Effects of Er,Cr:YSGG Laser Irradiation on the Root Surface: Morphologic Analysis and Efficiency of Calculus Removal

Chun-Chan Ting,* Mitsuo Fukuda,* Tomohisa Watanabe,* Tsunehiro Aoki,* Atushi Sanaoka,* and Toshihide Noguchi*

Background: This in vitro study was performed to determine the appropriate power output setting for an erbium, chromium-doped:yttrium, scandium, gallium, and garnet (Er,Cr:YSGG) laser used in periodontal pocket irradiation by examining the morphologic alterations of the root surfaces and the efficiency of calculus removal.

Methods: Sixty-five non-carious extracted human teeth were used in this study. For morphologic analysis of the root surface, the clean, single roots of 22 teeth were separated into 91 pieces, and these pieces were immersed in acrylic resin. The specimens with root-surface exposure were prepared and divided randomly into three groups: a control group (N = 8), an irradiation without water group (no water [NW] group; N = 39), and an irradiation in water to simulate the conditions in a periodontal pocket group (in water [IW] group; N = 44). The power output settings for laser irradiation were 0.5, 1.0, 1.5, and 2.0 W for each group. The roughness (Ra), depth (Z), and width (X) of the disk specimens were determined after laser irradiation. Eight other single-rooted teeth were examined by scanning electron microscopy (SEM) after laser irradiation under the same conditions. Thirty-five single- or multirooted teeth with heavy subgingival calculus were used to test the efficiency of laser scaling. The efficiency of calculus removal was quantified by measuring the time needed to remove the calculus completely using the laser.

Results: The mean Ra and Z values in the IW group were significantly higher than in the NW group with the same power output. In addition, these values with 0.5- and 1.0-W power output settings were significantly lower than with 1.5- and 2.0-W settings in the NW and IW groups. No obvious morphologic differences could be found between the 0.5- and 1.0-W power output specimens under SEM. Additionally, thermal alterations, i.e., carbonization or melting, were completely absent in the IW group. Regarding the efficiency of calculus removal, the 0.5-W setting (0.11 – 0.036 mm^2/second) was significantly inferior to the 1.0-W setting (0.27 – 0.043 mm^2/second). However, there was no significant difference between 1.0- and 1.5-W (0.36 – 0.11 mm^2/second). The 2.0-W setting (0.63 – 0.272 mm^2/second) was much more efficient but resulted in significant morphologic alterations.

Conclusions: Based on these findings, it is appropriate to use a 1.0-W power output setting with an Er,Cr:YSGG laser for root scaling. This may be done without any conspicuous morphologic alterations to the root surface and with acceptably efficient removal of calculus. J Periodontol 2007;78:2156-2164.

KEY WORDS

Calculus; laser; root.

* Department of Periodontology, School of Dentistry, Aichi-Gakuin University, Nagoya, Japan.

doi: 10.1902/jop.2007.070160