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# In-vitro study on bond strength of various intraoral ceramic repair kits used with different all-ceramic systems

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## Introduction

Current ceramic repair kits for intraoral repair use the adhesive technique with composites to cover defects. The industry provides for the use of these systems generally on all surfaces. But all-ceramic systems use different types of porcelain for substructure and veneering, depending on what system and indication are chosen. The purpose of this study was to examine shear bond strength in a universal testing machine of various commercial repair kits used with different all-ceramic systems. The results should offer a recommendation about the best compatibility between the repair material and all-ceramic systems for the in-vivo repair.

## Material and Methods

Four intraoral ceramic repair systems (Fig 1) : a) Cimara (Voco), b) Silistor (Heraeus Kulzer), c) Ceramic Repair (Ivoclar Vivadent), d) CoJet-System (3M Espe) were applied on four different all-ceramic systems: IPS Empress 2 (Ivoclar Vivadent), Vita In-Ceram Alumina Blank, Vita In-Ceram Alumina slickered (Vita Zahnfabrik) and Cercon (Degudent). The specimens (10□10□3mm) were divided into substructure and veneering porcelain and were prepared with the repair material with a silicon form (Ø5□3mm) following the guidelines for an intraoral repair (Fig. 2). After 24 hours of storage in artificial saliva (37° C), the prepared specimens were debonded using a shear bond strength test in a universal-testing-device (Zwick) with a crosshead-speed of 0.5mm/min until fracture (n=10) (Fig. 3). Fracture modes were examined visually and in some cases microscopally and divided into adhesive, cohesive, and combined fractures. Results were statistically analyzed (ANOVA, Duncan's, $p<0.05$).


Fig.1a Ceramic repair system: Cimara (Voco)


Fig.1b Ceramic repair system: Silistor (Heraeus Kulzer)


Fig.1c Ceramic repair system: Ceramic Repair (IvoclarVivadent)

Fig.1d Ceramic repair system: CoJet-System (3M Espe)

Fig.2 Specimen

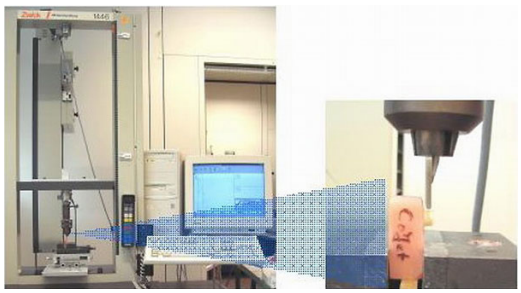

Fig.3 Universal-testing-device (Zwick)

## Results

In all groups with substructure material, specimens were debonded adhesively at the porcelain/composite interface (Fig. 4 and 5). Only in the group IPS Empress 2 plus Ceramic Repair, half of the specimens failed cohesive tests in the substructure ceramic and were taken out of the statistic (Fig. 4a). In all groups with veneering material, shear tests showed cohesive fractures in the ceramic (Fig. 6). In these cases, the shear bond strength of the composite resin was higher than the cohesive strength of the porcelain (Fig. 7). The results show that CoJet-System achieves generally high bond strengths; in particular in regard to oxide ceramics Vita In-Ceram Alumina (26N/mm²) and Cercon base (16N/mm²), significantly higher bond strengths were noted.

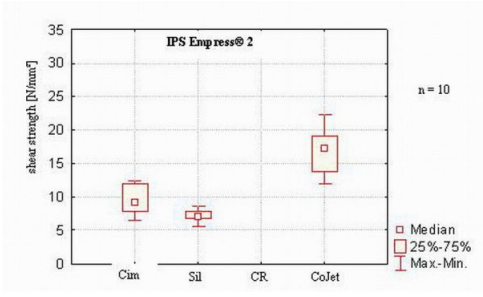


Fig.4a Substructure porcelain: IPS Empress 2

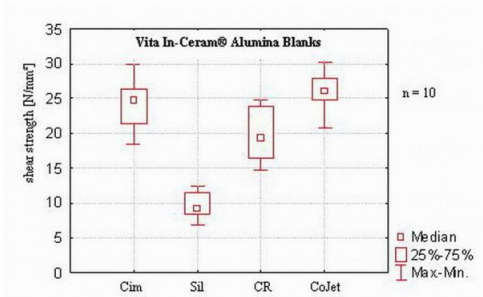


Fig.4b Substructure porcelain: Vita In-Ceram Alumina Blanks

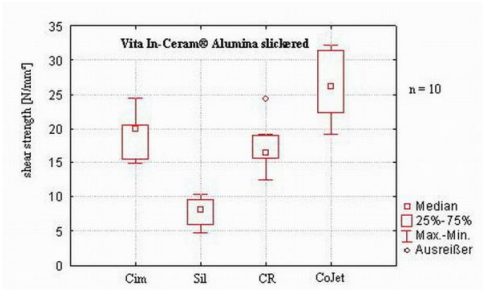


Fig.4c Substructure porcelain: Vita In-Ceram Alumina slickered

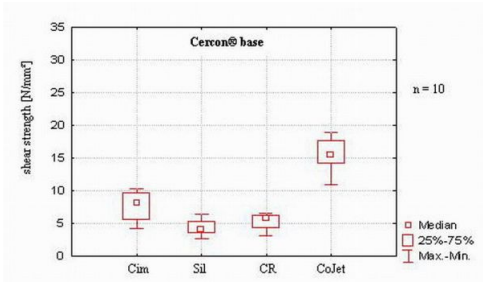


Fig.4d Substructure porcelain: Cercon base

Fig.5 Specimen with adhesive failure at the porcelain/composite interface

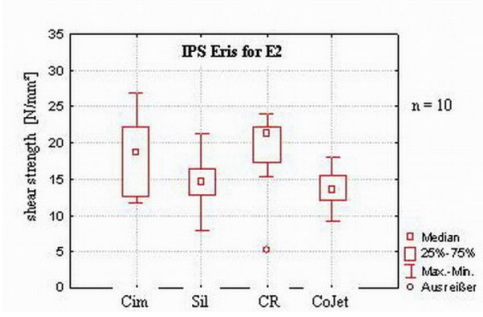


Fig.6a Veneering porcelain: IPS Eris for E2

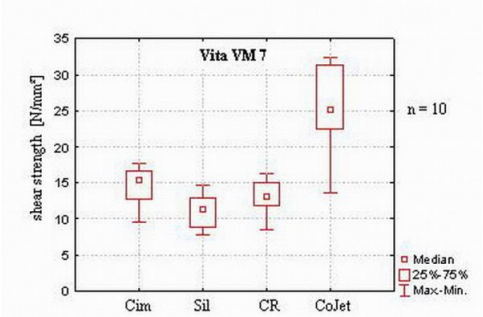


Fig. 6b Veneering porcelain: Vita VM 7

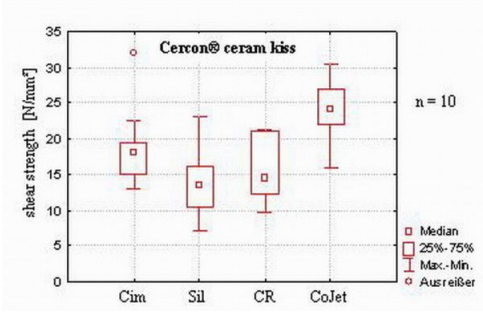


Fig.6c Veneering porcelain: Cercon ceram kiss

Fig.7 Specimen with cohesive fracture in the ceramic

## Conclusions

Conclusion: Results indicate that silicoating and silanization with the CoJet-System represent a suitable treatment for the intraoral repair of the materials tested in this study. Cimara achieves equivalent bond strengths on oxide ceramic In-Ceram Alumina Blank as CoJet-System. On glass-based ceramics (IPS Empress 2 and IPS Eris for E2), conditioning with phosphoric acid (Total Etch, Ivoclar Vivadent) tends to result in equivalent or even higher bond strengths than silicoating.

*This Poster was submitted by Dr. Milia Abou Tara.*

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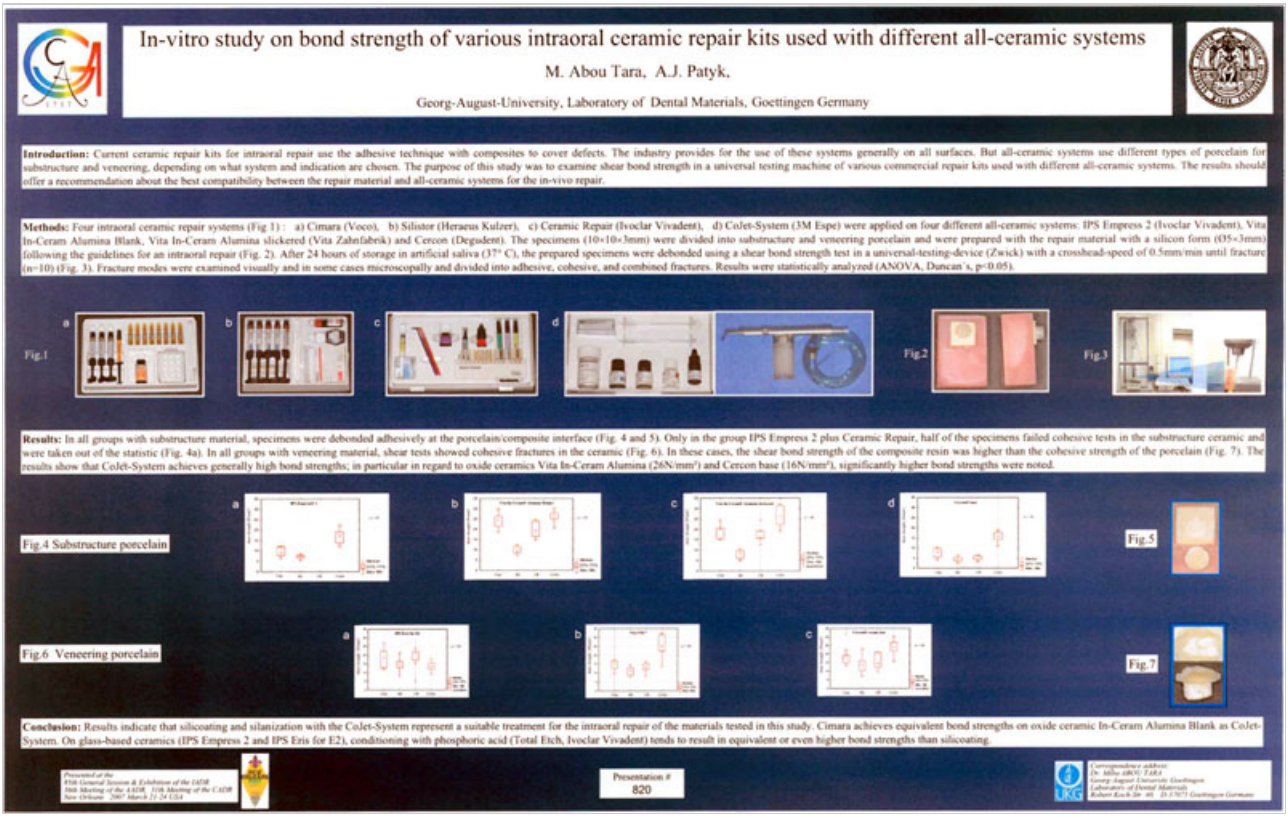
**Poster Faksimile:**



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**Introduction:** Current ceramic repair kits for intraoral repair use the adhesive technique with composites to cover defects. The industry provides for the use of these systems generally on all surfaces. But all-ceramic systems use different types of porcelain for substructure and veneering, depending on what system and indication are chosen. The purpose of this study was to examine shear bond strength in a universal testing machine of various commercial repair kits used with different all-ceramic systems. The results should offer a recommendation about the best compatibility between the repair material and all-ceramic systems for the in-vivo repair.

**Methods:** Four intraoral ceramic repair systems (Fig 1): a) Cimara (Voco), b) Silistor (Heraeus Kulzer), c) Ceramic Repair (Ivoclar Vivadent), d) CoJet-System (3M Espe) were applied on four different all-ceramic systems: IPS Empress 2 (Ivoclar Vivadent), Vita In-Ceram Alumina Blank, Vita In-Ceram Alumina slickered (Vita Zahnfabrik) and Cercon (Degudent). The specimens (10×10×3mm) were divided into substructure and veneering porcelain and were prepared with the repair material with a silicon form (Ø5×3mm) following the guidelines for an intraoral repair (Fig. 2). After 24 hours of storage in artificial saliva (37° C), the prepared specimens were debonded using a shear bond strength test in a universal-testing-device (Zwick) with a crosshead-speed of 0.5mm/min until fracture (n=10) (Fig. 3). Fracture modes were examined visually and in some cases microscopally and divided into adhesive, cohesive, and combined fractures. Results were statistically analyzed (ANOVA, Duncan's, p<0.05).

Fig.1 a b c d

Fig.2

Fig.3

**Results:** In all groups with substructure material, specimens were debonded adhesively at the porcelain/composite interface (Fig. 4 and 5). Only in the group IPS Empress 2 plus Ceramic Repair, half of the specimens failed cohesive tests in the substructure ceramic and were taken out of the statistic (Fig. 4a). In all groups with veneering material, shear tests showed cohesive fractures in the ceramic (Fig. 6). In these cases, the shear bond strength of the composite resin was higher than the cohesive strength of the porcelain (Fig. 7). The results show that CoJet-System achieves generally high bond strengths; in particular in regard to oxide ceramics Vita In-Ceram Alumina (26N/mm²) and Cercon base (16N/mm²), significantly higher bond strengths were noted.

Fig.4 Substructure porcelain a b c d

Fig.5

Fig.6 Veneering porcelain a b c

Fig.7

**Conclusion:** Results indicate that silicoating and silanization with the CoJet-System represent a suitable treatment for the intraoral repair of the materials tested in this study. Cimara achieves equivalent bond strengths on oxide ceramic In-Ceram Alumina Blank as CoJet-System. On glass-based ceramics (IPS Empress 2 and IPS Eris for E2), conditioning with phosphoric acid (Total Etch, Ivoclar Vivadent) tends to result in equivalent or even higher bond strengths than silicoating.

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