Laser Corrective Surgery with Fractional Carbon Dioxide Laser Following Full-thickness Skin Grafts

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Abstract

Full-thickness skin grafts (FTSGs) are frequently used to treat patients with burn injuries and to repair defects rendered by excisional (including Mohs) surgery. The evidence for corrective laser surgery after scar formation is well established. With regard to laser treatment of FTSG, the evidence is sparse. Laser treatment after FTSG is a novel concept, with minimal literature. We present a case series, one of the first to our knowledge, of the treatment of FTSG with fractional CO_2 laser in five patients after Mohs surgery.

Keywords: Laser, skin grafts

Introduction

Full-thickness skin grafts (FTSGs) are frequently used in dermatologic surgery. Skin grafts can stand out from neighboring recipient skin both in color and in texture, leaving suboptimal aesthetic results. Traditional methods of modifying the contour include dermabrasion, curettage, and camouflage techniques.

In our center, we frequently use laser technology to improve the erythema and contour irregularities of FTSGs. We present our experience of fractional carbon dioxide (CO_2) laser-assisted corrective surgery in five patients with FTSGs after Mohs surgery.

Materials and Methods

Five patients who underwent Mohs surgery with FTSG at our center were treated postoperatively with multiple sessions of fractional laser resurfacing. The CO_2 laser corrected the contour of the FTSG, and any residual erythema was subsequently treated with vascular lasers. UltraPulse (Israel) fractional CO_2 laser by Lumenis was used in this study. This device was used in the Active Fx handpiece, 150 Hz, fluence ranging between 100 and 150 mJ and a computer-pattern generator set at 1-2-5. However, this was adapted in accordance with site and thickness and background skin color. Usually one or two treatment sessions, three months apart, were conducted. To "blend in" the resurfaced area, a larger spot size was chosen with lower density coverage in Active Fx mode over the entire treated area with a margin of 2–3 mm of the surrounding tissue.

Results

Our case series reports the outcome of the treatment of FTSG with fractional CO_2 laser in five patients aged between 49 and 85 years. The results achieved in the present case series of five patients are summarized in Table 1. The successful endpoint of treatment was the achievement of flattening of the raised or uneven surface. The results were smooth transition from the FTSG to the surrounding skin, with improvement in contouring and also an improvement in color in some cases. Please see Figure 1 which demonstrates the scar pre CO_2 treatment, and Figure 2 which shows the improvement post CO_2 laser treatment.

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Access this article online

Quick Response Code:

Website: www.jcasonline.com

DOI: 10.4103/JCAS.JCAS_59_17

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How to cite this article: Forbat E, Ali FR, Mallipeddi R, Al-Niaimi F. Laser corrective surgery with fractional carbon dioxide laser following full-thickness skin grafts. J Cutan Aesthet Surg 2018; 10:157-9.

Table 1: Results of FTSG treated with CO_2 laser

Patient	Age (years), gender	PMH	Site	Donor site
1	49, Female	Renal transplant, hypertension	Microcystic adnexal carcinoma nose, Mohs 2014	
2	85, Male	Gout, hypertension	Mohs BCC excised from nasal bridge	Left ear
3	72, Female	Lichen planopilaris, seborrheic dermatitis	Mohs BCC nasal bridge	
4	60, Female	Coeliac disease, GORD	Mohs surgery for BCC (18.2.2015) on right nasal tip	Left preauricular skin (harvested)
5	56, Female	Actinic keratoses	Mohs left nasal sidewall	

BCC, basal cell carcinoma; GORD, gastroesophageal reflux disease; PMH, past medical history

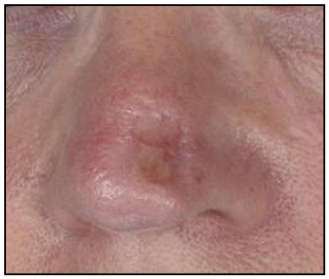

Figure 1: Pre CO_2 Ablation

Figure 2: Post CO_2 Ablation

Discussion

Lasers that have been used in the postsurgical period for amelioration or prevention of scarring include pulsed dye laser (PDL), nonablative fractional lasers (NAFLs), and ablative fractional devices.

It has been postulated that PDL works via neocollagenesis triggered by tissue hypoxia.[1] Nouri *et al.* assessed the efficacy of 585-nm PDL treatment commencing on the day of suture removal.[2] This was a blinded split-scar study (three treatments versus no treatment) in 11 patients. They found a significant improvement in scar appearance (with regard to pigmentation, vascularity, and pliability), as assessed by blinded clinicians (54% versus 10%). Furthermore, PDL was more effective depending on the anatomical location of the scar, with better improvement in the face, shoulders, and arms. Another uncontrolled study found an improvement in surgical scar outcome when PDL was used within two weeks of surgery.[3]

Fractional photothermolysis works by producing microscopic thermal wounds.[4] As the dermis is mainly targeted with no ablation, less downtime is experienced by patients with a greater safety.[5]

Tierney *et al.* carried out a randomized blinded split-scar study to compare NAFL with PDL ($N = 12$). NAFL was found to produce better results than by PDL (75.6% vs 53.9%, respectively), with respect to scar pigmentation, thickness, and texture. When compared to PDL, NAFL particularly improved the dyspigmentation (64.2% vs 45.8%).[6] The results of this trial are strengthened because the patients were blinded and randomized. However, it is limited by the fact that not all the scars were of the same anatomic location with a varied scar etiology and age. Of note, the authors did recognize that the blinding was not conclusive, as PDL creates a distinctive posttreatment purpura, recognizable to the evaluating clinicians.

One prospective clinical study investigated the efficacy of 1550-nm NAFL in facial surgical scars. Twelve of the 13 cases had scars after tumor extirpation and 2 of these were stated to be FTSGs. The patients overall reported an improvement in stiffness, thickness, and irregularity of scar posttreatment. One patient with FTSG received four treatment sessions and demonstrated an improvement in pigmentation at six-month follow-up, whereas the other did not. The authors of this study recognized the limitations of selection bias (patient volunteers) and lack of blinding; this study is one of the first to recognize the use of NAFL to treat FTSGs.[7] Another case study reported a 75% clinical improvement in a surgical skin scar, two weeks after a single treatment of 1550 nm.[8]

As far as fractional ablative lasers are concerned, there are hardly any studies of their use in patients with FTSG. CO_2 and Er YAG lasers are ablative devices capable of removing the epidermis in its entirety and hence having a more marked effect on contour, as well as yielding higher adverse outcomes such as infection and scarring.

The first successful use of unfractionated CO_2 laser in the revision of FTSGs was reported in 1988, whereby Wheeland found efficacious results of the CO_2 laser to revise hypertrophic scarring in FTSG.[9] The CO_2

laser treatment was shown to be useful in treating scar contractures secondary to split-thickness skin grafts in the forearms of three patients, who reported improved range of movement up to 15 months posttreatment.[10]

In this case series, we document the positive effect of fractional CO_2 laser resurfacing in patients with FTSG after Mohs surgery. In all patients within the case series, the corrective surgery led to an improvement in contour irregularity and any residual redness was treated with PDL. From the literature, it is clear that treatment of FTSG with lasers is a novel concept. To date, there are only a handful of examples looking at the laser corrective surgery after FTSG.

Conclusion

This case series shows that the treatment using CO_2 laser has a positive outcome in the appearance of FTSG after Mohs surgery. This case series is one of the first to demonstrate the effectiveness of CO_2 laser to revise FTSG contour irregularities.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Financial support and sponsorship

Nil.

Conflicts of interest

None.

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