

Letter to the Editor

Dosimetry for Laser Sulcular Debridement

Debridement and disinfection of the diseased periodontal sulcus are objectives in the treatment of periodontitis. In Laser Sulcular Debridement [1], the fiber tip from an Nd:YAG or diode laser is placed in the periodontal pocket and laser energy is used to remove the necrotic debris and the infected soft tissue pocket lining (epithelium). The bactericidal potential of the laser is also exploited to destroy pigmented oral pathogens [2].

The purpose of this letter is to propose a standardized approach to reporting data on laser sulcular debridement using a dosimetry index which is joules per millimeter pocket depth. This will allow for more valid comparison of studies using different laser operating parameters as well as different types of lasers.

In 1992, Drs. Terry Myers, Michael Yessik and I developed a protocol for use of the PulseMaster® pulsed Nd:YAG Dental Laser System to evaluate the safety and efficacy of laser sulcular debridement as an adjunctive treatment for periodontitis. In the protocol laser parameters were constant with a pulse duration of 100- μ sec, energy per pulse of 80-mJ, repetition Rate of 25-Hz and the average power was 2.0-Watts. A quantitative endpoint was developed, based on Dr. Myers' clinical experience, by generating a dosimetry table that defined treatment time separately for each pocket given the probing depths:

Pocket depth (mm)	Duration of Tx (seconds)
< 4	5-10
4 - 6	20
7 - 9	30
> 9	40

[100- μ sec, 80-mJ, 25-Hz (2.0-W) @ 1064-nm]

Based on data generated with this protocol [3] FDA granted market clearance in 1998 for the PulseMaster for "sulcular debridement (removal of diseased or inflamed soft tissue in the periodontal pocket) to improve clinical indices including gingival index, gingival bleeding index, probe depth, attachment level and tooth mobility." An additional clinical trial at the University of Louisville [4] replicated the results. This was the original clearance for use of the laser in the periodontal pocket and, since then, virtually all dental laser systems have received 510(k) substantial equivalence market clearance for this indication for use. However, the dosimetry table from the clinical trial is useful only for that specific set of laser

parameters. In order to accurately prescribe a dosimetry for laser sulcular debridement using various dental laser systems one must consider the total energy delivered to the target tissues.

In 2001, with Drs. Robert Gregg and Delwin McCarthy we published the first case reports specifying "light dose" in a defined laser periodontal protocol [5]. "Light dose" is defined as the quantity of laser energy delivered to the treatment site. To apply the concept to laser sulcular debridement; for each pocket, multiply the average power (Watts) times the duration of treatment (seconds) to yield the total energy (Joules) per pocket. This value divided by the pocket depth (mm) defines a clinically useful measure of light dosimetry in Joules per millimeter pocket depth. Light dose (J / mm pd) is thus similar to drug dose (mg / kg body weight) in that light dose defines the concentration of laser energy at the treatment site as drug dose defines the concentration of a drug in the tissues.

Light dose is a useful parameter inasmuch as it provides a measure for comparisons across studies. For example, the light dose used in the clinical trials that demonstrated efficacy [3, 4] was approximately 6-10 J/mmpd. Gutknecht, et al [6] delivered a lower dose of 5-7 J/mmpd, but treated multiple times. LANAP (Laser-Assisted New Attachment Procedure [5,7]), a laser sulcular debridement protocol modified for the private dental practice, uses the PerioLase Pulsed Nd:YAG at average powers of 3-3.5 Watts. The light dose for LANAP is in the range 12-16 J/mmpd. Cobb et al [8] treated 6 mm deep pockets *in vivo* at 1.75-3.0 Watts for 60 to 180 seconds with pulsed Nd:YAG and examined extracted roots for damage with SEM. They noticed root surface damage at 90 and 67.5 J/mmpd but none at 17.5 J/mmpd. From this we can estimate a toxic dose (causing root surface damage) to be within the range of 20-60 J/mmpd, which is above the recommended dosage in current practice.

*Correspondence to: David M. Harris, PhD. Bio-Medical Consultants & associates, Inc., Department of Preventative and Restorative Dental Sciences, School of Dentistry, University of California, San Francisco, CA. E-mail: bmcinc@comcast.net

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Diode dental lasers are also popular for laser sulcular debridement. The continuous or “gated” diode has different wavelength and temporal characteristics and subsequently different tissue effects than the 100 μ sec pulsed Nd:YAG. Consequently, we need to develop a different dosimetry that is appropriate to each laser modality. Precise dosimetry is important since the clinical outcomes of laser sulcular debridement, such as adverse effects and antisepsis, are dose dependent. Lasers that have a direct readout of cumulative Joules delivered simplify the dosimetry calculation for the user.

Applying Joules / mm pocket depth as a measure for laser sulcular debridement does not account for pockets of varying width and complexity. Furthermore, if more than one pocket is treated at a time, as is usual in practice, then one must do the math ... not always practical chair-side. There are also differences in tissue response from patient-to-patient and site-to-site (e.g., smokers, presence of edematous, fibrotic or hemorrhagic tissue) so that the recommended dosimetry will always be a “rule of thumb” that is increased or decreased based on specific circumstances and informed clinical judgment. However, despite these limitations, a consistent method for recording of the dosimetry will result in data which is much more useful in clinical studies and practice.

David M. Harris, PhD*

Department of Preventive and Restorative Dental Sciences
School of Dentistry, University of California, San Francisco,
California

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