# Fractional Laser Systems

If you are considering the purchase of a fractional laser system, you should be aware that the fractional treatment is one of the most profitable procedures currently on the aesthetic market. All medical aesthetic practices should own a fractional device. The first fractional aesthetic laser was introduced to the market in 2004. This technology was developed because the laser manufacturers intended to satisfy the needs of patients who wanted more dramatic results than what was currently available, while avoiding the extended downtime, irritation, swelling and redness associated with traditional full resurfacing procedures. This line of reasoning was accurate; fractional treatments are now one of the fastest growing segments of medical aesthetics, even in a down market. The fractional laser treatment is gaining popularity with all aesthetic patient demographics because they get the dramatic improvements with the major selling point of reduced downtime.

The original fractional skin resurfacing laser was the Fraxel, which was a non-ablative device operating in the wavelength of around 1500nm (1530nm to 1550nm). To this day, many people incorrectly refer to a fractional procedure as a Fraxel treatment; it's the same as calling all facial tissues a Kleenex. That early, non-ablative technology required multiple sessions to make a difference in the patient's skin; the procedure was rather painful and very few patients chose to receive the full series of recommended treatments. In the time since that first device came on the market, the vast majority of advancements in fractional technology have been in the ablative wavelengths and very few devices sold today are non-ablative.

The wavelength that is dominating the fractional market is $CO_2$ at 10,600nm. The majority of fractional devices currently being sold are $CO_2$, with a couple Erbium/2940nm devices, and some others in wavelengths below 2940nm. The $CO_2$ is the most popular for a number of reasons, but primarily because the technology behind this wavelength is well established and the components are readily available at reasonable costs. The erbium/2940nm wavelength is a little more gentle than $CO_2$, reducing the potential for negative side effects, but because high-quality components for erbium technology is more expensive, there are only a couple 2940nm devices on the market capable of providing the level of treatment to match the technological advancements in $CO_2$ fractional: the Sciton ProFractional (and MicroPeel) or the Focus Medical NaturaLase ER with MicroHex handset. Both are excellent systems in terms of efficacy, with one being more affordable than the other.

A very important fact to keep in mind is the majority of the components which make up any type of laser system are made by companies who specialize in that type of component. There are very few companies that specialize in the manufacture of the laser generator/lasing chamber. None of the aesthetic laser manufacturers make their own generators and they all purchase that part from a company who specializes in that technology. The same is true for the pump energy component, the power supply, the LCD screen, the articulated arm, the scanner, etc. Laser companies decide on the specifications of their product and, based on the availability of the internal components, will design their system around current technology. They may design and build specific printed circuit boards that are part of the controlling mechanism, but they purchase the remaining components, utilize an engineer to design the software that controls the various components, design an exterior case and put it all together. What sets one device apart from the next in a certain category of laser devices could be just minor differences in the LCD screen and case. When evaluating $CO_2$ fractional laser technology, you have to know what is comprised of a quality device in this category and how the different components/features bring value to the overall product.

Here are the technology options to be familiar with on $CO_2$ fractional lasers:

- there are two types of $CO_2$ lasing chambers (tubes); glass or metal,
- the system is cooled by either air or water,
- the pump energy (what "excites" or initiates the generation of the laser beam) can be one of three options; light (generated by a flashlamp), DC (Direct Current electricity), or RF (Radio Frequency),
- the laser beam is delivered in one of two modes; Superpulse (which are extremely short pulses stacked one on top of another), or Continuous Wave (CW),
- the scanner delivers the micro-spots in a variety of patterns and sequences

First step is to lay out the basics: All types of lasers incorporate similar technologies to generate a laser beam, the difference is the lasing material (what element creates the photons that make up the specific wavelength beam of energy) and the electronics utilized to modify the beam to fit the needs of the designated treatment. A $CO_2$ laser has a lasing chamber, also called the generator or tube, containing a lasing material that is made up of a combination of gases, but the primary gas is Carbon Dioxide ($CO_2$). This generator is essentially a tube to contain the gas/element, which has mirrors on each end. A $CO_2$ tube is long (about 3 feet) and thin. The tube is exposed to high intensity energy, also called the pump energy, in the form of light from a flashlamp, or DC, or RF. This intense energy "excites" the electrons orbiting the nucleus of the $CO_2$ molecules by bumping them out of their usual path, and this disturbance causes the release of photons. The photons are a specific wavelength based on the lasing material in the generator (the wavelength emitted from $CO_2$ gas is 10,600nm). The photons are collected within the tube, reflected by the mirrors, amplified, and then released as a beam of energy in the form of light. How the energy is released is determined by the electronics designed into the laser system.

A fractional laser system is different than a standard laser in the aspect of the size of the beam striking the tissue. Also, the true definition of fractional does not accurately describe most fractional laser systems currently on the aesthetic market. A true fractional laser beam is generated by taking a single beam of laser light and splitting it into multiple, smaller beams (also called micro-spots). This is done with optics that consists of lens to split up the single beam and distribute the smaller beams into some type of pattern, usually a grid of equally spaced micro-spots. Some aesthetic fractional lasers utilize this type of technology and it is called the stamping method since a laser such as this will deliver a complete pattern of micro-spots with one pulse from the laser (as an example, it delivers 81 micro-spots, configured in a 9 x 9 pattern, all at once). The most common technology used today in aesthetic fractional lasers involves a scanner system that takes the single beam emitted from the laser generator, shrinks it down into a very narrow beam, and delivers it one at a time as individual micro-spots in a scanned pattern on the skin. The benefits of utilizing a scanned fractional pattern over a stamped pattern is you can concentrate the energy of the entire laser system into one spot with a scanner, so it can deliver a very deep treatment. A stamped pattern is generated by taking the beam and splitting it into multiple smaller spots, thereby dividing the light energy equally between all spots, resulting in a lower energy per micro-spot and less depth penetration overall. An effective fractional laser must have enough pulse energy per micro-spot to penetrate far enough into the skin to deliver results; a scanned-pattern laser can be made with less peak power than a stamped-pattern laser, thereby lowering the cost of the technology required.

Through years of research in $CO_2$ skin resurfacing, it has been determined that a CW beam cannot create a high enough peak energy within a short period of time for a controlled removal of tissue without causing unintended collateral thermal damage and excessive charring. Superpulse technology was invented in the early 1980's and, with the application of this technology to the fractional resurfacing procedure, was found to have an excellent ratio of tissue removal with coagulation of the surrounding structure, providing the right combination of consistent patient outcomes, safety, and tissue tightening due to surface contraction and dermal collagen remodeling. A Superpulse beam will deliver a controlled heating of the skin and cause far less thermal damage due to the fact the tissue is exposed to high peak energy for a shorter period of time, when compared to a CW beam. The CW beam will cause more uncontrollable and unintentional thermal damage because the peak energy is insufficient to create the intended response in the tissue without lengthening the time of exposure. This thermal damage from a CW beam equates to increased chances of PIH (post inflammatory hyperpigmentation), possible charring of the tissue, longer patient down time and an overall higher potential for complications. Some of the low-end CO2 fractional devices will use a "chopper blade" in a futile attempt to make their CW beam perform in a similar fashion as a Superpulse beam (essentially they use a spinning fan with multiple blades that alternately block and release the CW laser beam to create short pulses), but this does not have the same effect on the skin as true Superpulse technology. There is one additional pulsing technology in the market, Ultrapulse, utilized by the Lumenis ActiveFX, DeepFX and TotalFX. Lumenis has the term “Ultrapulse” trademarked and no other technology or manufacturer can incorporate this into their design. Based on studies done by Lumenis, the Ultrapulse technology is a slight improvement over Superpulse technology, while both Ultrapulse and Superpulse were far superior to CW technology.

The low-end/low priced CO2 fractional lasers have a glass tube generator that is light or DC excited (the pump energy) and water cooled. The vast majority of these low-end tubes produce a CW beam. This is due to the fact the pump energy provided by a flashlamp or DC is somewhat variable and is not consistent enough to support a Superpulse beam technology. Most of the light/DC excited glass tubes are made in China, which have a high chance of premature failure. There are a few light or DC excited glass tube systems that can produce a Superpulse beam, but that beam quality is not ideal because, as previously mentioned, the energy from light or DC can be variable. RF delivers a much more precise and consistent source of pump energy, ideal for producing a Superpulse beam, but is expensive to incorporate into a design. Metal tubes, which are the most expensive and currently only made in the U.S.A., will last 2 to 3 times longer than any glass tube, regardless of where the glass tube is manufactured. A metal, RF excited tube is the best combination of beam quality and component longevity, but because of cost, that combination is seen only in the high-end devices.

The scanner handset is an important component and can make a system more or less useful. Most scanners can deliver the micro-spots in a variety of patterns of various sizes and shapes (square, rectangle, triangle, circle, etc.), and in a variety of sequences (like a “typewriter” – left to right, down one line and left to right again; like a “lawnmower” – left to right, down one line, right to left, etc.; or outside-in, or inside-out, or random – in a completely random manner all over the pattern without any two adjacent spots being placed immediately after one another). A scanner is a very high-tech, precision device that involves rotating mirrors/reflectors within the scanner handset, placing the micro-spots in very precise patterns, one after another, at lightning-fast speeds. The scanners will vary in terms of quality, but the rule of thumb is that a low quality scanner will deliver the micro-spots in the more simple sequences such as the "typewriter" and "lawnmower" (mentioned above) while a high-end scanner can do the simple sequences plus the more complex random sequence.

Examine the articulated arm on the laser system. The most common issue with a laser of this type is the mirrors tend to fall out of alignment. When this happens, a technician is required to realign the mirrors or replace the arm. If the articulated arm does not have removable caps on the joints of the arm, adjusting the mirrors is extremely difficult and may require the complete arm to be replaced. Having removable caps on the joints of the articulated arm will allow a technician to easily and quickly make adjustments, which results in a lower repair cost.

When talking with salespeople from the fractional laser manufacturers, there are a variety of tactics they will use to convince you to purchase their device. It could be a low cost, or the best technology, or the most well-known name/brand, etc. Most practices are looking for the highest level of technology they can purchase, at a price that can fit within their budget. Some buyers can be persuaded to spend well beyond their means and/or needs. Some practices only look at price and then wonder why that portion of their practice never really takes off and does not reach the same level of success they have seen other local practices attain. This information is meant to help you get the best technology available without overpaying.

When a salesperson tries to convince you their system is double the price of the competition simply because of their superior technology and brand value, keep in mind that it is very expensive to advertise in the aesthetic marketplace. Placing full-page advertisements in the high-gloss aesthetic magazines, having a large booth at trade shows and compensating physicians to speak about their technology at conferences, all have a high price tag. The cost to advertise goes into the sales price of every laser system; just because a laser has a high price tag does not necessarily mean it incorporates the highest technology. If you are considering a $100,000 laser, it could have a built-in marketing cost of $50,000, resulting in a true technological value of only $50,000. What value does that marketing cost bring to you or your patients? If you saved $50,000 on the laser purchase, you could spend the other $50,000 on advertising/promoting your practice.

Another aspect of the sales pitch you have to be aware of is the tactic of creating confusion or uncertainty when it concerns the competition. If a laser company calls their technology, or some feature/benefit of their device, a unique name or label, they are trying to set themselves apart from the rest. It could be a valid point, or it could be a way to redirect your attention. The question is; how do you research the competition and do a fair comparison when no other system has that “special” feature/benefit? You can’t, which leaves you somewhat confused and that can result in the laser manufacturer’s advantage. When a salesperson tells you their system can deliver something no other laser is able to deliver, and call it some unique name or label, dig deeper than just taking their word for it. Find out what component or part of the laser device produces that result. They must be able to explain it to you in terms anyone can understand, as long as the company’s scientific department explained it well enough to the salespeople. There must be some tangible factor that creates this feature/benefit. Since the sources for all laser components are somewhat limited, it is very possible that many of the fractional lasers on the market utilize the same internal parts, and (as mentioned earlier) it is possible that the only difference from one laser to the next is the outside cover, the LCD screen and the software program controlling the system. If you understand how these systems work and what is comprised of a high quality fractional laser system, you can determine if that unique feature/benefit is actually unique and beneficial, and worth the extra thousands as reflected in the purchase price. It could be sold at an inflated cost simply because the laser manufacturer spent millions in advertising, which has no additional benefit to your practice or your patients.

Use this information as your guide to make your choice based on the real value of each component or feature and how those items affect the performance of the overall system.