Improving the efficiency of an Er:YAG laser on enamel and dentin

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Objective: To evaluate the influence of air pressure, water flow rate, and pulse frequency on the removal speed of enamel and dentin as well as on their surface morphology. **Method and Materials:** Twenty-four bovine incisors were horizontally cut in slices. Each sample was mounted on an experimental assembly, allowing precise orientation. Eighteen cavities were prepared, nine in enamel and nine in dentin. Specific parameters for frequency, water flow rate, and air pressure were applied for each experimental group. Three groups were randomly formed according to the air pressure settings. Cavity depth was measured using a digital micrometer gauge, and surface morphology was checked by means of scanning electron microscopy. Data was analyzed with ANOVA and Duncan post hoc test. **Results:** Irradiation at 25 Hz for enamel and 30 Hz for dentin provided the best ablation rates within this study, but efficiency decreased if the frequency was raised further. Greater tissue ablation was found with water flow rate set to low and dropped with higher values. Air pressure was found to have an interaction with the other settings, since ablation rates varied with different air pressure values. **Conclusion:** Fine-tuning of all parameters to get a good ablation rate with minimum surface damage seems to be key in achieving optimal efficiency for cavity preparation with an Er:YAG laser. *(Quintessence Int 2012;42:xxx–xxx)*

Key words: air pressure, efficiency, Er:YAG laser, morphology, water spray

Due to its unique emission wavelength at 2,940 nm (which is extremely well absorbed by water and hydroxyapatite), Er:YAG laser is the preferred type of laser for cavity preparations.[1] However, emission wavelength is only one parameter influencing laser efficiency and its effect on surface morphology of the substrate. Power density, frequency, and pulse length are other important parameters (as they are in the ablation of mineralized tissue) **[au: edit ok?]**.[2–4]

Previous studies have demonstrated the influence of pulse frequency on ablation rate in cavity preparations.[2–4] By increasing frequency, more shots are applied and more tooth substance is thus removed during the same time interval, resulting in reduced operation time. On the other hand, increasing energy density seems to have a lesser influence on the laser's efficiency, at least in enamel.[2,6] **[au: cite reference 5]**

Because Er:YAG lasers must use water spray for cavity preparation to reduce adverse thermal effects,[7–12] spray settings represent another issue that may influence the laser's effects. It was shown that external water spray is not only beneficial as a coolant, but also has a significant influence on the ablated volume.[10–13] The amount of water is also significant, because an excessive amount may decrease the rate of ablation.[9]

Although previous studies demonstrated the influence of water flow rate on ablation rate,[8,10,11,14] efficiency, and surface morphology, there is no report on the influence of added air pressure to water spray.

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