



Academy of Laser Dentistry
Source 2007: Lasers in Dentistry
Nashville, Tennessee

Friday, March 30, 2007

9:20 AM – 9:35 AM

STUDENT SCHOLARSHIP

**Differential Ablation of Radicular Dentine with Er:YAG Laser Radiation
Under Varying Water Flow Rates**

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Aim of the Study

The aim of this study was to compare the ablation characteristics of dentine when ablated from the root canal (radicular) aspect compared with the external root (periodontal) aspect, determine the ablation threshold, and examine the effect of water mist spray flow rate on the efficiency of ablation.

Material and Methods

A free-running pulsed Er:YAG laser (KEY Laser 3, Model 1243, KaVo, Biberach, Germany) was used at the parameters of 250-500 mJ/pulse, fluence 44 - 88 J/cm², 250 microsecond pulse duration, 0.85 mm spot size, with a model 2060 noncontact sapphire window handpiece in focus (0.85 mm spot size at a working distance of 13 mm) at a frequency of 1Hz for a total of 5 superimposed pulses on the same target spot, either with low (0.5 mL/min) or high (1.5 mL/min) water spray. The crowns were removed from 10 single-rooted extracted teeth that had been stored in water, and the cementum was removed with an ultrasonic scaler. The roots were cut into longitudinal halves using a diamond disc. After removal of pulpal soft tissue remnants, the split tooth portions were divided into two matched groups to test the effect of low or high water flow rates. All samples were kept moist and were lased under moist conditions. The external (periodontal) surface of the split roots was subjected to pulse energies of 250, 300, 400 and 500 mJ at 1 Hz for 5 pulses, delivered at 90 degrees to the surface. This procedure was repeated on the internal radicular (root canal) surfaces. Ten sites were irradiated for each of the 16 unique energy/water flow rate/site combinations, giving 160 sites. The diameter of the craters created by lasing were measured with the aid of an Olympus binocular dissecting microscope with a micrometer scale, while the depth of the craters was measured using a contact micrometer with a penetration needle (to an accuracy of 10 microns). The craters were photographed with a digital camera (Nikon Coolpix) attached to the microscope (X30) and the samples sputter-coated with platinum and examined under low vacuum using a JEOL 6400F SEM system. Numerical data for crater parameters were found to be normally distributed in all groups, and thus intergroup differences were analyzed using one way ANOVA, and repeated measures t- tests.

Results

All sites showed ablation at 250 mJ/pulse. There was a consistent increase in crater depth and diameter with increasing energy in all subgroups, with larger craters with low water flow than with high water flow on the periodontal aspects. Comparing the effect of location, there was significantly greater ablation on the periodontal aspect in the low water flow group than on the

root canal (radicular) aspect. In contrast, in the high water flow group, there was no significant difference between the two locations. Irradiated surfaces had open dentinal tubules and no carbonization, cracking, or other microscopic types of surface thermal injury. Since Er:YAG laser radiation is well absorbed by water, these differences due to water flow rate and dentine location (inner or outer) are not surprising, although it was initially predicted that the internal root surface with its larger dentinal tubules would ablate more readily at all settings, which did not in fact occur.

Conclusions

These results indicate that significant interactions occur between dentine ablation and the variables of water spray flow rate and dentine location (radicular or periodontal). This data will be useful for developing methods to ensure that sufficient energy can be delivered to radicular dentine to achieve effective ablation for the biomechanical preparation of root canal dentine.

***Biography:** Dr. Roy George is presently pursuing his PhD at the University of Queensland, Brisbane, Australia.*

***Disclosure:** Dr. George has no commercial relationships relative to this presentation.*

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