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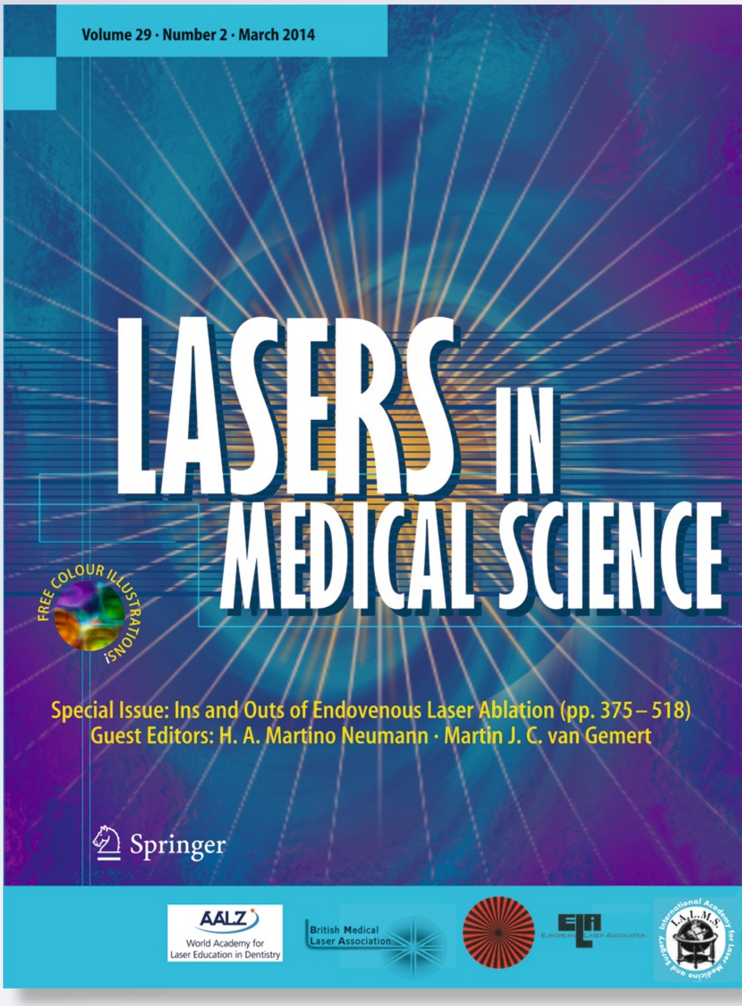

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BRIEF REPORT

Fractional CO_2 laser in the treatment of facial scars in children

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Abstract Facial scars in children have a profound psychosocial impact and require early and aggressive treatment. In this age group in particular, however, attention must be placed on the methodology so as not to trigger additional trauma—whether physical or emotional—as a sequela to the treatment. We assess the safety and efficacy of fractional CO_2 in a prospective study of pediatric facial scars from various etiologies. Twenty four children, age 2–16 years, underwent fractional CO_2 laser resurfacing. Recovery, clinical response, and adverse events were monitored at 3 days, 1 week, 1 month, 2 months, and 6 months. Photographs taken before treatment and 2 months after final treatment were independently evaluated and scored by two physicians. All patients tolerated treatment well, with minimal erythema an edema. The clinical improvement was scored as excellent in 14 patients (58 %), good in 7 (29 %), and fair in 3 (13 %). No cases were graded as poor or worse. No adverse events were noted. The study supports the use of fractional CO_2 resurfacing of pediatric facial scars as well tolerated and effective. Given the particularly rapid healing and clinical improvement of pediatric skin, fractional CO_2 treatment should be offered early to mitigate both the physical and psychosocial stigmata of scars as early as possible.

Keywords Scar · Fractional photothermolysis · Co2 laser · Resurfacing · Pediatric

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Introduction

Despite the advances in treating scars, pediatric scar management continues to be a major challenge. Facial scars in children are most commonly due to hemangiomas and burns, and less commonly to trauma, infectious diseases, and inflammatory disorders. Facial scars can have a profound psychosocial impact, particularly in children. Surgical reconstruction is sometimes advised, but the most favorable outcome for improving skin texture is achieved by facial resurfacing. Fractional photothermolysis, introduced in 2004, lays down a matrix of energy beams to form an array of microscopic thermal wounds (microscopic treatment zones), to stimulate a therapeutic response in the dermis [1]. Non-ablative fractional photothermolysis at wavelengths of 1,550 and 1,540 nm has been found to be effective for the treatment of scars, but fractional ablative laser has gained popularity in the last years due to its potentially greater efficacy in the treatment of both the dermal and epidermal components of scar tissue [2–7]. The current study describes our clinical experience with carbon dioxide fractional laser resurfacing in the treatment of facial scars in children.

Methods

The study group consisted of 24 children aged 2–16 years (mean age, 4.2), who were treated in the laser unit of Rabin Medical Center, Israel, between 1 January 2008 and 31 December 2011. All patients presented with mild to severe facial scars. Six patients had Fitzpatrick skin type II, 12 had Fitzpatrick type III, five had Fitzpatrick type IV, and one had Fitzpatrick type V. The causes for the scars were varied: 12 were sequelae of segmental hemangiomas, 6 were burns, 2 were caused by motor vehicle accidents, 2 were sequelae of

Fig. 1 A 15-year-old girl; facial scar induced by hemangioma. Before and 6 months after two treatments, parameters 25 W and 200 ms pulsed duration

cutaneous leishmaniasis, 1 was incurred during a terrorist attack, and 1 was the residua of pyoderma gangrenosum. All of the scars were mature and stable. None of the patients had undergone prior skin resurfacing. Exclusion criteria were photosensitivity, use of photosensitizing drugs, history of scarring after vaccinations, or active skin disease in the treatment area. Patients' parents were provided with a detailed description of the purpose and possible outcomes of treatment and signed informed consent forms.

In 20 of the 24 patients, treatment was performed under general anesthesia, with an attending anesthesiologist. In four patients with localized lesions, treatment was performed after local infiltration of 1 % lidocaine. The fractional ablative photothermolysis was performed with a 7×7 (49 dots) splitting handpiece (Pixel CO_2 Omnifit, Alma Lasers, Israel) which was placed onto a standard CO_2 laser (Sharplan 40C, Lumenis, Israel). Treatments were performed at 25 W and 200 ms pulsed duration, yielding 102 mJ/pulse. Two passes were performed at each treatment session.

Follow-up examinations were performed by the physicians at 3 days, 1 week, 1 month, 2 months, and 6 months after the last treatment to monitor recovery, improvement, and sequelae. Scar improvement and adverse events were recorded and photographs were taken with a digital camera (Nikon D90 Tokyo, Japan). Pretreatment and 2-month photographs were independently evaluated and compared either by a plastic surgeon and a dermatologist or by two dermatologists, who graded the results on a five-point scale: excellent, 75–100 % textural improvement; good, 50–75 % improvement; fair, 25–50 % improvement; poor, <25 % improvement; or worse, final outcome worse than the pretreatment.

Results

The treatment was well tolerated by all patients. The immediate skin reaction consisted of erythema and mild edema, accompanied by some sensation of burning but not significant pain. Erythema lasted 7–18 days (mean, 9.2±2.2 days), while edema resolved more quickly. No permanent adverse outcomes were noted. Patients underwent one to three treatments (mean, 1.8).

All 24 patients returned for the 2-month clinical assessment. Evaluation of the outcome was rated excellent in 14 patients (58 %) and good in 7 (29 %), fair in 3 (13 %). No cases were graded as poor or worse. Representative before and after photographs are presented in Figs. 1 and 2. Evaluation of 18 of the patients who presented for follow-up 6 months after final treatment revealed that clinical results were maintained, significant change in the skin texture. No pigmentary changes were noted at any timepoint.

Conclusion

The present study reports the outcome of 24 children with facial scars treated with ablative fractional CO_2 laser photothermolysis. Although confluent ablative resurfacing with the CO_2 or Er:YAG laser remains the gold standard in skin rejuvenation, it is associated with considerable downtime and a risk of prolonged erythema, infection, scarring, and delayed hypopigmentation [8–11]. Moreover, it is painful and usually requires general anesthesia. In the search for alternatives that would also promote some collagen regrowth, researchers first turned to nonablative and intense pulsed light lasers [12, 13]. These were found to be safe but limited in efficacy, and the results were not comparable to ablative resurfacing.

Fig. 2 A 2-year-old girl at time of CO_2 treatment; facial scar induced by hemangioma. Original hemangioma, scar before and 3 months after one treatment, parameters: 25 W and 200 ms pulsed duration

In 2004, Manstein et al. introduced fractional photothermolysis to bridge the gap between ablative and nonablative resurfacing [1]. Resurfacing with a 1,550 nm non-ablative laser using an array of microscopic thermal wounds proved effective, and downtime and morbidity were minimal. However, the procedure required multiple sessions and local anesthesia, and the results were sometimes variable [2, 14–16]. Fractional ablative lasers soon followed and appear to provide better epidermal textural effects [11, 17–22]. These are anticipated to have particular benefit in mature scars, in which the epidermal and dermal pathology has been fixed, and in which removal and regeneration of tissue are required.

It is noteworthy that neither hyperpigmentation nor hypopigmentation, both particularly troublesome sequelae of ablative laser resurfacing, were not noted in these patients, even at 6 months post treatment. This is likely explained by the microscopic pattern of injury induced by the CO_2 laser, which induced minimal inflammation and therefore no clinically evident pigmentary changes.

The approach used in the current study also warrants mention. The treatment was done within a public hospital, using an existing CO_2 laser designed for confluent ablation, which was adapted to fractional photothermolysis by the addition of a retrofitted handpiece, which splits the beam into a fractional pattern to deliver the desired matrix of microablation zones. This approach provides a cost-effective method of maximizing the clinical utility of existing equipment.

The current study demonstrates clear clinical efficacy in the treatment of facial scars with fractional CO_2, regardless of the etiology of the scar. It is important to note that pediatric skin is known to respond briskly and heal well to treatments, a factor which likely contributes to the success of treatment in this age group. The very high level of clinical efficacy, even in fully mature scars, supports the use of the approach even after scars have are considered to be static, a condition that might have suggested reduced plasticity of tissue. Based on these results, we recommend early intervention in pediatric facial scars, to maximize the clinical benefit and to mitigate social stigmata as early as possible.

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