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

Emily Forbat, Faisal R. Ali, Raj Mallipeddi, Firas Al-Niaimi
King Edward VII Hospital, 5–10 Beaumont Street, ‘Dermatological Surgery & Laser Unit, St John’s Institute of Dermatology, Guy’s Hospital Cancer Centre, Guy’s & St Thomas’ NHS Foundation Trust, London, UK

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 CO2 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 (CO2) 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 CO2 laser corrected the contour of the FTSG, and any residual erythema was subsequently treated with vascular lasers. UltraPulse (Israel) fractional CO2 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 2–3mm of the surrounding tissue.

RESULTS
Our case series reports the outcome of the treatment of FTSG with fractional CO2 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 CO2 treatment, and Figure 2 which shows the improvement post CO2 laser treatment.

Address for correspondence: Dr. Firas Al-Niaimi, Dermatological Surgery & Laser Unit, St John’s Institute of Dermatology, Guy’s Hospital Cancer Centre, Guy’s & St Thomas’ NHS Foundation Trust, London SE1 9RT, UK.
E-mail: firas55@hotmail.com

This is an open access article distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 3.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as the author is credited and the new creations are licensed under the identical terms.

For reprints contact: reprints@medknow.com

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.
Forbat, et al.: Laser corrective surgery following full-thickness skin grafts

**Table 1: Results of FTSG treated with CO₂ laser**

| Patient | Age (years), gender | PMH | Site | Donor site |
|---------|---------------------|-----|------|------------|
| 1       | 49, Female          | Renal transplant, hypertension | Microcystic adnexal carcinoma nose, Mohs 2014 | Left ear |
| 2       | 85, Male            | Gout, hypertension            | Mohs BCC excised from nasal bridge | |
| 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 CO₂ Ablation**

**Figure 2: Post CO₂ 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. Nouri et al. assessed the efficacy of 585-nm PDL treatment commencing on the day of suture removal. 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.

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

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%). 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. Another case study reported a 75% clinical improvement in a surgical skin scar, two weeks after a single treatment of 1550 nm.

As far as fractional ablative lasers are concerned, there are hardly any studies of their use in patients with FTSG. CO₂ 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 CO₂ laser in the revision of FTSGs was reported in 1988, whereby Wheeland found efficacious results of the CO₂ laser to revise hypertrophic scarring in FTSG.
Forbat, et al.: Laser corrective surgery following full-thickness skin grafts

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 CO2 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 CO2 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 CO2 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.

**References**

1. Dierickx C, Goldman MP, Fitzpatrick RE. Laser treatment of erythematous/hypertrophic and pigmented scars in 26 patients. Plast Reconstr Surg 1995;95(1):84-90; discussion 91-2.
2. Nouri K, Jimenez GP, Harrison-Balestra C, Elgart GW. 585-nm pulsed dye laser in the treatment of surgical scars starting on the suture removal day. Dermatol Surg 2003;29(1):65-73.
3. McCraw JB, McCraw JA, McMellin A, Bettencourt N. Prevention of unfavorable scars using early pulse dye laser treatments: a preliminary report. Ann Plast Surg 1999;42(1):7-14.
4. Geronemus RG. Fractional photothermolysis: Current and future applications. Lasers Surg Med 2006;38(3):169-76.
5. Glaich AS, Rahman Z, Goldberg LH, Friedman PM. Fractional resurfacing for the treatment of hypopigmented scars: a pilot study. Dermatol Surg 2007;33(3):289-94; discussion 293-4.
6. Tierney E, Mahmoud BH, Srivastava D, Ozog D, Kouba DJ. Treatment of surgical scars with nonablative fractional laser versus pulsed dye laser: A randomized controlled trial. Dermatol Surg 2009;35(8):1172-80.
7. Pham AM, Greene RM, Woolery-Lloyd H, Kaufman J, Grunebaum LD. 1550-nm nonablative laser resurfacing for facial surgical scars. Arch Facial Plast Surg 2011;13(3):203-10.
8. Behroozan DS, Goldberg LH, Dai T, Geronemus RG, Friedman PM. Fractional photothermolysis for the treatment of surgical scars: A case report. J Cosmet Laser Ther 2006;8(1):35-8.
9. Wheeland RG. Revision of full-thickness skin grafts using the carbon dioxide laser. J Dermatol Surg Oncol 1988;14(2):130-4.
10. Kroonen L, Shumaker PR, Kwan JM, Uebelhoer N, Hofmeister E. Treatment of split-thickness skin graft-related forearm scar contractures with a carbon dioxide laser protocol: 3 case reports. J Hand Surg 2013;38(11):2164-8.