BOND STRENGTH EVALUATION ON DENTAL STRUCTURES AFTER NON-THERMAL PLASMA TREATMENT

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This study aims to evaluate the potential of atmospheric pressure non-thermal plasma technology (NPT) to enhance the adhesive bond strength on normative dentin substrates. Two different microplasma jets were used in our experiments, a direct-current driven microhollow cathode discharge jet operated in air and a rf-driven jet operated in Ar. Other gas mixtures, e.g. He/O_2 are also being explored.

Initial experiments were carried out using fresh, non-carious third molars obtained under a protocol approved by the New York University College of Medicine Institutional Review Board. The occlusal enamel of each tooth was removed perpendicular to the long axis of the tooth to expose a flat dentin surface, which was subsequently polished. The specimens were randomly assigned to 3 groups for bonding and NPT applications. For the control group, three teeth were etched with phosphoric acid etched, the dentin bonding agent (DBA) was applied and the teeth were restored with a 4 mm thick resin composite. Another group of 3 teeth was treated with an Ar plasma and a third group was exposed to an air plasma. For the plasma-treated groups, the dentin substrates were etched for 15 s, rinsed for 10 s and treated by the plasma for 20 s followed by DBA application and resin composite placement. All specimens were stored in water for 24 h prior to a microtensile bonding test.

Preliminary data indicate that the bond strength values were not significantly affected by the Ar or air plasma treatment. We observed that teeth treated with the Ar plasma exhibited an enhanced premature failure rate (~50%) during the cutting or specimen mounting phases. This was not observed for the control or for the air plasma treated groups. Extensive surface characterization studies using various microscopy techniques, XPS, and micro-Raman are underway to assess the effect of the plasma on the surface. Optical emission spectroscopy is used to monitor the presence of reactive species (eg. OH, O) in the plasma for various operating conditions and feed gases or gas mixtures. The results of these studies will be presented and discussed in detail at the Conference.