

Fracture toughness of CAD-CAM materials/implant Ti-base interface

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Abstract

Objectives

To evaluate the interfacial fracture toughness (IFT), after aging or not, of Ti-base material bonded to four different classes of ceramic and composite CAD-CAM materials.

Methods

High translucent zirconia (Katana; KAT), lithium disilicate-based glass-ceramic (IPS. emax; EMX), polymer-infiltrated ceramic network material (Vita enamic; ENA), and dispersed filler composite (Cerasmart 270; CER) were cut into equilateral triangular prisms (6.3 ± 0.2 mm) to be bonded to titanium prisms with identical dimensions using a self-adhesive composite cement (Panavia SA Cement Universal). The surfaces were pre-treated following the manufacturers' recommendations. IFT was determined using the Notchless Triangular Prism test in a water bath at 36°C before and after thermocycling (10,000 cycles) ($n=40$ samples/material). Weibull analysis was carried out. Developed interfacial ratio (Sdr) measurements and SEM analysis of pre-treated surfaces were also performed.

Results

The IFT of materials ranged from 0.82 ± 0.24 to 1.10 ± 0.21 before thermocycling and from 0.71 ± 0.24 to 1.02 ± 0.25 after thermocycling. Statistical differences were only found between the IFT of CER and the two top performers in each scenario (KAT and EMX before aging; KAT and ENA after aging). Thermocycling only significantly decreased the IFT of EMX (-16%, $p=0.033$). Before thermocycling, there was no statistical difference in the Weibull modulus of IFT of the different groups and the influence of thermocycling on the Weibull modulus was insignificant. Sdr measurements showed significant differences between the different groups with ENA (7,60) > Ti (4,97) > CER (2,85) > KAT (1,09) = EMX (0,96).

Conclusion

CAD-CAM materials do not exhibit equal bonding properties to Ti-base material, which could be explained by their specific surface properties after pretreatment and/or their chemical affinity with

the composite cement. IFT of Li-Si glass-ceramic group was more affected by aging than other materials, while surface roughness, and then cement micromechanical bonding potential is lower.

Keywords: up to 5 in Mesh list

Conflict of interest: Michaël Sadoun is the founder of MaJEB, which contributes to the development of PICN materials. Amélie Mainjot is married with Michaël Sadoun.