

Impact of Cold Atmospheric Pressure Plasma on Shear Bond Strength in Two-Piece Abutments

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Objectives: The usage of CAD-CAM-manufactured single implant restorations is a common method in prosthetic dentistry. Several benefits lead to an adhesive connection of individualized ceramic crowns and prefabricated titanium bonding bases. However, the bonding has to resist permanent thermal, chemical, and mechanical stress in the oral cavity. The durability of the bonding is a weak point and is especially dependent on sufficient surface pretreatment. Cold atmospheric pressure plasma (CAP) is a conventional method for improving surface characteristics in car industry and space engineering. The aim of this study was to evaluate the impact of CAP on shear bond strength in two-piece abutments.

Methods: Ten CAD-CAM-manufactured and sintered crowns of zirconia and ten prefabricated titanium bonding bases were divided into two groups (n=5) each. Group A was pretreated as specified by the manufacturer (sandblasting (Al₂O₃, 50µm, 1bar) + adhesive primer (Ceramic Bond, VOCO GmbH, Cuxhaven, Germany)). Group B had additional CAP treatment with a maximum power consumption of 30W (piezobrush PZ2, relyon plasma GmbH, Regensburg, Germany) (Fig. 1 and 2). Optimal pretreatment with CAP was evaluated in pretrial studies by analyzing water contact angles on polished surfaces after different duration of exposure. The wetting properties suggested a CAP application time of 15 seconds. After pretreating the interfaces, the pieces were glued together under standardized pressure by using Bifix Hybrid-Abutment-Cement by VOCO. The specimens were thermocycled for artificial aging (5000 cycles, 5°C and 55°C, 30 sec. dwelling time) and then shear bond strength was measured in a universal testing machine (Zwick 1425, Zwick Roell AG, Ulm, Germany).

Results: The shear bond strength in two-piece abutments pretreated with CAP was higher than in those without. Mean values differed significantly (Mann-Whitney-Test, p=0.008) from **601.6 ± 86.3N** (Group A) to **755.0 ± 37.2N** (Group B) (Fig. 3).

Conclusion: The study showed that additional usage of CAP for surface pretreatment in two-piece abutments leads to a significant increase of shear bond strength by about 25%. Furthermore, the results vary less widely (Fig. 3). Thus, CAP can be recommended as a pretreatment procedure in this special field of indication. Further investigations by using different ceramic materials and luting cements are intended.



Fig. 1

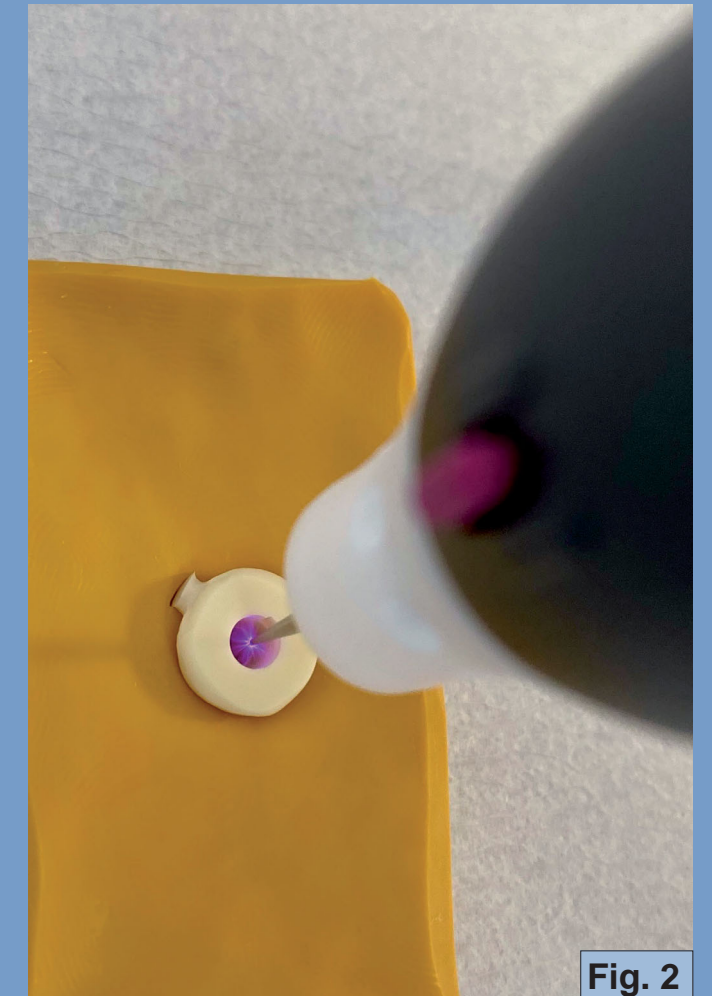


Fig. 2

Group	Mean	SD	Min	Max
A	601.6 N	86.3 N	499 N	703 N
B	755.0 N	37.2 N	706 N	797 N

Fig. 3