Adhesion Mechanisms at the Interface Between Lava and Lava Ceram: EDS micro-analysis

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OBJECTIVE: This in vitro study was carried out to investigate the mechanism acting at the interfaces between a commercially available Y-TZP and its veneering ceramic.

MATERIALS AND METHODS: Thirty-two specimens of presintered zirconia (Y-TZP) (Lava Frame; 3M ESPE, Germany) were cut with a low speed diamond blade (MDS100, Norton, USA) and polished (600-800-1000grit paper) (Fig.1a); the dimensions were 7.2 x 9.2 x 9.2mm. The specimens were divided in two major subgroups for testing after fracture (-F specimens) (Fig.1b) or after mirror finishing (-M specimens) (Fig.1c) and sintered following manufacturer’s instructions. Each major subgroup was randomly divided into 4 groups, by using or not the dedicated Framework Modifier, with or without a preliminary silica coating (Cojet, 3M ESPE) as resumed in Table 1; the suitable veneering ceramic was used for each group (Lava Ceram Overlay Porcelain, 3M ESPE).

GROUP | ZIRCONIA | CoJet TREATMENT | ZIRCONIA MODIFIER | VENEERING
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A | Lava | | | Lava Ceram
B | Lava | | | Lava Ceram
C | Lava | | | Lava Ceram
D | Lava | | | Lava Ceram

The specimens of the -M subgroup were mirror finished in a dedicated machine, exposing one side of the interface between zirconia and ceramic out of the embedding resin. The -F specimens were instead fractured starting from two opposing cuts in zirconia and veneering ceramic. The microstructure of the surface and the interfaces between the two ceramics was analysed by using a scanning electron microscope (SEM, Zeiss EVO 40, Germany) equipped with an energy-dispersive X-ray analyser (EDS, Inca, Oxford Instruments, UK), after gold sputtering.

RESULTS: The SEM analysis of the zirconia-veneering ceramic interface, clearly shows as the use of the framework modifier allows to obtain a more continuous contact between the two material, with a very low amount of porosity and a better wettability of the zirconia surfaces. Different punctual micro-analysis, conducted in the contact area zirconia-veneering ceramic, on the cross section of the samples of all groups (Fig. 2-3-4-5), showed the presence of a certain reaction area at the interface of the different materials. This phenomenon has been shown in all the tested specimens of both subgroups. The EDS spectrum corresponding to the interface area presents large amount both of zirconia and the elements characteristics of the veneering layer.

CONCLUSION: The use of the framework modifier improved the contact between zirconia and veneering ceramic. Moreover, it’s possible to assume that after sinterization of veneering ceramic on the zirconia a small "hybrid layer" is present at the interface between the two ceramic materials, in all the tested groups.

CONCLUSION: The use of the framework modifier improved the contact between zirconia and veneering ceramic.