Improvement of disfiguring skin conditions by laser therapy
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ABLATIVE FRACTIONAL CO$_2$ LASER FOR ATROPHIC SCARS: COMPLICATIONS IN FOUR CASES

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Submitted
ABSTRACT

Under normal conditions, ablative fractional laser therapy (AFLT) restores epidermal integrity in less than 24 hours, which allows faster healing and thus reduces downtime and the risk of adverse events. As AFLT is a relatively new modality few complications are reported. Reporting complications from AFLT is important in order to acknowledge the limits and improve the safety.

We report four patients who developed wounds after AFLT for atrophic scars on their extremities. The patients’ photographs and clinical files were carefully reviewed to search for explanations for the wounds.

This complication could be explained by aggressive treatment in vulnerable areas. As treatment depth and density, and use of intralesional anesthetics might play a role, caution is mandatory when treating atrophic scars on the extremities.
INTRODUCTION

Ablative fractional laser therapy (AFLT) creates microscopic thermal wounds in both epidermis and dermis, separated by surrounding untreated skin. The intact, undamaged tissue around each treated zone acts as a barrier to infections and allows for rapid reepithelialisation which makes the healing faster and reduces the downtime dramatically. In addition, AFLT allows much deeper treatment, up to 2000 microns, than conventional ablative laser. Different types of scars were reported to improve after ablative and non-ablative fractional laser therapy. Except for transient hyper- and hypopigmentation, few complications of AFLT have been reported. To improve efficacy and safety of AFLT, research is needed and complications need to be recognized and reported.

Since 2007, atrophic and hypertrophic scars were treated with AFLT at the outpatient clinic of the Netherlands Institute for Pigment Disorders (SNIP) of the Academic Medical Center in Amsterdam. Four of these patients with scars developed wounds after AFLT and were analyzed to determine the cause of the wound development. The following three different 10600 nm ablative fractional CO$_2$ lasers were used; the Fraxel Re:pair (Solta Medical Inc., Hayward, CA), the Ultrapulse Encore Active FX (Lumenis Inc. Santa Clara, CA, USA) and the Ultrapulse Encore Deep FX (Lumenis Inc. Santa Clara, CA, USA). The patients’ photographs and clinical files were carefully reviewed to search for explanations for the complications.

Case #1: Wound on medial side of the upper leg associated with Pseudomonas infection after fractional CO$_2$ treatment

A 40-year-old female with Fitzpatrick skin type III presented with atrophic scars on the medial side of the left upper leg. The scars resulted from plastic surgery 18 months ago. Her past medical history was significant for diabetes mellitus type II and coronary arteries disease. There was no history of abnormal wound healing in the past. Preoperatively, intralesional xylocaine 2% adrenaline 1:80000 and topical chlorhexidine-alcohol was administered. Medications included oral glimepiride, metformine, ascal, and propanolol. A test region was treated with the Ultrapulse Encore 10600 nm Deep FX (Lumenis Inc. Santa Clara, CA, USA) at 25 mJ per microbeam and 15% coverage of the exposed skin. Immediate postoperative treatment included topical use of silversulfadiazin under occlusion for 1 day followed by thrice daily application of fucidic acid cream. At 2 weeks follow-up both treated and surrounding untreated skin developed a painful ulcer with yellow exsudate suggestive of a bacterial infection (Figure 1a). Erythromycin 500 mg twice a day was started. When *Pseudomonas aeruginosa* was cultured from the wound, the antibiotic was switched to ciprofloxacin 500 mg twice daily and the wound gradually improved. Seven weeks post treatment the wound was closed.

Case #2: Wound on left forearm after fractional CO$_2$ laser treatment

A 60-year-old female with Fitzpatrick skin type II presented for treatment of atrophic burn scars on the left forearm. Preoperatively, intralesional xylocaine 2% adrenaline 1:80000 and topical chlorhexidine-alcohol was administered. Three test regions were
treated using the Ultrapulse Encore 10600 nm Active FX (Lumenis Inc. Santa Clara, CA, USA) at 200-225 mJ and 55% coverage of the exposed skin.

Immediate postoperative treatment included topical use of silversulfadiazin under occlusion for one day followed by thrice daily application of fucidic acid cream. After treatment all treated areas showed superficial wounds followed by crusts. After 6 weeks all the treated areas were healed.

**Case #3: Wound on medial site of left upper leg after fractional CO\textsubscript{2} laser treatment**

A 13-year-old boy with Fitzpatrick skin type II presented with atrophic scars after surgery on the medial side of the left upper leg. His past medical history was significant for a rhabdomyosarcoma on the left leg and an attention deficit hyperactivity disorder (ADHD). Preoperative medications included topical application of eutectic mixture of **lidocaine** 2.5%/ prilocaine 2.5%, topical chlorhexidine-alcohol, and oral methylphenidate. Five test regions were marked and treated with the fractional 10600 nm CO\textsubscript{2} Fraxel Re:pair laser. All areas were treated with 4 passes resulting in 45 % coverage of the exposed skin. Area I was treated with a pulse energy of 10 mJ, area II with 15 mJ, area III with 20 mJ, area IV with 30 mJ and area V was treated with 50 mJ. Immediate postoperative treatment included topical use of an emollient (cremor cetomacrogolis) and acetic acid application during 4 weeks. The patient noted pain, especially in area V. Six weeks post-treatment we saw marked erythema in area IV and V and a wound in area V (Figure 1c). Two month after treatment, the wound was closed. At one year follow-up we observed post-inflammatory hyperpigmentation in area IV and V.

**Case #4: Wound on right knee after fractional CO\textsubscript{2} laser treatment**

A 34-year old woman with Fitzpatrick skin type II presented for the treatment of an atrophic scar on the upper half of her right knee. This scar was caused by excision of a melanocytic nevus 5 years previously.

After a test region was marked, preoperative intrallesional xylocaine 2% adrenaline 1:80000 and topical chlorhexidine-alcohol was administered, and the scar was treated with the Ultrapulse Encore 10600 nm Deep FX (Lumenis Inc. Santa Clara, CA, USA) at 20 mJ per microbeam and 15% coverage of the exposed skin. Immediate postoperative treatment included topical use of silversulfadiazin under occlusion for 1 day and thrice daily application of fucidic acid cream during 5 days following treatment. The patient failed to start this treatment until at least 4 days after laser therapy on the scar.

Five weeks post treatment the patient presented with abnormal crusting and bleeding of the treated area on the right knee. There was a small ulcer with crusting and some exudate (Figure 1d). Systemic antibiotics were started (Clarithromycin 500 mg daily for one week) and local wound treatment was adjusted. Around nine weeks after treatment the ulcer had completely closed.
DISCUSSION

The purpose of this report is to draw attention to the risk of complications from AFLT for the treatment of atrophic scars. Wounds following AFLT for the treatment of scars have not been reported before.

Whereas scarring, hypopigmentations and long recovery periods remain a concern for conventional ablative laser therapy, AFLT was expected to reduce the risk of these problems substantially. However, scarring in the neck after ablative fractional rejuvenation has recently been reported. Presumably, thin skin in this area explains why it is vulnerable for complications. All four cases in this report had atrophic scars on extremities.

Atrophic scars are characterized by tissue loss and thus could be comparable to areas with a thin skin, such as the neck area. In addition, atrophic scars lack hair follicles and...
pilosebaceous glands adding to poor wound repair. Moreover, skin on the extremities has a greater risk of impaired wound healing.

In case 1, the diabetes mellitus could have played a role in prolonged wound healing, thereby increasing the risk for the *Pseudomonas* infection. Case 3 shows a dose response as only the highest pulse energy provoked complications. We assume that the chosen energy and coverage of the treatment contributed to the development of complications.

To date, there are no accepted laser settings for the treatment of post-traumatic scars. We used 3 different devices and laser settings that were reported to be effective in facial acne scars previously. In case 2 and 3 the coverage was rather high (45% and 55%). However, in case 1 and 4 we used conservative settings for both coverage and density. Other circumstances that may have played a role are the type of anesthesia and the after-care. Three of our patients were pretreated with intraleional xylocaine 2% adrenaline 1:80000 and one patient with a topical anesthetic. Chuang et al. reported 2 cases of ulceration following nonablative fractional laser therapy. They hypothesized that the intraleional anesthetic (lidocaine/epinephrine) was responsible for the complications. However, in our practice, intraleional anesthetics are regularly used as pretreatment of AFLT in the face without such complications. Possibly, there is a multifactorial pathogenesis with type of scar, location, laser settings, and intraleional anesthesia all being involved.

In summary, four patients with atrophic scars on the extremities treated with AFLT developed wounds. These complications could be due to impaired wound repair in vulnerable areas. Possibly, intraleional anesthetics contributed. For atrophic scars on the extremity we recommend to use very cautious settings for coverage and energy, to give preference to topical instead of intraleional anesthesia, and to perform a trial treatment.

REFERENCES