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Early treatment using fractional CO₂ laser before skin suture during scar revision surgery in Asians

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ABSTRACT

Fractional CO₂ laser is one of the most effective treatment options used to resurface scars. However, most previous studies have been performed on mature scars at least 2 months after surgery. Recent studies have emphasized the importance of early treatment to reduce scar formation. In the present study, we described our experience with fractional CO₂ laser intervention before skin suture during scar revision surgery in Asians, and found the treatment was safe and effective.

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KEYWORDS

Early treatment; fractional CO₂ laser; scars

Introduction

Disfiguring scars may be associated with a heavy emotional burden for patients. An increasing number of therapeutic options have been explored to improve scar appearance, including surgery, aggressive physical therapy, corticosteroid therapy, silicone sheeting, compression, cryotherapy, and various laser treatments (1). Fractional CO₂ laser therapy is one of the most effective treatment options for resurfacing scars of different etiologies (2–9). The recommended time frame for scar treatment using fractional CO₂ laser in most previous studies has remained relatively constant at >2 months after surgery (10). However, recent studies have emphasized the importance of early treatment to reduce scar formation using fractional CO₂ laser (10,11). Ozog and Moy (12) even reported on the use of intraoperative fractional CO₂ laser treatment of wound edges, which significantly improved the appearance and texture of the scars. Thus, it appears that early, even intraoperative, treatment to the wound may mitigate scar formation (13). However, to our knowledge, no report on fractional CO₂ laser intervention before skin suture in Asian patients has been published thus far. Hence, in the present study, we aimed to determine new parameters for fractional CO₂ laser treatment before skin suture during scar revision surgery in Asians and report on the clinical observations.

Methods

A total of 10 patients (Fitzpatrick skin type III–IV) aged 22–47 years were treated with fractional CO₂ laser before skin suture during scar revision surgery. None of the patients reported a history of keloid formation, frequent and prolonged sun exposure within 1 month, or isotretinoin use within the last 6 months. Scar reduction was carefully performed, and both sides of the wound experienced subcutaneous separation.

Hence, subcutaneous absorbable sutures (Vicryl® 5/0) were applied to reduce the tension and align the wound. Two passes of the fractional CO₂ laser (Acupulse®, Lumenis) were performed using two different modes and parameters: deep mode: 20–22.5 mJ, with a density of 5%; and superficial mode: 80–100 mJ, with a density of 40%. The wound was then closed using a nonabsorbable suture, which was removed after 1 week. All the patients were followed up 6 months later.

Report of typical case

A 27-year-old patient with Fitzpatrick skin type IV presented with a deep traumatic scar on the left side of the face (Figure 1). The patient underwent scar reduction and Z-plasty (Figure 2), followed by two passes with the fractional CO₂ laser in the deep mode (Figure 3: 22.5 mJ, with a density of 5%) and superficial mode (Figure 4: 80 mJ, with a density of 40%). The wound was then closed (Figure 5), and the suture was removed after 1 week (Figure 6). After 8 months, the patient exhibited significant improvement of the scar (Figure 7).

Results

After comparing the images of each patient before and after treatment, all the patients were found to exhibit apparent aesthetic scar improvement. The erythema was resolved within 3 months in all of the cases. No cases of permanent hyperpigmentation, hypopigmentation, or scar hyperplasia were observed.

Discussion

Several types of lasers have been used to treat surgical scars, although most of these techniques have involved mature scar



Figure 1. A 27-year-old patient presented with a deep traumatic scar on the left side of the face.



Figure 4. Superficial mode treatment with the fractional CO₂ laser was performed.



Figure 2. Scar reduction and Z-plasty surgery was performed.



Figure 5. The wound was closed using a non-absorbable suture.



Figure 3. Deep mode treatment with the fractional CO₂ laser was performed.



Figure 6. The nonabsorbable suture was removed after 1 week.



Figure 7. The scar exhibited significant improvement after 8 months.

treatment (10). With that technique, individuals would have to wait to be treated for months to years after surgery. However, most patients desire scar intervention as soon as possible, particularly when the scars are located at visible sites. Moreover, early intervention may aid in alleviating scar contracture and benefit wound rehabilitation, which represent potential breakthroughs in scar treatment (1). Capon and colleagues demonstrated that 810-nm diode laser treatment, performed immediately after surgery, can improve the appearance of surgical scars (14). The authors termed this procedure as “Laser-assisted skin healing,” which has been used to prevent and reduce scars in plastic surgery. Furthermore, Taudorf and colleagues applied non-ablative fractional laser treatment directly on the wounded skin barrier, immediately after punch biopsy collection, to improve scar appearance (15). However, future research may define the role of laser therapy before surgical treatment to soften scars and potentially improve the surgical outcomes (1).

In recent years, the early intervention of scars using fractional CO₂ laser therapy has received considerable attention. Jung and colleagues showed that early postoperative fractional CO₂ laser treatment of thyroidectomy scars 2–3 weeks after surgery is safe and effective (11). Lee and colleagues showed that the fractional CO₂ laser is an effective treatment modality for surgical scars in the early postoperative period, within 3 weeks after surgery (10). Ozog and Moy reported on the intraoperative fractional CO₂ laser treatment of wound edges, which significantly improved the appearance and texture of scars (12). The fractionated CO₂ laser combines the principles of traditional laser ablation with the technology of fractional laser intervention (16). This therapy is based on the damage and removal of microscopic portions of the epidermis and part of the dermis, which consequently stimulates wound healing responses and the replacement of the skin surface. The presence of relatively large adjacent areas of untreated skin may facilitate rapid healing (17). Following laser treatment, several growth factors are released, and cytokines are generated sequentially with varying levels over time; this leads to the coordinated expression of heat shock proteins, matrix metalloproteinases, growth factors, and other mediators that are crucial for early epidermal regrowth and collagen

remodeling (17–21). Histopathological findings also suggest an increase in type 3 collagen and decrease in type 1 collagen after fractional CO₂ laser treatment of burn scars (22). Anderson et al believed that ablative fractional resurfacing will play a prominent role in future scar treatment paradigms, with the possible inclusion of early intervention for contracture avoidance and assistance with wound healing (1).

In the present study, we explored the clinical efficacy and safety of scar treatment using the fractional CO₂ laser before skin suture in Fitzpatrick type III–IV skin. We combined the deep mode to the dermabrasion of the superficial mode for laser treatment. Each column treated with the deep mode was approximately 120 μm in diameter with a vertical thermal injury depth of 800 μm; this treatment produced a confluent array of ablation and coagulation that extended through the stratum corneum, epidermis, and dermis (23). The column-shaped injury led to the unique stimulation of collagen remodeling and synthesis (24). We found that the dermal contraction after deep mode treatment also helped avoid the invagination of the wound and contributed to wound alignment and healing. In previous studies, combined treatment of deep and superficial patterns of fractional CO₂ laser therapy was very effective and safe for Asian patients with acne scarring, and did not lead to permanent dyspigmentation or hyperpigmentation (23,25). Moreover, no cases of permanent hyperpigmentation, hypopigmentation, or scar hyperplasia have been observed in the present study. Therefore, intraoperative ablative fractional CO₂ laser therapy is safe and effective for treating surgical scars in Asian patients.

This article presents a new therapeutic approach for scar improvement in Asian patients. A limitation of the study was the lack of half-segment control with and without laser treatment in the same patient, and future studies should assess whether superficial settings alone or a combination of superficial and deep settings are more effective. Moreover, randomized controlled studies should be performed to verify the present clinical observations.

Declaration of interest

The authors declare that they have no conflicts of interest to disclose.

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