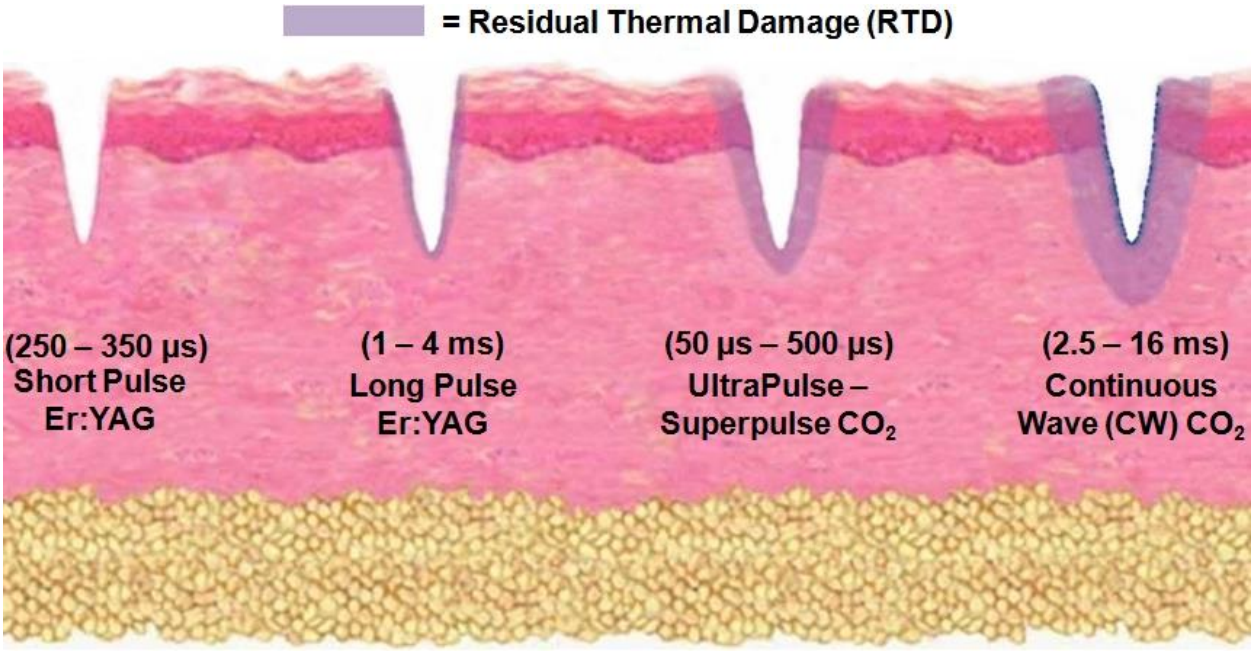
Why CO_2 Fractional Laser Resurfacing Using CW is Superior!

Point 1: It is well documented in the medical literature that a zone of thermal damage to the dermis as a result of ablative CO_2 laser resurfacing increases collagen synthesis and long term skin tightening. Greater thermal injury (up to a certain point) results in greater cosmetic improvement. Also, the thickness (depth) of the thermal damage zone is a function of both the amount of laser beam energy and width of the laser beam pulse (dwell time); the wider the pulse, the greater the thermal injury:



Note: The above diagram is not necessarily drawn to scale but is useful for comparison purposes only.

A) *"Initially it was proposed that tissue removal (ablation) was the most important mechanism in laser skin resurfacing. This concept was embraced because of its intuitive attractiveness and the observation that wrinkle crests could be gradually sculpted down by multiple passes of the laser. It was later determined that ablation depths into the dermis were often much less than wrinkle depths, and yet marked cosmetic improvement was still observed. Also, microscopic studies failed to show significant dermal ablation (>50 µm), even after multiple passes. This led to the proposal that other mechanisms, namely, collagen shrinkage and wound healing–induced fibroplasia, were mainly responsible for cosmetic improvement".*[1]

B) *"The depth of ablation is most critical in determining the depth of injury and subsequent fibroplasias produced by Er:YAG lasers, whereas the depth of residual thermal damage is more important in CO_2 laser resurfacing, which produces more long term wound contraction and fibroplasias".*[2]

C) ***"****As the dermis is penetrated and the relative concentration of water decreases, the laser energy is increasingly dissipated to the surrounding tissue as heat. This thermal transfer is probably responsible for dermal collagen denaturation. Denaturation of*

collagen has been theorized to contribute to tissue shrinkage and the ultimate clinical goal of wrinkle reduction".[3]

D) *"The residual thermal damage zone is well documented to accelerate collagenogenesis and remodeling of the immediately subepidermal collagen fibers".*[4,9]

E) *"Tissue shrinkage from dehydration and contracted denatured collagen is only present for a short period (14 days) after laser resurfacing, but continued improvement in skin texture and contour has been observed clinically up to 1 year after treatment. New collagen deposition and remodeling in the dermis appear to be responsible for such improvement, the extent of which is dependent on the extent of residual thermal damage produced by the laser beam".*[2]

F) *"The depth of residual thermal damage is dependent on the fluence and pulse duration of the laser system used".*[5]

G) "*Longer pulses resulted in larger zones of residual thermal damage. If the pulse is long enough that significant thermal diffusion occurs during the pulse, then the volume of tissue heated during the pulse will increase. Consequently, there will be less efficient tissue ablation, a larger total volume of tissue heated, and a larger zone of thermal damage, . . . For pulses longer than T_R a larger zone of thermal damage is observed because significant thermal diffusion occurs during the pulse; the extent of thermal diffusion, and thus damage, is a function of the pulse duration".*[6]

H) "*The scanned (CW) laser wounds showed 44% greater new collagen synthesis on day 7 post-op and 48% greater new collagen synthesis on day 14 post-op than the short-pulsed laser. The amount of new collagen synthesis was found to directly correlate with the amount of thermal damage, with the CW laser creating both more thermal damage and more collagen synthesis".*[7]

I) *"In addition, Kuo T. reported that additional thermal damage causes increased collagen synthesis. These findings suggest that the thermal damage with CO_2 lasers might be advantageous and that a scanned continuous wattage carbon dioxide laser might even produce better collagenogenesis than the pulsed laser".*[8]

J) *"It seems that a more efficient volume of residual thermal damage is produced by high incident power densities combined with comparatively long irradiation times, such as delivered by the continuous-wave system".*[9]

K) *"Probably because of the greater degree of residual thermal damage associated with the continuous wave system, at 2 years after treatment there was more prolific synthesis and better orientation of collagen fibers, which were maintained for longer times, compared with the pulsed-treated specimens".*[10]

Point 2: Another benefit of performing ablative fractional CO_2 laser resurfacing using continuous wave (CW) is that at wider pulse widths a narrow zone of hyper-coagulated (basophilic) tissue is created that lines the inner most surface of the ablation crater. This thin layer of intense basophilia (mistakenly at times called 'char' by some researchers) will better seal off nerve endings reducing post-op pain, will increase coagulation of small lymphatic vessels reducing edema after treatment and will advance closure of small blood vessels decreasing bleeding

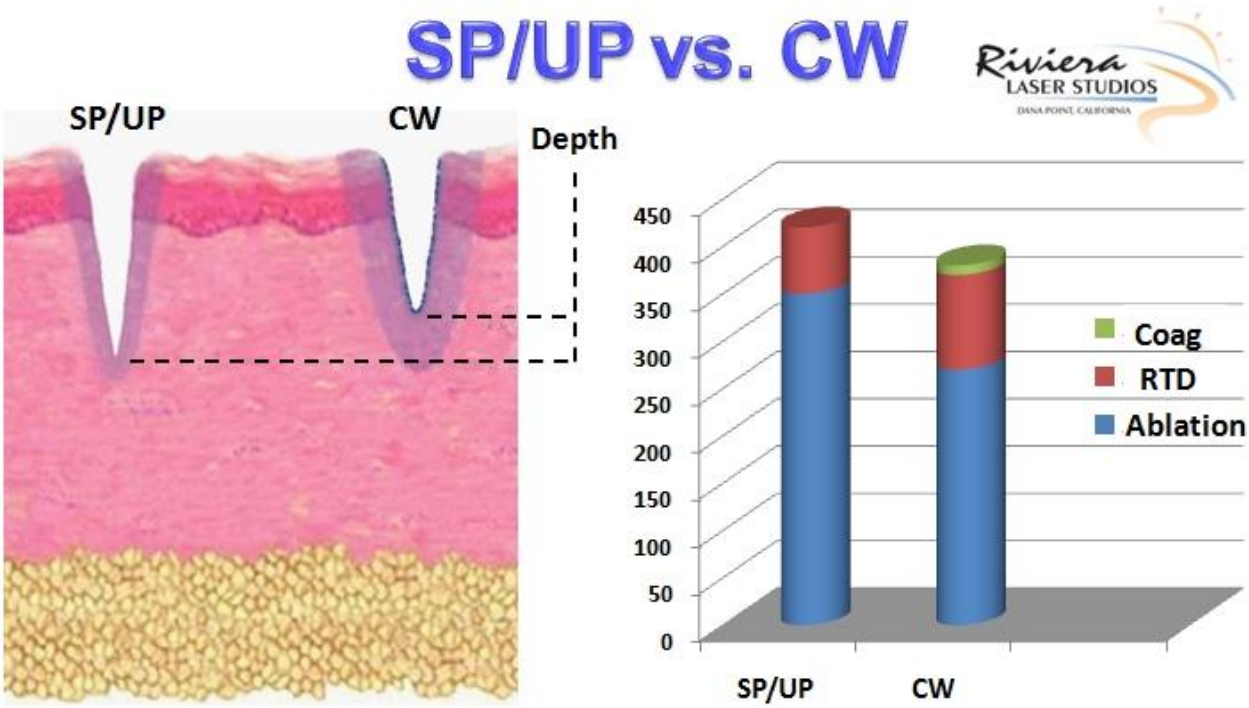
which improves vision in the surgical field, with less post-operative bruising and swelling. Less bleeding and oozing will also lessen the chance of any post-op infection as deep wet drill holes are a vector for bacteria. This results in less anxiety for the patient after treatment and simplifies post-care:

A) *"The gross and histologic effects of TEA (2 µsec-long pulses), electrically pulsed (200-µsec-long pulses to CW) and shuttered CW CO_2 laser irradiations on epilated guinea pig skin were investigated. Grossly, charring was noted only for pulse durations of 2 msec or longer; all lesions were nonhermorrhagic".*[6]

B) *"CW histology revealed a thin hyper-coagulation zone at the edge of the ablation crater at all fluences tested".*[13]

C) "*The risk of hypertrophic scarring (HS) of the neck may relate more to ablation of the epidermis providing in exuded blood and serum an excellent culture medium for potentially pathogenic skin flora to grow and gain entry into the skin".*[12]

D) *"This thin layer of highly coagulated tissue will provide for a dryer, safer procedure while at the same time lowering the risk of post-treatment infection".*[13]



With similar parameters, the CW laser beam will produce less depth of ablation but more residual thermal damage surrounding the ablation crater than short pulsed CO_2 with the added benefit of a thin zone of hyper-coagulated tissue lining the crater wall.

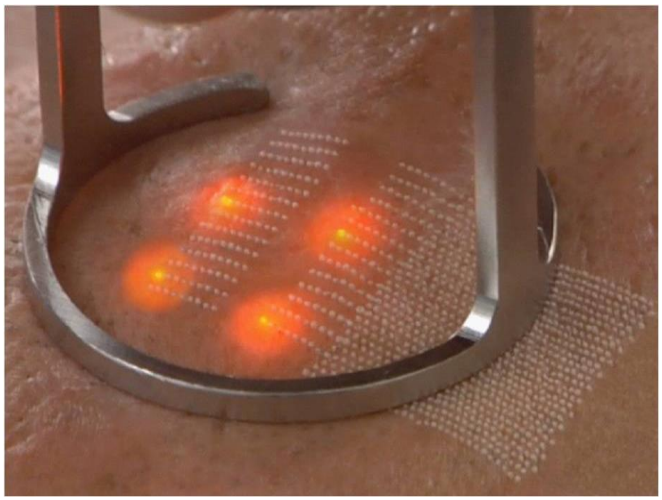
Point 3: Early CO_2 lasers operating in CW mode when used for 100% traditional resurfacing often resulted in excessive thermal injury to the skin and were linked to higher intra-operative pain, increased risk of post-op side effects, and prolonged erythema.[6,11] This led to the invention of newer short pulsed (superpulse & UltraPulse) CO_2 lasers which create less thermal damage in the dermis to increase the margin of safety and improve efficacy.

In the process, operating CO_2 lasers in CW mode for ablative resurfacing has gotten a bad rap. The medical community is replete with white papers, clinical studies and published research extolling the virtues of short pulsed CO_2 while proclaiming the harmful effects of CW CO_2. Often time's companies selling short pulsed CO_2 lasers in the process of marketing their products disseminate misleading or false information about CW.

The current goal of cosmetic medicine when performing CO_2 laser resurfacing should be to obtain a wide zone of residual thermal damage for ultimate aesthetic improvement while at the same time limiting excessive thermal injury to the surrounding dermis.

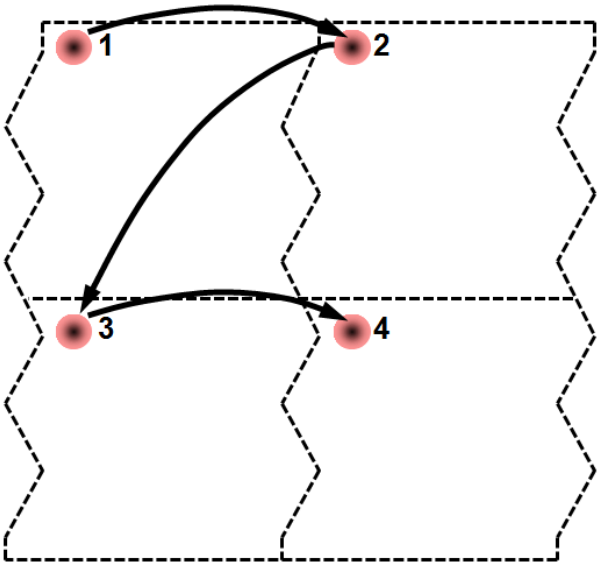
The MiXto SX® CO_2 laser (although having superpulse capability for general dermatology) operates in the CW mode when performing ablative fractional resurfacing. Using CW pulses allows the clinician to maximize RTD while at the same time minimize excessive thermal buildup and its associated problems, thus increasing the benefit-risk ratio over competing technology.

The MiXto SX® CO_2 laser is able to accomplish this for two reasons:



A) Because the laser is operated in fractional mode (versus 100% coverage when doing traditional resurfacing) there is much lower overall thermal injury to the skin allowing for the safe use of CW mode.

B) The MiXto SX® laser from LASERING USA utilizes a scanner that creates a proprietary patent pending algorithm which produces a "non-sequential" pattern in the shape of a Z. This Z pattern separates the laser beams both temporally and spatially and is unique in that it provides the longest time possible between adjacent pulses while filling in a predefined area of tissue per given period of time. This allows for maximum tissue cooling of each laser spot before another spot is placed beside it lowering the risk of adverse side effects while maximizing patient comfort.



Courtesy of Dr. Alan Gardner

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