Fractional laser skin resurfacing: looking at the key applications and advancements

The use of fractional laser technology can reduce the appearance of fine lines, treat photodamaged skin and minimise scarring caused by acne. Over the last decade, there have been many advancements in this area, with the most recent development being the introduction of mixed technology laser systems. Samantha Hills discusses key considerations for practitioners offering this procedure

It has now been over 10 years since Manstein et al (2004) introduced the first prototype fractional laser device and the the accompanying theory of fractional photothermolysis. The concept of delivering laser beams to the skin in a pixelated fashion has truly revolutionised the way in which practitioners carry out treatments for a vast array of indications, including skin rejuvenation, stretch marks, and the treatment of scars, to name a few.

Common applications for fractional lasers

Some of the common applications that fractional lasers are used for are:

- Photodamaged skin, i.e. roughened, thickened skin, with uneven tone, large pores, excessive secretion of sebum, and loss of elasticity
- Congested skin
- Acne scarring (*Figure 1*)
- Traumatic scars, including surgical scars and burn scars
- Stretch marks (striae)
- Mild, static wrinkles (*Figure 2*)
- Pigmented lesions, dyschromia and melasma (although results may be variable with this condition)
- Total skin rejuvenation of facial and non-facial areas.

Method of delivery

Light of any wavelength can be delivered to the skin fractionally, in microscopic beams, but this has no real benefit for wavelengths of light used for hair removal or vascular lesion applications, for example. Fractional delivery has found its niche in its use with lasers that target water in the skin, which have traditionally been used for skin rejuvenation, either at ablative wavelengths (e.g. the carbon dioxide (CO_2) laser at 10 600 nm and Erbium YAG (Er:YAG) laser at 2940 nm) or non-ablative wavelengths (e.g. Er:glass and gallium arsenide (GaAs) lasers at 1540 nm).

Whereas ablative lasers use wavelengths of light that are highly absorbed by the water in the skin, creating very high temperatures and vaporisation of the water in the tissue and leading to ablation (or resurfacing) of the epidermis, non-ablative lasers are less well absorbed by water, meaning the temperatures required for vaporisation are not reached and a more gentle heating effect is seen within the dermis. When the above wavelengths are delivered to the skin fractionally, microscopic holes are created if using ablative wavelengths, or, with non-ablative wavelengths, columns of thermal damage are formed that stimulate significant collagen renewal. The skin appears tighter due to immediate collagen shrinkage, and this is followed by long-term stimulation of fibroblasts which produces new collagen over the following months.

Treatment outcomes

Fractional laser technology was introduced with the aim of delivering results comparable to traditional fully ablative resurfacing procedures without the prolonged downtime. With traditional (non-fractional) resurfacing treatments, erythema could last up to 6 months and the incidence of hyperpigmentation, hypopigmentation and even scarring was comparatively high. A significant benefit of delivering laser light fractionally is that the surrounding, non-affected areas of skin facilitate rapid wound healing; aiding the body's natural recovery process. With even the most aggressive fractional CO_2 treatments, downtime rarely lasts more than 7–10 days; however, with non-ablative fractional treatments, downtime can virtually be eliminated, with as little as an hour of erythema post treatment.

Potential complications

Although side effects are uncommon with non-ablative fractional treatments (Graber et al, 2008), reports suggest that complications can develop with fractional ablative treatments and that these treatments should only be carried out by health professionals (Metelitsa and Alster, 2010). Nevertheless, the overall rate of complications associated with fractional laser skin resurfacing is much lower than with traditional ablative techniques. For example, the rate of herpes simplex infection following fractional laser treatment is thought to be about 0.3–2% compared with 2–7% for traditional resurfacing procedures, and the occurrence of bacterial infection is even lower (0.1%) (Setyadi et al, 2008).

Managing expectations

As with all aesthetic procedures, it is important to gauge patients' expectations and establish realistic outcomes. Fractional skin rejuvenation is not a substitute for surgery or fully ablative laser treatments. It is, however, appropriate for people with sun-damaged or congested skin, or those with dyschromia or mild scarring and stretch marks. Treatment can also reduce the appearance of lines, wrinkles and acne scars, improve skin elasticity, and promote a more even skin tone. Recent studies have also shown fractional lasers to be beneficial for

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the treatment of more extensive scarring, such as that caused following burns, with the ability to not only greatly improve the appearance of the scarring, but also reduce the functional restriction associated with burns and trauma (Sanders, 2015).

Number of treatments

The number of treatments required depends almost entirely on the type of system being used—often just 1–2 treatments are sufficient for a more aggressive CO_2 fractional laser treatment, but a course of 4–6 treatments is generally required for non-ablative lasers, which will also have correspondingly less downtime associated with them).

Before and after

Although fractional laser resurfacing is suitable for all skin types, the risk of post-inflammatory hyperpigmentation in darker skins means that some pre-loading with pigment suppressants may be required for more aggressive treatments. For non-ablative treatments, post-treatment aftercare is minimal. For fractional CO_2 treatments, prophylactic antibiotics and antiviral medications should be administered. Post treatment, the skin will feel sore and 'sunburnt' and therefore the skin should be cooled to minimise discomfort. This can be done using cold gel packs, wet gauze or a forced air cyrogenic cooling system. As the healing process occurs, the skin may have a 'bronzed' appearance that lasts 3–10 days, as the epidermal debris comes to the surface of the skin. Some flaking of the skin may also be apparent.

Recent developments

An exciting recent advance is the launch of 'mixed technology' fractional lasers and an increasing number of laser systems now offer dual wavelengths for the treatment of a variety of skin conditions.

It is generally accepted that the sequential delivery of certain wavelengths of light (e.g. 585 nm, 1064 nm) can be beneficial for the treatment of recalcitrant vascular lesions. However, the YouLaser MT (Quanta Systems, distributed in the UK by Lynton Lasers) is the first mixed wavelength fractional laser platform combining CO_2 and GaAs lasers, and also delivering ablative 10 600 nm and non-ablative 1540 nm simultaneously.

PHOTO CREDIT

Figure 1. Acne scarring pre and post fractional laser resurfacing with WHAT TECHNOLOGY?

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Figure 2. Wrinkles pre and post fractional laser resurfacing with WHAT TECHNOLOGY?

The combination of superficial fractional ablation and deeper fractional non-ablative wavelengths induces a pronounced coagulation effect within the medium and deep dermis, with a net saving on surface ablation. The two wavelengths work together synergistically to achieve dermal remodelling effects similar to aggressive CO_2 treatments, but without the prolonged downtime or the requirement to have an extended course of treatments, as is the case with purely non-ablative fractional treatments.

The presence of the non-ablative 1540 nm wavelength appears to act on inflammation and can reduce the appearance of vascular concerns, despite not directly targeting haemoglobin (Tierney and Hanke, 2010). JAN

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