White Paper

April 2018

# Multi Radiance Research Series: ACTIV PRO Laser

*Increasing Power*
*without the unwanted*
*Photothermal Effects*

Multi Radiance Medical®

ACTIV® PRO

# The ACTIV PRO Laser White Paper

*Increasing Power without the Unwanted Photothermal Effects*

Multi Radiance Research Series
April 2018

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**Executive Summary:**

Multi Radiance Medical continues to innovate light therapy technology and develop the most advanced therapeutic lasers for accelerating healing and reducing pain. The latest advancement is the successor to the MR4 ACTIV, the MR5 ACTIV PRO. Optimized by extensive scientific and laboratory studies from the Proof of Concept process (POC), the ACTIV PRO has a 300% increase in power; however, it remains first in class for industry safety. The ACTIV PRO combines synchronous Super Pulsed Laser with ultra-bright infrared, red and blue LEDs (850 nm, 660 nm and 455 nm) in a cordless, portable design for in-clinic therapy or on-the-go treatment. With shorter treatment times and the unique ability to accelerate biological effects across the entire phototherapeutic window, the ACTIV PRO delivers consistent and reproducible outcomes.

This white paper will detail the clinical testing used to confirm the new power and light parameters of the ACTIV PRO. Not all light devices are equally effective; therefore it is critically important to perform the POC process to validate device parameter selection. The optimal depth of penetration time profile (DPTP) and favorable thermal time profile (TTP) of the ACTIV PRO result in a safer -- and superior -- alternative to Class IV lasers for controlling pain and accelerating recovery.

**Validated:**

The ACTIV, the predecessor to the ACTIV PRO, was introduced in mid-2011. With true mobility in mind, the cordless design offered the first viable alternative to desktop and clinic-only use. Successive improvements in light and battery technology allowed for laser treatment to move beyond the clinic for on-the-go treatment anywhere.

Multi Radiance Medical (MRM) embarked on a POC series of studies in early 2012 with the goal to optimize parameters for the combination of wavelengths, power levels and light sources. All the studies in the POC confirmed that a synergistic effect exists between the different light sources (laser and LEDs) of the core MRM technology. Published in 2014, The Pillars Paper details the entire scientific process and identifies the optimal parameters necessary for the safe delivery of consistent and clinically relevant outcomes.

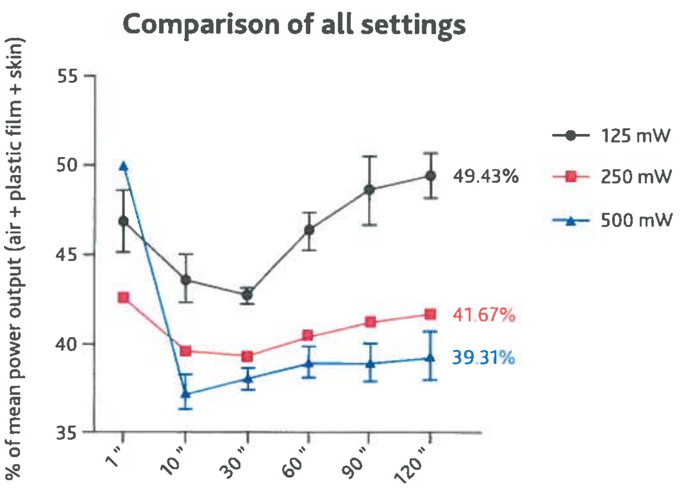
## Optimized:

The product design and development of the ACTIV PRO was based upon the ideal parameters identified in the POC studies. The all-new hardware and electronics make the ACTIV PRO a 50 W super pulsed laser with ultra-bright infrared, red and blue LEDs (850 nm, 660 nm and 455 nm); this represents a 300% increase in power to shorten treatment times and boost clinical outcomes.

The safe delivery of increased power was a primary concern. Two further experiments were performed at the Laboratory of Phototherapy in Sports and Exercise (Sao Paulo, Brazil) under the direct supervision of Dr. Ernesto Leal-Junior to optimize the device for clinical use. The amount of light entering the body (depth of penetration time profile or DPTP) and heat generated on the skin surface (thermal time profile or TTP) were measured to validate the proposed parameters for the ACTIV PRO.

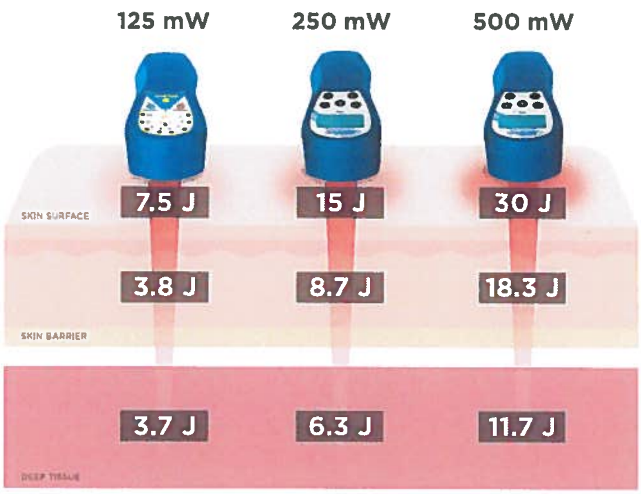
## Depth of Penetration Time Profile (DPTP):

Leal-Junior and Albuquerque-Pontes[1] evaluated the DPTP of the original ACTIV to determine the effects of concurrent multiple wavelengths of red (660 nm) LED, infrared (875 nm) IRED and super pulsed (905 nm) laser with a total average of approximately 100 mW of power. The original data suggest and demonstrate a pattern of linearly increasing penetration of the light over time with 43% of the available light penetrating beyond the skin. This represented a 100% increase when compared to the actual summative total of the individual light sources. The study concludes that a combination of multiple wavelengths creates a "synergism" that enhances each individual wavelength's ability to penetrate the skin.




Albuquerque-Pontes et al.[2] repeated the study procedure with the ACTIV PRO to evaluate the proposed increase in power on the previously reported DPTP synergy. Three groups including the original settings of the ACTIV, a 100% and 300% increase in power respectively from the original were compared. There was a noted increase in the original amount of light through the skin with the original ACTIV power level to approximately 49% DPTP. This represents an over 14% improvement and may be attributed to the higher efficacy of the new ultra-bright red and infrared LEDs of the ACTIV PRO model.

The two additional proposed power settings delivered an expected decrease in the DPTP as the power output was increased. A 14% increase in the loss of light when the power is doubled compared to ACTIV setting and a 20% increase when the power is doubled again. However, a net increase in the amount of light is delivered below the surface of 70% when the power is doubled and over 215% when the power is increase by a factor of 4.

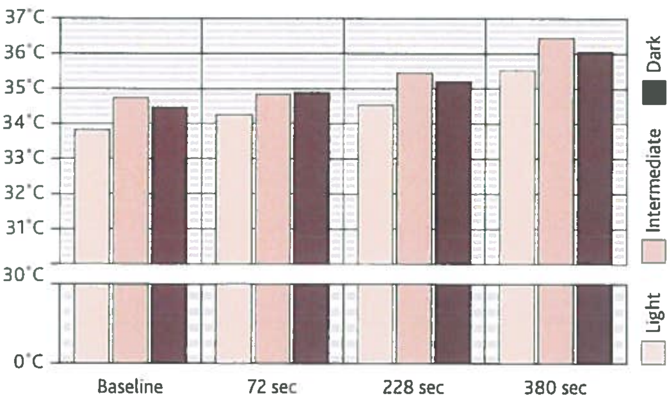



## Thermal Time Profile (TTP):

The North American Association for Photobiomodulation Therapy (NAALT) has recognized that light therapy is a non-thermal process.[3] However, most continuous wave lasers/LEDs and all high powered Class IV lasers produce unwanted heat that may limit the phototherapeutic response or photocytotoxicity and apoptosis when excessive ROS is present.[4] Khan et al.[5] established a correlation between a rise in surface temperature (> 45 °C) and phototoxic tissue damage. An evaluation of thermal response to skin absorption for all high powered devices can provide an insight into the safe use of the device by measuring the thermal response at the skin surface.[6] Testing ranges should include small and large doses, but also measure the dose rates over time known as a Thermal Time Profile (TTP).

Vanin et al.[7] replicated a study by Grandinétti et al.[8] that evaluated the thermal impact of the ACTIV PRO on light, medium and dark skin. Baseline measurements were taken prior to the start and skin temperatures were measured using a FLIR thermographic camera. Four doses were applied to the skin: placebo, 25 J, 80 J, and 133 J. The ACTIV PRO was set to full power (450 mW and 50 Hz frequency).

There was a non-significant increase ($p>0.05$) in all skin types and with all doses. No groups experienced excessive photothermal effects that may affect patient safety and no threat or concern regarding cytotoxicity in clinical practice exists. The lack of accumulating skin temperature may be attributed to the ultra-short pulse structure related to the frequency of the super pulsed laser and pulsing of the LEDs and IREDs. The laboratory trials performed with the new ACTIV PRO confirmed that the increased power did not produce an unwanted photothermal effect unlike high powered lasers.



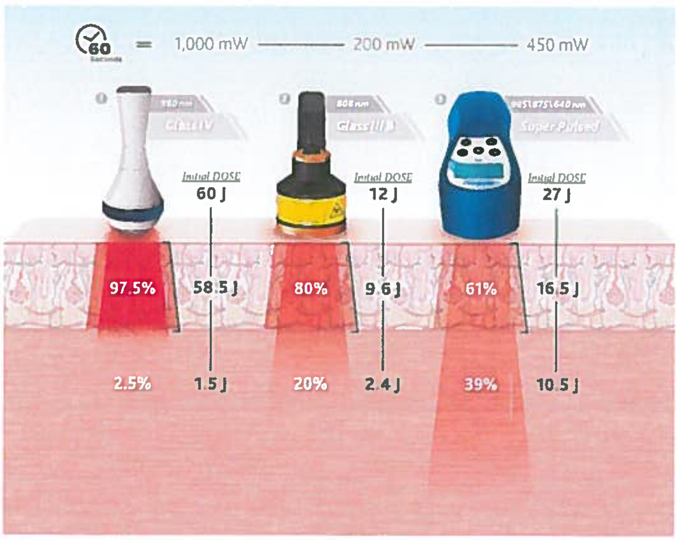

## Unrivaled:

Laser therapy treatments are generally considered safe and virtually without complications. All low-level laser devices offer a power range between 5 mW and 500 mW (upper limit of Class IIIb). The international system of laser classification has nothing to do with effectiveness of the laser treatment, nor does it mean a generational change, nor does it ensure any improvement in efficacy.[9] It is simply a classification based on the precautions needed to avoid the hazards of using progressively high powered lasers. Many different parameters are considered in eye risk evaluation, such as laser wavelength, beam diameter, beam divergence, exposure time, pulsing vs. continuous emission, type of pulsing and more.

Lasers are classified for safety purposes based on their potential for causing injury to humans' eyes and skin. With an increase in power, there is often a resulting increase in the amount of energy also delivered to the surface. Laser, like ultrasound, at low levels, can stimulate while at higher levels it becomes destructive.[10] Isman et al.[11] found evidence that the increased heat accumulation from high powered laser stimulated apoptotic pathways of cell death. Khan et al.[12] observed large doses delivered by high powered lasers generate ROS that when combined with accumulating heat in the skin resulted in phototoxic tissue damage. Therefore, it can be argued that a higher powered laser that generates superficial tissue heating in the skin does not provide beneficial effects as we currently understand it, but rather triggers apoptotic pathways.

The favorable DPTP, created by the core of multiple wavelengths, allows a greater percentage of light energy to penetrate beneath the skin and minimizes the amount of energy being transformed into heat. However, any decrease in the DPTP can contribute to an increase in skin surface temperature, which can lead to a reduction in the phototherapeutic effects and a dangerous rise in tissue temperature. A TTP study was necessary to establish if the increased power outputs in the ACTIV PRO were tissue safe.

All Multi Radiance Medical Lasers are class 1 laser technology, which is the safest category of therapeutic lasers. Unlike a Class IV laser, a lower powered laser can also be applied in contact with the skin and held steady for the necessary time to deliver the appropriate amount of energy. This is significantly more efficient, accurate, predictable and safe.



## The ACTIV PRO with LaserStim

It has been said that "... successful outcomes are a matter of adequate dosage and hitting the right target." While the concept is quite simple, the reality of it is quite the opposite. Where to apply the laser and more importantly how much time is necessary for the phototherapuetic effect remains as perplexing today as it was years ago.

While research continues to validate laser therapy use, what complicates its overall acceptance is the incredible amount of variables in the laser therapy equation. This has been dauntingly termed the "Impossible Dose" because what may work with one patient, in that moment and that dose, may not have the same outcome on another patient with a similar condition or even with the same patient again.

If laser therapy was always successful by blasting a painful area with an abundance of photons, it would always work, 100% of the time. This is obviously not the case. With success hinged on providing an adequate stimulus, improper target selection and inadequate doses always results in lackluster results.

Multi Radiance Medical has developed an innovative and patented solution to the Impossible Dose. The LaserStim™ combines laser/light and electrical stimulation; moreover, it features TARGET ™ and DOSE™ technology.

Overall success of any laser application is in the clinician's ability to locate potential targets. This has been typically done only through assessment (and should be a part of any light therapy application). Acupuncturists have long used impedance meters to locate acupoints. Acupuncture points have been found to be points of low electrical resistance compared to the surrounding tissue. Many of these locations can be attributed to injury, inflammation, spasm, or any other tissue disturbance.

The inbuilt electrode of the LaserStim™ enables users to locate asymmetries or "active sites" through bio-impedance deviations, i.e., highly probable laser therapy targets. This unique marriage of technology may improve the overall efficacy of the laser application by ensuring proper target identification.

## LaserPuncture and PhotoProbes

The laser aperture of the ACTIV PRO is threaded to allow the attachment of photoprobes constructed of non-toxic, optical organic glass. The ACTIV PRO includes a set of 4 light bending or light focusing lenses: two for Laserpuncture [13], one for trigger point deactivation and one designed to facilitate healing.

## Conclusion:

Upgraded with the latest advances in light technology, the ACTIV PRO is unsurpassed as a cordless, ultra-portable laser therapy system. The synchronous high power Super Pulsed Laser (GaAs 905 nm), and ultra-bright infrared, red and blue LEDs (850 nm, 660 nm and 455 nm) creates a synergistic effect to optimize the biological benefits of the entire phototherapeutic window. With a 300% increase in power, treatment times are reduced but the technology remains safe due to the optimal DPTP and favorable TTP. The ACTIV PRO delivers consistent, reproducible outcomes to accelerate healing and reduce pain.

In the United States, Multi Radiance Medical devices are cleared by the Food and Drug Administration (FDA) for the following indication of use:

- Temporary relief of minor muscle pain
- Temporary relief of joint pain
- Temporary relief of arthritis
- Temporary relief of muscle spasm
- Relieving stiffness and promoting relaxation of muscle tissue
- Temporarily increasing local blood circulation where heat is indicated

## Appendix:

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[12] Khan, I., Tang, E., & Arany, P. (2015). Molecular pathway of near-infrared laser phototoxicity involves ATF-4 orchestrated ER stress. Scientific reports, 5.

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