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Case Report

Carbon dioxide laser for precise and bloodless contouring of soft tissue ahead of skin grafting–A case example of technique and benefits

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ABSTRACT

Scarring is a dynamic development as a result of the wound healing process. Post-burn scars are often hypertrophic in nature and thus exhibit a much thicker and firmer scar, often leading to contractures. Various strategies have been implemented by burns surgeons to endeavour to mitigate and improve such symptoms and appearances. Laser therapy in the control of hypertrophic scarring is of continual developing interest within this field. We demonstrate the advantageous, intra-operative use of a carbon dioxide laser for precise contouring of a burn scar prior to skin grafting in a 36 year-old female with hypertrophic scarring following a 65% total body surface area flash flame burn. This method provided a bloodless surgical field with no post-operative complications, good graft take and a favourable cosmetic outcome.

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Introduction

Scarring is a dynamic process as a result of wound healing activity. Post-burn scars are often hypertrophic in nature and thus exhibit a much thicker and firmer scar, often leading to contractures

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Figure 1. Pre-operative photos of post-burn hypertrophic scarring to lip and chin with loss of mentolabial angle.

and cosmetic deformities. Various treatment modalities and reconstructive strategies have been implemented by burns surgeons to mitigate and improve the symptoms and appearances of adverse scarring.[1]

Laser therapy for scar treatment is an expanding area of interest.[2] Lasers are typically used for a variety of indications in a non-surgical setting. Currently the main use of Carbon Dioxide (CO2) laser is targeted around scar resurfacing in the day case setting, as well as the management of various skin lesions. However, the high cost of lasers and variable expertise make their availability limited.[3]

We demonstrate the advantageous, intra-operative use of a CO2 laser for precise contouring of a hypertrophic burn scar prior to skin grafting. A technique not previously described within the literature.

Case report

A 36-year-old female with hypertrophic scarring following a 65% total body surface area flash-flame burn, involving the face, was referred to the Burn Centre at Whiston Hospital. She was initially managed acutely and successfully at another burns service and required long-term scar therapy following her recovery. An area of hypertrophic scarring and contracture to her lower lip and chin was one of the areas of concern (Figure 1). This area had been excised and grafted in the acute setting with secondary scar contracture release and full thickness skin grafting (FTSG). Under our care, the patient underwent CO2 laser resurfacing, with limited success. A decision was made to regraft the area using fully ablative CO2 laser of the scar and previous graft to allow for a precise contouring prior to re-grafting. The procedure was performed under general anaesthetic. CO2 laser fine-touch 10–35 W, 0.05–0.1 ms PT, 1.5 mm spot was used to ablate and contour the scar tissue in a bloodless field, allowing re-creation of the mento-labial angle in a bloodless field at variable depths across the previously-grafted area. A full thickness skin graft FTSG was harvested from the right side of the abdomen and inset using a custom-designed intra-oral silicone prosthesis to allow for interrupted quilting with 4.0 Silk at maximal stretch (Figure 2). The abdominal donor site was closed directly. The patient healed favourably with full graft take, no post-operative complications and a good cosmetic outcome with which the patient was delighted. Post-operative images demonstrate how the use of the ablative CO2 laser enabled precise contouring of the scar tissue to re-create the mento-labial angle in a way that would not have been possible with a scalpel (Figure 3).

Discussion

In recent years, the use of lasers within surgical procedures has gained significant interest, specifically in relation to scar management.[4] Among the various lasers that exist, CO2 lasers stand out for their versatility and efficacy with regards to tissue ablation.[5-7] In the main, CO2 lasers are used in the treatment of scarring using a fractionated mode; alternatively, when used in the ablative mode,

Figure 2. Intra-operative images demonstrating targeted area for contour, custom-designed intra-oral silicone prosthesis and FTSG quilted at maximal stretch.

Figure 3. A. Pre-operative & B. Post-operative images demonstrating reformation of mentolabial angle.

this is typically for keloid or hypertrophic scarring, after which the treated areas heal by secondary intention.

CO2 lasers produce a wavelength within the infrared spectrum at around 10,600 nm and can be used in a continuous or pulsed mode. The mechanism of action is based on the principle of using carbon dioxide gas as a medium for a laser beam, generating high energy wavelengths of light. The process involves several steps including; excitation of CO2 molecules, population inversion, amplification of photons, reflective cavity, emission of laser beams and the delivery system itself. The excited CO2 molecules release photons at a wavelength of around 10.6 micrometers. This wavelength is well-absorbed by water, making CO2 lasers particularly effective for the ablation of tissues as seen within our case report. This allows precision of tissue ablation by controlling the removal of tissue in layers, supporting removal of damaged or unwanted material and furthermore stimulating collagen

remodelling within the surrounding areas. Other advantages of this method include minimal thermal damage to the surrounding matters and reduced postoperative downtime.[2]

Few contraindications to CO2 laser therapy exist. These include but are not limited to the presence of active infections or open wounds, recent use of isotretinoin and diseases such as vitiligo and psoriasis which are associated with koebinerization. Perhaps the main limitation is access to a laser (including cost implications) and training.

When planning treatment with CO2 lasers appropriate pain control is important. Local or topical anaesthesia is typically used unless there is a specific indication or General anaesthesia, including patient request. Eye protection should be implemented for both the patient and operator[8] according to local and/or national protocols.

Following treatment with CO2 lasers, healing time is typically variable depending on depth and surface area of ablation and the presence or absence of fractionation, and normally occurs via secondary intention over a week or two with suitable dressings or topical ointment(s). In this instance, the presence of a skin graft after laser treatment converts the aftercare to a standard skin grafting regime with dressing change in an outpatient setting until healed.

CO2 lasers in ablative mode are widely recognised to allow for successfully management of a range of conditions where precise tissue debulking and contouring is required, including Rhinophyma[8,9] whereby the relatively quick and efficient removal of the hypertrophied tissue allows for sculpting of the tissues, efficient haemostasis, less scarring and minimal down-time. Similar advantages correspondingly seen within our case report.[2,9,10]

Conclusion

We present the successful technique of using a CO2 laser for scar contouring prior to skin grafting in the face. This method of application of CO2 laser treatment within scar management has not been widely described or adopted – CO2 lasers are typically used either ablatively or fractionated following which threated areas will heal spontaneously. Our approach to ablation followed by skin grafting allows for a more precise contouring of tissues in a bloodless field in situations where the depth and surface area is no longer limited. Hence anatomical areas that are to be skin-grafted can be more precisely contoured than ever before, and in a way that is simply not possible with a scalpel.

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Ethical approval

Not required.

Declaration of competing interest

The authors declare there is no conflict of interests.

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