

Hybrid Fractional Laser: The Future of Laser Resurfacing

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OBJECTIVE

A new category of fractional laser device has been developed and is referred to as a Hybrid Fractional Laser. This study will detail the technology and mechanism of action behind a Hybrid Fractional Laser, and will compare the technology to existing resurfacing lasers.

INTRODUCTION

CO₂ lasers for resurfacing were introduced in the mid-1990's and changed the landscape of aesthetics overnight. The initial lasers were continuous wave with very little control and delivered less-than-stellar results with many adverse events compared to modern day resurfacing lasers. Fortunately, continuous wave CO₂ lasers led to the development of pulsed and scanned CO₂ lasers and eventually pulsed, scanned Er:YAG lasers. This next generation Erbium technology offered much more control to deliver better results with significantly reduced downtime and adverse events.

The rise of pulsed resurfacing lasers led the industry further down the path towards lower downtimes and less adverse effects, which gave rise to fractional laser technology. Fractional lasers offered acceptable results with much lower downtime and almost no adverse events but required more treatments. Ablative Fractional Lasers (Fig.1) remove small columns of epidermal and dermal tissues, which regenerates into brand new tissue. Non-Ablative Fractional Lasers (Fig.2) create microscopic zones of tissue injury which becomes remodeled, but does not remove tissue like an ablative laser. These lasers continued to lower treatment downtime but required even more treatments to achieve desired results.

For the last decade, patients who did not desire deep, full field Er:YAG resurfacing, which offered the best results but prolonged

downtime, were given two options. They could choose ablative fractional treatments (fewer sessions, more downtime), or non-ablative fractional treatments (more sessions, lower downtime). Today, new resurfacing technology from Sciton completely changes the idea that better results require either more downtime or more treatments. Halo™, the world's first Hybrid Fractional Laser, combines the best attributes of both non-ablative and ablative fractional lasers. Now, patients can get ablative-like results with non-ablative-like downtimes.

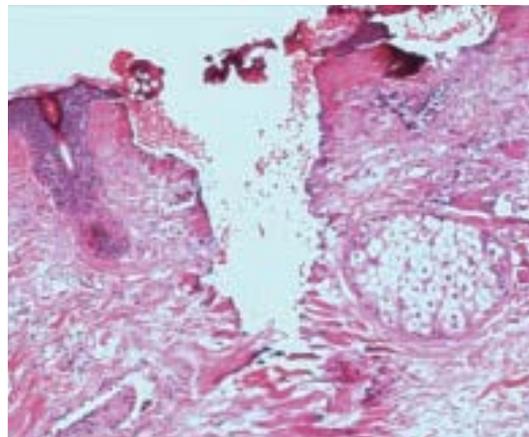


Figure 1. Ablative Fractional Laser Treatment Zone

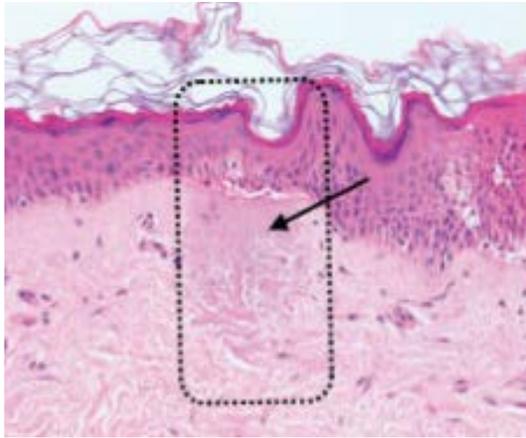


Figure 2. Non-Ablative Fractional Laser Treatment Zone (1)

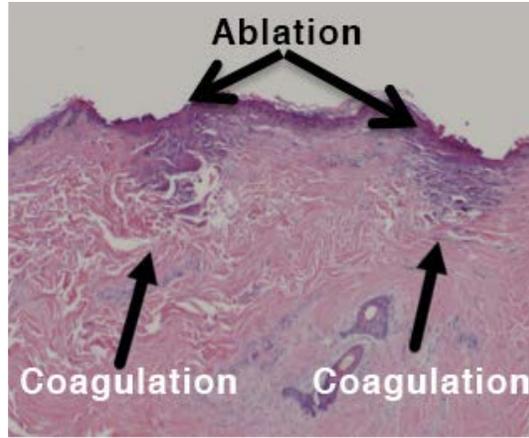


Figure 3. Intra-Epidermal Ablation (<100 microns) courtesy of Robert G. Aycock, MD, FACS

HYBRID FRACTIONAL LASER

Each patient is different, from their skin type, to their lifestyle, to their tolerance for downtime. Hybrid Fractional Lasers (HFLs) offer a customized treatment with maximum results and low downtime.

HFLs work by delivering ablation sequentially followed by coagulation to the microscopic thermal zone (MTZ). (Fig.3) Halo uses 2940 nm Er:YAG to deliver 100% pure ablation between 0 to 100 microns into the epidermis and 1470 nm diode to deliver 100% coagulation between 100 to 700 microns to the epidermis and dermis. This gives Halo the unprecedented ability to provide

separate treatments to the epidermis and dermis in the same treatment spot. Independent variable treatments in the epidermis and dermis demonstrates some very interesting effects. A fractional treatment, (whether ablative or coagulative), allows the epidermis to heal quickly as long as the dermis remains intact. This is because basal keratinocytes can migrate across the fractionated holes quickly. When less than 100 microns of ablation are used, the epidermis regenerates within 24 hours. The ablated epidermis is allowed to heal quickly while the coagulated dermis regenerates more slowly over a period of 7 days¹.

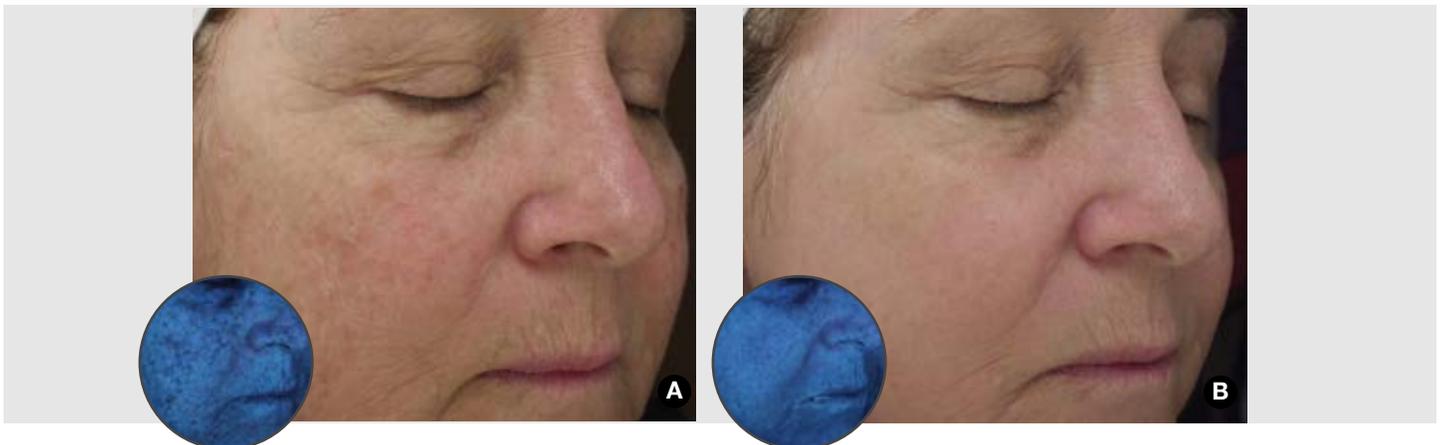


Figure 4. HALO A) before and B) after 2 treatments | 1470 nm: 425 µm, 45%; 2940 nm: 50 µm, 30% courtesy of Sanctuary Medical Center

¹ Laubach HJ, Tannous Z, Anderson RR, Manstein D. Skin responses to fractional photothermolysis. Lasers Surg Med 2006;38:142-9.

MECHANISM OF ACTION

Adding tunable ablation to a non-ablative treatment creates varying effects when different levels are used. Using low levels of ablation (up to 20 microns) causes faster clearance of microscopic epidermal necrotic debris (MENDs). Heavier levels of ablation (up to 100 microns) seem to create a synergistic wound healing response. The clinical effect is ablative-like results with nearly non-ablative-like healing. (Fig. 4)

During a non-ablative treatment, a column of the skin (MTZ) is heated to a temperature that necroses the epidermis and denatures dermal collagen. In the first 24 hours, the basal cell layer regenerates across the MTZs, under the necrosed epidermis, and then proliferates upwards, expelling the necrosed tissue. This necrosed tissue becomes small packets of debris (MENDs) that are trapped under the stratum corneum, taking between 2 to 7 to days to clear. Performing a 20 micron ablation followed by coagulation allows faster removal of MENDs. By removing the stratum corneum, the MENDs are free to exit the skin within a day of forming. This results in 1 - 2 days faster healing time as compared to non-ablative treatments.

Ablating tissue creates a stronger wound healing response than just coagulating the tissue². This wound healing response can be leveraged by adding more ablation during a Halo treatment. Adding up to 100 microns of ablation removes some of the tissue

that would otherwise be necrosed near the surface, eliminating any MEND formation and limiting adverse events near the surface. In addition, the increased wound healing response in ablated tissue has a synergistic effect when combined with coagulated tissue through activation of Activator Protein 1 (AP-1) transcription factor leading to upregulation of Matrix Metalloproteinase (MMPs) which drive dermal remodeling³. The combination of the ablated epidermis' inflammatory response with the denaturing of the dermis' collagen probably accounts for the greater, ablative-like results that are seen with a hybrid fractional treatment.

TECHNOLOGY

Beyond the hybrid technology that makes Halo so unique are many features that help improve usability and safety. Some of the features include:

- i) Tunable 1470 nm depth
- ii) Dynamic Thermal Optimization technology
- iii) Intelligent energy-based parameters
- iii) Platform approach

Halo (Fig.5) offers the flexibility of completely turning off ablation for users that are not qualified to use an ablative laser or for those looking for the simplest laser treatments. Both the ablative and non-ablative laser wavelengths can be delivered in the same pass, and many different permutations of depths and coverage are possible. (Fig.6)



Figure 5. Halo Hybrid Fractional Laser Handpiece

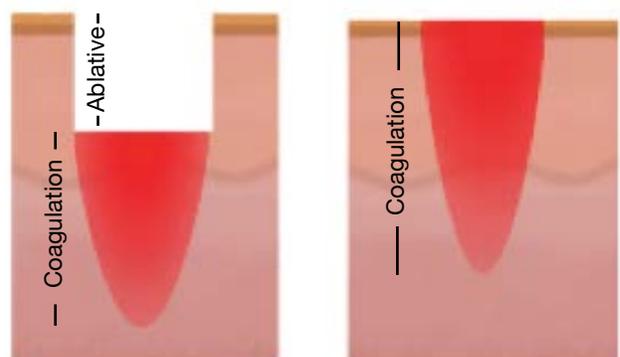


Figure 6. Adjustable Ablation and Coagulation

² Cohen JL, Ross EV. Combined fractional ablative and nonablative laser resurfacing treatment: a split-face comparative study. J Drugs Dermatol. 2013 Feb;12(2):175-8.

³ Orringer JS, Rittié L, Hamilton T, Karimipour DJ, Voorhees JJ, Fisher GJ. Intraepidermal erbium:YAG laser resurfacing: impact on the dermal matrix. J Am Acad Dermatol. 2011 Jan;64(1):119-28. doi: 10.1016/j.jaad.2010.02.058.

The tunable 1470 nm depth is an important feature of Halo, whether employing the Hybrid Fractional Treatment or a non-ablative treatment. The 1470 nm wavelength is ideal for non-ablative resurfacing because coagulation can be tuned from as little as 100 microns (completely within the epidermis) to 700 microns (within the dermis). Most solar damage exists within the superficial dermis, the first 200 to 400 microns of the dermis, and because of this, the best results are seen in the range of 300 to 400 microns, where the 1470 nm is best suited⁴.

Previous wavelengths, such as 1550 nm, can achieve results but often go too deep, causing unnecessary pain and discomfort. The introduction of wavelengths, such as 1927 nm, helped make treatments more comfortable, but were limited to depths of approximately 100 microns, which is too shallow to achieve dramatic changes in the dermis. The 1470 nm wavelength optimally cuts right between these two wavelengths, allowing treatments that are comfortable and effective. (Fig.7)

New Dynamic Thermal Optimization (DTO) technology (Fig.9) ensures tunable treatments that are even from start to finish. In non-ablative fractional treatments, depth of treatment changes with the temperature of the skin. Most non-ablative lasers cannot compensate for skin temperature changes, resulting in treatments

that go deeper as the temperature of the skin heats up⁵. This occurs when the laser raises the temperature of the MTZ to above 70 °C, causing necrosis. When the temperature of the skin rises during treatment, the treatment can go deeper than expected. Also, as the treatment continues, energy, and therefore heat, can build up in the skin. Conversely, you may risk under treating if you over cool the skin with a Zimmer chiller. DTO technology monitors the temperature of the skin before each pulse and adjusts the pulse energy to ensure that the depth of the treatment matches the depth displayed on the user screen ensuring a safe and even treatment.

Halo uses intelligent energy-based parameters to supersede current non-ablative fractional laser resurfacing technologies. Traditional non-ablative treatments with pass-based treatment protocols can be very uneven, since it is difficult to see where the previous pass was placed or to know the actual number of passes performed. However, an energy-based system ensures a consistently even treatment by measuring the size of the area being treated and calculating the energy necessary to complete the treatment. As long as the user moves the handpiece throughout the measured area evenly, the treatment will be consistent. Adding ablation to a treatment further simplifies the process since the treatment can be easily visualized on the skin even at very mild ablation in the 20 micron range. (Fig.8)

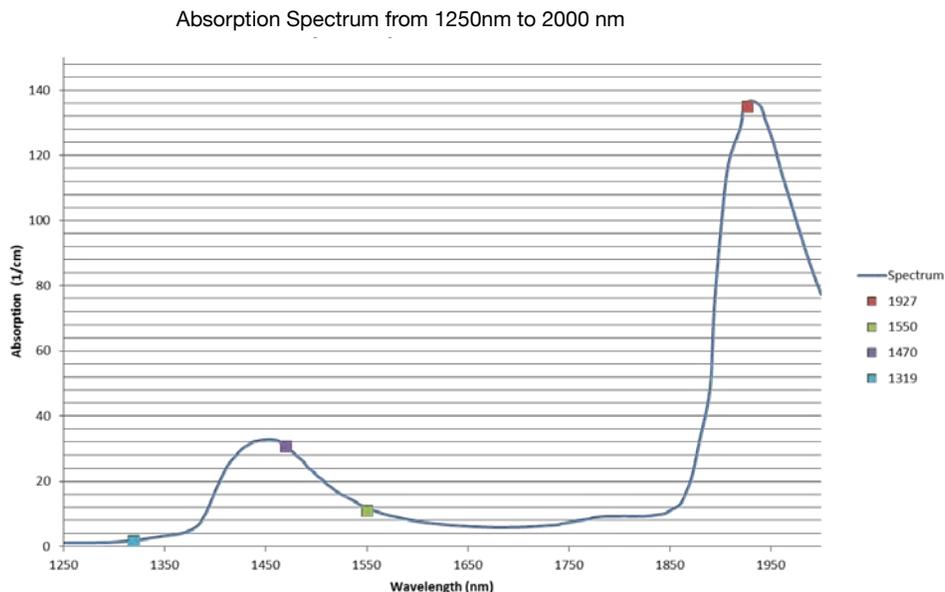


Figure 7. Water Absorption Spectrum

⁴ Paithankar DY, Clifford JM, Saleh BA, Ross EV, Hardaway CA, Barnette D. Subsurface skin renewal by treatment with a 1450-nm laser in combination with dynamic cooling. J Biomed Opt. 2003 Jul;8(3):545-51.

⁵ Laubach H, Chan HH, Rius F, Anderson RR, Manstein D. Effects of skin temperature on lesion size in fractional photothermolysis. Lasers Surg Med. 2007 Jan;39(1):14-8.



Figure 8. Halo Hybrid on Forehead

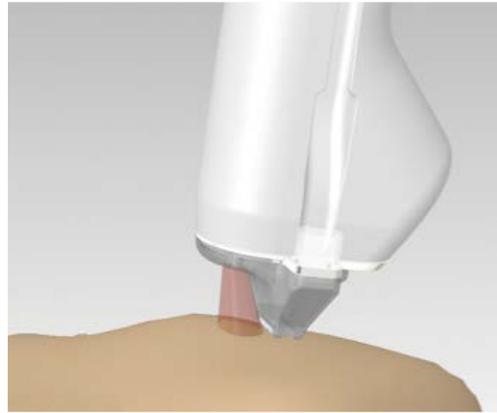


Figure 9. DTO Technology Measuring Skin Temperature

Halo is a part of Sciton’s configurable JOULE™ platform, making it the most versatile system on the market. A JOULE system can be configured to provide 100% non-invasive treatments or deep, full field resurfacing or anything in between. A wide range of treatment parameters (refer to the JOULE operation manual for protocol) can be selected and programmed into the JOULE system.

Investing in a JOULE platform allows a practice to grow without the need for purchasing additional lasers.. As a practice grows and becomes more comfortable with laser resurfacing, more capabilities and treatment options can be offered. No other laser provides all of these capabilities on one platform. The JOULE platform has long provided the most value of any laser system on the market. Now Halo increases that value further by delivering the possibilities inherent in the first and only Hybrid Fractional Hybrid Laser.

CLINICAL RESULTS

Halo has undergone years of testing to perfect the Hybrid Fractional Laser technology. The design goal was to build a better non-ablative fractional laser for physicians looking for an alternative to Contour TRL™ and ProFractional™ with less downtime.

In testing, investigators found something remarkable. Patients treated with Halo had much better appearance related to texture and pigment improvement than expected. Patients had amazing results in 1-2 treatments while older non-hybrid technology needed 5-6 treatments to have similar texture changes but did not approach Halo in terms of pigment correction. In addition, there was remarkable, unexpected improvement in pore size and number. (Fig 10, 11)

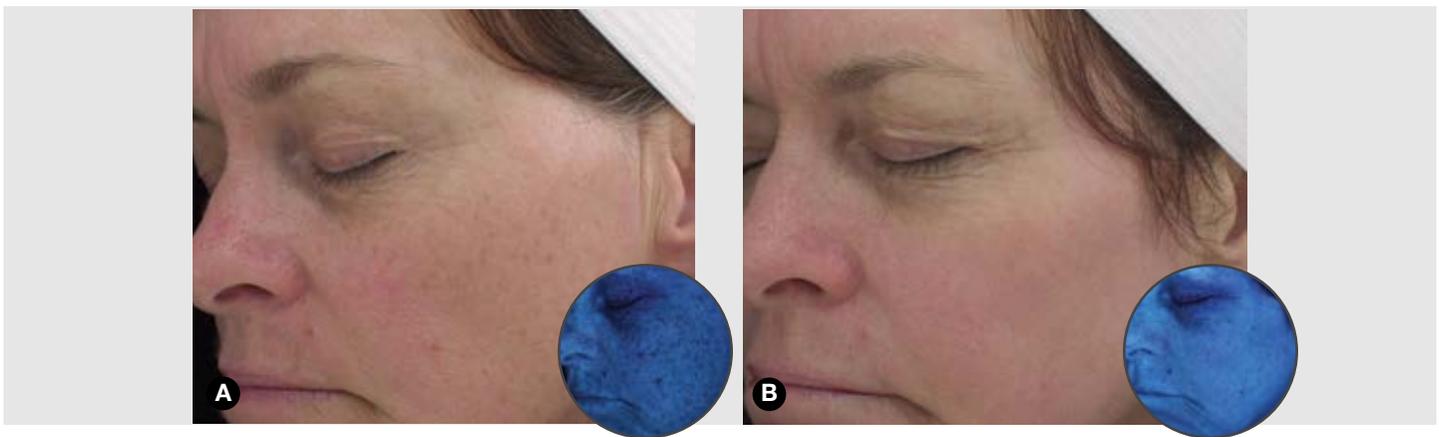


Figure 10. HALO A) before and B) after 2 treatments | 1470 nm: 350 μm, 45%; 2940 nm: 20 μm, 30% courtesy of Sanctuary Medical Center

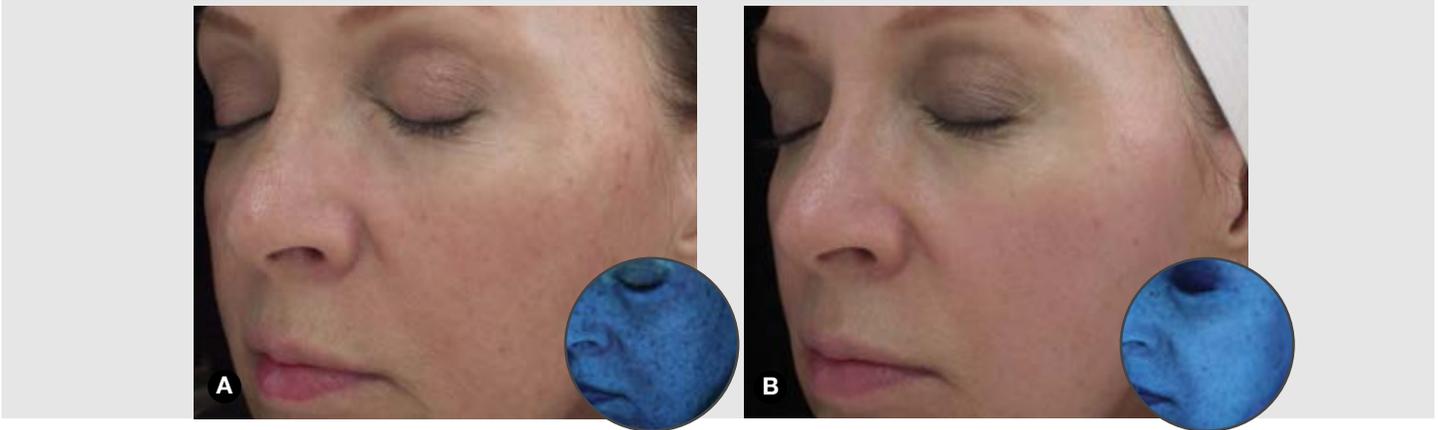


Figure 11. HALO A) before and B) after 2 treatments | 1470 nm: 350 μ m, 35%; 2940 nm: 50 μ m, 30%
courtesy of Sanctuary Medical Center



Figure 12. HALO A) before and B) after 1 treatment 1470 nm: 400 μ m, 30%; 2940 nm: 30 μ m, 20%
courtesy of Chris Robb, MD, PHD



Figure 13. HALO Non-Ablative Only A) before and B) after 1 treatment 1470 nm: 400 μ m, 10%
courtesy of Chris Robb, MD, PHD

CONCLUSION

This clinical study of Halo treatments on the face and neck demonstrated that Halo can produce targeted, consistent, and reproducibly effective results that improve the appearance of dermal damage with little to no side effects. Patients that have received even light ablative treatments prior to Halo treatments preferred the healing experience from Halo. Reasons for their preference include: no need for nerve blocks, less overall pain

after treatment, the ability to put makeup on in just one day after the treatment, and short duration of peeling. Investigators successfully achieved ablative-like results while allowing patients non-ablative-like downtime.

In summary, Halo, from Sciton, sets the standard for the future of laser resurfacing by providing a safe, tunable, and effective long term hybrid option for resurfacing treatments.



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