ON THE SURFACE

DR PATRICK TREACY ON FRACTIONALISED CO_2 LASER SKIN RESURFACING

As patients continue the trend of seeking less invasive procedures with lower downtime and associated risks, fractionalised carbon dioxide (CO_2) laser skin resurfacing with newer generation lasers such as the Lumenis ActiveFx or the Deka SmartXide DOT has become an important component of facial rejuvenation surgery.

This recent behavioural change in patient attitude has largely been prompted by a realisation, by both doctors and patients, that the much hyped radiofrequency type non-ablative methods are not comparable with ablative skin resurfacing and are often subject to extravagant claims in terms of efficacy.

For the past 10 years, CO_2 laser resurfacing was considered the 'gold standard' for the treatment of wrinkles and photo-damaged facial skin. The first system CO_2 laser developed for cutaneous laser resurfacing was approved by the US Food and Drug Administration (FDA) in 1996. The earliest systems were continuous-wave CO_2 lasers, which were effective for gross lesional destruction. However, these systems could not reliably ablate fine layers of tissue because of their prolonged tissue-dwell times, and they produced unacceptably high rates of scarring and dyspigmentation. Subsequent development of high-energy pulsed lasers made it possible to safely apply higher energy densities with exposure times that were shorter than the thermal relaxation time of water-containing tissue, which lowered the risk of thermal injury to surrounding non-targeted tissue. Two of the first of these devices were the UltraPulse 5000 and Silk-Touch lasers (Lumenis Corp). The UltraPulse emitted individual CO_2 pulses with variable dwell time and a peak energy density 500mJ, whereas the SilkTouch was a continuous-wave CO_2 system with a microprocessor scanner that continuously moved the laser beam so that light does not dwell on any one area for more than one millisecond. Many proceduralists of this period stated the ultrapulsed CO_2 laser was the most effective modality for repairing years of skin exposure to harmful ultraviolet light and photo-damaged skin. This photo-ageing effect is demonstrated clinically as a gradual deterioration of cutaneous structure and function. It manifests itself in the epidermis and upper papillary dermis by giving skin a roughened surface texture as well as laxity, telangectasias, wrinkles and variable degrees of skin pigmentation. Although, ultrapulsed CO_2 laser skin resurfacing was largely considered the best option for treatment of this type of photo-aged facial skin, it also had certain post-procedural problems, including prolonged post-operative recovery, pigmentary changes and a high incidence of infective adverse side effects, including acne flares and herpes simplex virus (HSV) infection. Many patients also complained of oedema, burning, and erythema that sometimes lasted for many months. The delayed healing, the implied risks and long downtime made many patients reluctant to accept this method.

SEEKING SAFETY

The short-pulsed Er:YAG laser was introduced as an alternative to the CO_2 laser for skin resurfacing in an attempt to minimise the recovery period and limit side effects while maintaining clinical benefit. It was approved by the FDA in 1996 for use in cutaneous resurfacing. It emitted 2940nm light that corresponded to the 3000-nm absorption peak of water making it 12 to 18 times more efficiently absorbed by H_2O-containing tissue than the light of the CO_2 laser. It was also a more precise ablative tool than the CO_2 laser, although its shorter pulse duration resulted in decreased thermal

diffusion and less effective haemostasis. This in turn increased intra-operative bleeding, which was favoured by neither doctor nor patient. The new safer Er:YAG laser eventually proved less favourable for deeper dermal treatment and this, in turn, led to the development of many non-ablative treatments such as the Thermage®, Polaris® and the Titan®. These devices quickly fell into disfavour as they created a high level of non-responders after quite expensive treatments that often required multiple painful sessions.

Although non sequential fractionalised technology is relatively new, its benefits of faster recovery time, more precise control of ablation depth and reduced risk of post-procedural problems are already clear. The obvious benefits of these lasers has led to many new fractional resurfacing lasers reaching the market at the same time. The recent adoption of the newer fractionalised CO_2 lasers by many physicians also appears to have reduced the morbidity associated with this type of laser treatment. Damage to the epithelium is less apparent because, unlike in conventional ablation, some of the stratum corneum remains intact during treatment and acts as a natural bandage. This allows the skin to heal much faster than if the whole area was treated, as the 'healthy' untreated tissue surrounding the treated zones helps to fill in the damaged area with new cells. Downtime is also reduced and erythema is moderate, permitting patients to apply cosmetics five days after treatment.

FRACTIONALISED CO_2 LASERS: CURRENT DEVICES

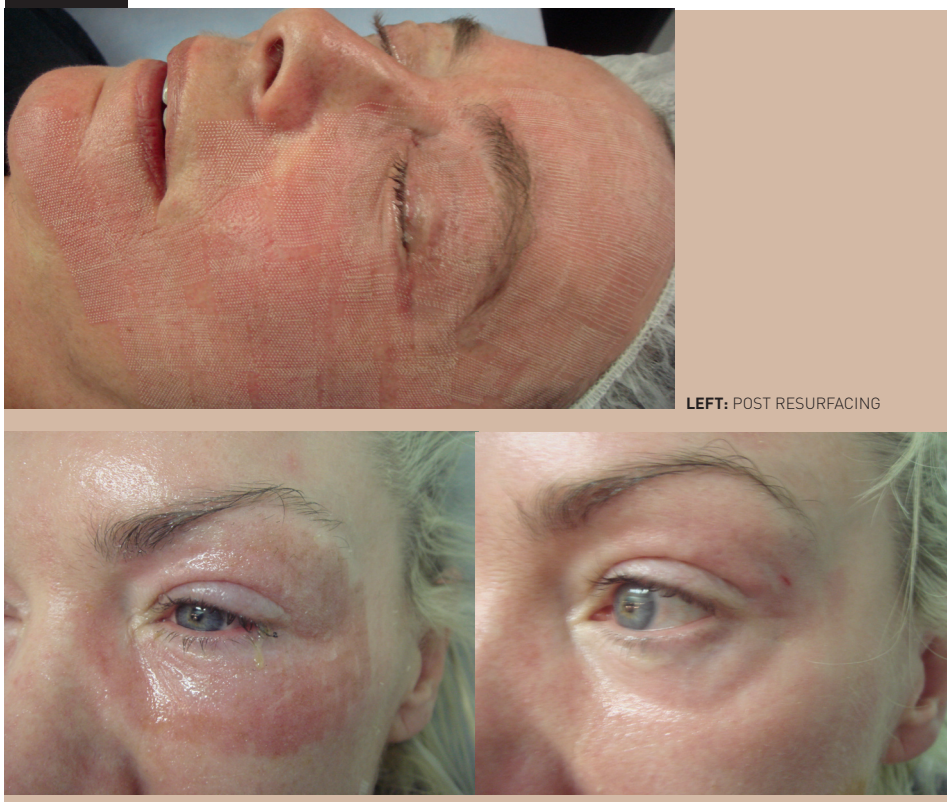
Fractionalised CO_2 lasers are extremely versatile, in that they can be used for the treatment of facial rhytides, acne scars, surgical scars, melasma and photo-damaged skin. There are presently several high-energy, fractionalised CO_2 lasers currently available for cutaneous resurfacing.

Although each laser system adheres to the same basic principles there are significant differences between lasers with respect to tissue dwell time, energy output, and laser beam profile. These differences may result in variable clinical and histological tissue effects.

ActiveFx

The ActiveFx (although technically the name of a set of parameters) is an upgrade of the Ultrapulse Encore with smaller spot size and a new Computerised Pattern Generator (CPG), giving a random pattern and reducing the possibility of having several adjacent spots with resultant heat accumulation. Other technical differences include the device leaving intact tissue bridges between spots, which results in faster healing time and less thermal damage to the basal cell membrane. The device also has a smaller spot size (1300mm instead of 2500mm) resulting in less post procedure erythema due to reduced heat build up in these tissues. Lastly, the CPG lays down a random series of spots rather than a sequential sequence resulting in greater thermal relaxation time and less overheating of the treated tissue. The application of random rather than sequential beams is termed 'Cool Scan' and this feature was used with every patient in the study.

CASE 1



LEFT: POST RESURFACING

DAY 2 LASER RESURFACING

DAY 7 POST RESURFACING

SmartXide DOT

The SmartXide DOT (Dermal Optical Thermolysis) laser is a 30W fractionalised CO_2 laser with computerised scanner which enables the user to deliver a customised scanned pattern with adjustable power, pattern density and dwell times. With DOT technology the physician is able to deliver a superficial 'soft' treatment with no downtime, a moderate treatment requiring a few days of downtime, or a fully ablative traditional laser resurfacing treatment. The SmartXide DOT adopts lightweight titanium articulated arm in conjunction with a user friendly colour touch-screen control panel to display the settings. The SmartXide DOT requires an external plume device.

TREATMENTS

Pre laser procedure

For full-face resurfacing, I prescribe the following analgesic type medications to be started on the day of treatment:

Before treatment

One hour before, the patient applies a thin layer of Anestop® : (Amethocaine; Propitocaine; Lignocaine) topical anaesthetic to the entire facial area. This is used with particular care in the periorbital areas and other lateral facial regions not easily covered by a regional block. A plastic wrap is not used during this procedure.

For anxiety and analgesia

Valium (Diazepam5-10mg po), Tylex (Paracetemol Codeine) to be given 45 minutes prior to the procedure.

For herpetic infection

If the patient has a strong history of HSV, Famvir (Famciclovir) 750mgs daily for 10 days or Valtrex (valcyclovir) 500 mg bd for 10 days starting five days before surgery. I routinely prescribe Famvir (Famciclovir) 750mgs daily or Valtrex (valcyclovir) 500mg bd for seven days starting three days before surgery to every patient. (I found a 10% viral outbreak from more than 450 patients treated by this method)

For bacterial infection

If the patient has a strong history of acne, Keflex (Cephalexin 500 mg bd), ByMycin (Doxycycline 100mgs daily) or Augmentin Duo, (Amoxil Clavulinic Acid) for seven days, starting the day of surgery).

For yeast infection

If the patient has a strong history of fre-

quent yeast infections, Diflucan (Fluconazole 150mgs), starting on the fourth post-operative day and taken once orally every other day.

I do not routinely prescribe antibiotic and antifungal medication. Prior to resurfacing, the nurse washes the patient's entire face and neck to remove the topical anaesthetic.

Procedural treatment

As a dermasurgeon, I normally prefer a deeper form of anaesthesia for full-face ablative laser procedures and use regional nerve blockade and sometimes IV sedation, to provide more complete anxiolysis, amnesia, and sedation.

Since the advent of fractionalised CO_2 lasers this is not required but I still feel more comfortable providing regional anaesthesia in the supraorbital, perioral and marionette areas. I usually treat the cheek area and perioral area (which are under regional anaesthesia) first in order to get the patient used to the laser with the periorbital area next and finally extend down into the neck area. When treating the neck area, the parameters were modified to use the lowest energy density possible (ActiveFx density 1).

I always use the Cool Scan. Care is taken in the inferior regions of the neck with a tendency to feather in the posterior border. The patients are then placed under a 633nm Omnilux Revive to try and biomodulate fibroblast activity, thereby leading to faster and more efficient collagen synthesis.

Regional anaesthesia

Normally, I give patients this regional anaesthesia during the procedure:

Supraorbital and supratrochlear nerve block

Locate the supraorbital foramen and insert the needle lateral to supraorbital foramen. Direct the needle medially, parallel to the brow, towards the nose. Infiltrate mid-two thirds of lower edge of eyebrow. Use 1cc of 1-2% Lidocaine and inject just above bone level.

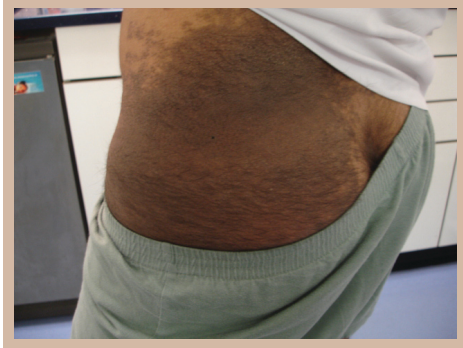
Infraorbital nerve block

Locate the infraorbital foramen. Insert the needle inferior to the foramen by 1cm (slightly medial). Direct the needle towards the supraorbital foramen (avoid approaching orbit) Infiltrate at infraorbital foramen. Use 1cc of 1-2% Lidocaine and inject just above bone level.

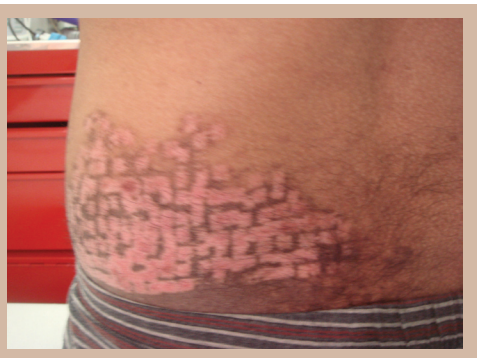
Mental nerve block

Locate the mental foramen. Insert the needle 1.5cm posterolateral to the mental foramen. Direct the needle towards the mental foramen (avoid approaching orbit). Infiltrate at the mental foramen. Use 1cc of 1-2% Lidocaine and inject just above bone level.

CASE 2



PRE RESURFACING OF CONGENITAL NEVUS



POST AFX RESURFACING

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Post laser procedure care

If the patient has pain I resolve this with ice packs. The patients' face is covered with Vaseline (petrolatum gel) using a tongue depressor and they are asked to continue doing this every few hours. I used to use dilute vinegar soaks (one teaspoon of distilled white vinegar to two cups of water) applied over the layer of Vaseline petrolatum every few hours post-operatively, but not with the newer fractionalised devices.

The patients are reviewed at seven to 10 days post-operatively, during which time the treated areas of the face have mostly returned to normal.

Outbreaks of herpetic infection are reviewed on an almost daily basis and the patients are either admitted or commenced on Famvir 750mgs tid during this period. Topical steroids (1% Hydrocortisone) can be applied for a short period to patients for continual itch but balance this against potential problems such as stopping new collagen formation.

My own evaluation shows both CO_2 lasers (Lumenis ActiveFx and Deka SmartXide) appear to produce equivalent clinical improvement of lesions and rhytides. It is also noted that re-epithelialisation occurs in all laser treated areas by both devices by day seven. Residual erythema can remain for a period of 14 days but this is rather unusual at the lower settings. Most patients can use camouflage make-up to cover up the erythema on day four to five. No significant sex differences are noted in the duration of reepithelialisation, erythema or in the histopathologic changes. It should be noted that most patients do not really feel pain with these devices until the proceduralists moves them into higher energies.

The adoption of the single-pass technique, which was widely adopted with earlier non-fractionalised devices in order to reduce the morbidity associated with CO_2 laser treatment, is not as necessary with these devices. Single pass techniques tended to limit the depth of penetration thereby decreasing the risk of scarring and permanent pigmentary alteration.

Post-inflammatory hyperpigmentation is also unusual with proper patient selection with these newer devices. Histological studies demonstrate that 50 to 150µm of skin may be ablated with a single pass of a CO_2 laser. In my own experience, skin biopsies (as shown) show effect of thermal treatment with thermal coagulation of epidermis and superficial dermis in a depth ranging from 85 to 113 microns. This was similar in both lasers with the SmartXide consistently getting below 100µm.

If fractionalised laser skin resurfacing with minimal downtime is now considered the latest method of 'softly' treating patients for skin conditions such photo-ageing then the SmartXide DOT has certain cost advantages to the operator. However, the lack of an internal exhaust device to remove the laser plume is a distinct disadvantage. I feel the SmartXide also works faster, covers a greater area and has a more sophisticated CPG effect. It has yet to be established whether this device will continue to require multiple treatment sessions or not. However, if the physician is treating patients with deeper facial rhytides or other pathology such as deeper congenital nevi in a one off session, then the variable settings of the ActiveFx appears to have the advantage.