---|
| Patient | Surgeon | Patient | Surgeon | Patient | Surgeon | Patient |
| 1 | 0 | 0 | 2 | 1 | 4 | 4 |
| 2 | 0 | 0 | NA | NA | 4 | 5 |
| 3 | NA | NA | NA | NA | 3 | 4 |
| 4 | 0 | 0 | 0 | 0 | 2 | 3 |
| 5 | 0 | 0 | −2 | −1 | 2 | 3 |
| Total | 0 | 0 | 0 | 0 | +15 | +19 |
| Average score | 0 | 0 | 0 | 0 | 3 | 3.8 |

Comparative scar evaluation was based on cosmetic appearance using a visual analog scale from −5 (worst) to 5 (best) after laser treatment at 10 days, 3 months, and 12 months.
NA, not assessed.

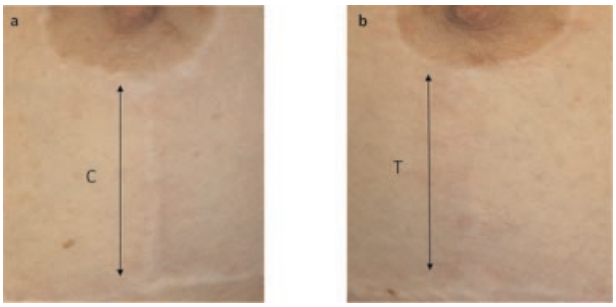


Fig. 1. Result of one clinical case (breast, vertical scar) treated with high dose (87 J/cm$^2$). **a**: Female patient (35-year-old) non treated. **b**: Female patient (35-year-old) treated by laser. The treated portion (T) and the control portion (C) are indicated.

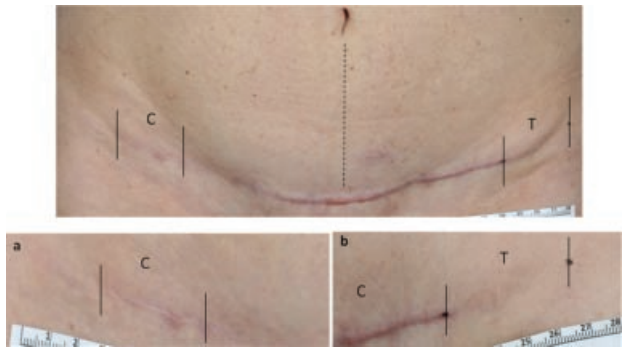


Fig. 2. Result of one clinical case (abdominoplasty) treated with high dose (104 J/cm$^2$). **a**: Female patient (47-year-old), scar portion non treated. **b**: Female patient (47-year-old), scar portion treated by laser. The treated portion (T) and the control portion (C) are indicated.

In conclusion, these preliminary results suggest that early diode 810-nm laser treatments can change fundamentally the physiology of wound healing if applied in the early phases. Further studies may be warranted to optimize 810-nm diode laser parameters for scar revision, and to understand the cellular mechanisms leading to laser-induced wound healing. LASH could be certainly utilized to improve scar appearance of hypertrophic and keloid scars.

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