Temporal Change in Bonding Strength and Antimicrobial Effect of a Zirconia after Nonthermal Atmospheric Pressure Plasma Treatment

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Abstract : Purpose: Plasma treatment under various conditions has been studied to increase the bonding strength and surface sterilization of dental ceramic materials. We assessed the evolution of the shear bond strength (SBS) and antimicrobial effect of nonthermal atmospheric pressure plasma (NTAPP) treatment over time. Methods: Presintered zirconia specimens were manufactured as discs (diameter: 15 mm, height: 2 mm) after final sintering. The specimens then received a 30-min treatment with argon gas (Ar^2, 99.999%; 10 L/min) using an NTAPP device. Five post-treatment intervals were evaluated: control (no treatment), P0 (within 1 h), P1 (24 h), P2 (48 h), and P3 (72 h). This study investigated the surface characteristics, SBS of two different resin cement (RelyXTM U200 self-adhesive resin cement, Panavia F2.0 methacryloyloxydecyl dihydrogen phosphate (MDP)-based resin cement), and Streptococcus mutans biofilm formation. Results: The SBS of RelyXTM U200 increased significantly ($p < 0.05$) within 2 days following plasma treatment (P0, P1, P2). For Panavia F 2.0, a significant decrease ($p < 0.05$) was detected only in the group that had undergone cementation immediately after plasma treatment (P0). S. mutans adhesion decreased significantly ($p < 0.05$) within 2 days of plasma treatment (P0, P1, P2) compared to the control group. The P0 group displayed a lower biofilm thickness than the P1 and P2 groups ($p < 0.05$). Conclusions: After NTAPP treatment of zirconia, the effects on bonding strength and antimicrobial growth persist for a limited duration. The effect of NTAPP treatment on bonding strength depends on the resin cement.

Keywords : NTAPP, SBS, antimicrobial effect, zirconia