Marginal Integrity of Ceramic Inlays luted with **Visalys**® CemCore

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Scientific Report

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Background and aim of the study

Adequate adhesive luting is a fundamental prerequisite for good clinical performance of ceramic inlays and partial crowns.[1] Compared to direct restorations, where both adhesive and luting composite are light-cured, light transmission through ceramics is always a problem because a high percentage of energy is filtered.[2]

Dual-curing luting composites are an appropriate way to meet the above-mentioned challenges. It is important that dark curing properties are pronounced in order to get good adaptation in deep cavities.[3]

Aim of this in vitro study was to evaluate the dual-curing luting composite **Visalys**® CemCore regarding adhesive performance after different pre-treatments in deep Class II cavities and to compare it with standards. Methodology of choice was chewing simulation, allowing to look deeper into fatigue phenomena in the resin-ceramic and resin-tooth interfaces.[4]

[1] Van Meerbeek et al., 2003; Frankenberger et al., 2009
[2] Krämer & Frankenberger, 2000; Frankenberger et al., 2008
[3] Frankenberger et al., 2011
[4] Frankenberger & Tay, 2005; Garcia-Godoy et al., 2011

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Study design – materials & methods

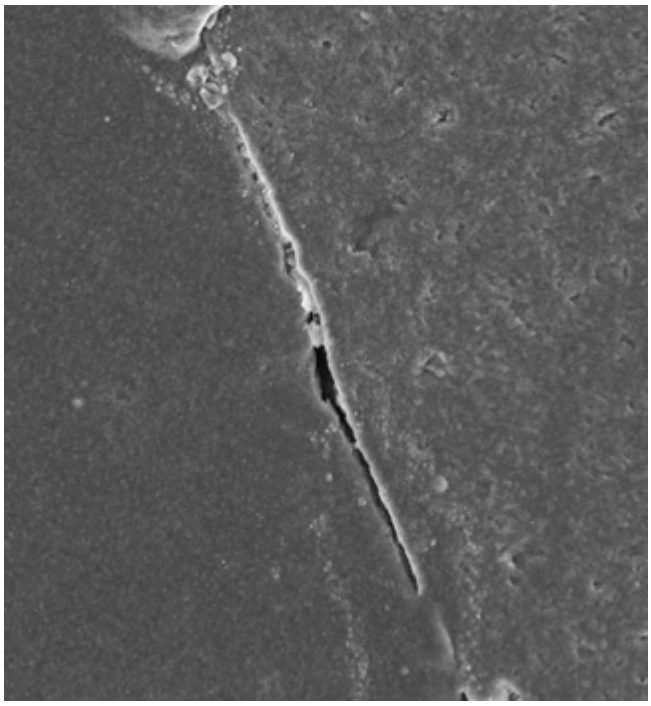
Fifty-six freshly extracted human third molars received extended MOD preps (n = 8; width 6 mm, isthmus 3 mm, mesial box in enamel, distal box in dentin/cementum). Cavities were scanned (Cerec 3D, Sirona) and restored with CAD/CAM ceramic inlays (e.max CAD, Ivoclar Vivadent). Intaglio surfaces were etched with 5 % hydrofluoric acid for 20 s, rinsed, dried, and silanated with **Visalys**® Restorative Primer (**Visalys**® CemCore groups) or Monobond Plus (Ivoclar Vivadent). Groups 8-11 were investigated in another study (independent of this study) and the results have been supplemented for a better classification.

The pretreatment of the teeth was conducted analogously to Table 1.

Ceramic inlays were adhesively luted according to manufacturers' recommendations and experimentally modified; additional light-curing was always carried out. After polishing specimens were stored for 21 days in aqua dest. at 37 °C, and epoxy replicas were manufactured for further SEM analysis (Alpha-Die MF, Schütz Dental).

Class II specimens were subjected to thermomechanical loading (TML) in the Marburg type chewing simulator (100,000 cycles à 50 N after 2,500 thermocycles 5 / 55 °C – our clinical correlation to two years of clinical service; SD Mechatronik, Feldkirchen) and replicated before and after TML.

Replicas were gold sputtered and analyzed under an SEM (Phenom, Phenomworld) at 200 x magnification relating to marginal quality (= percentage of gap-free margins; Winmes 2.0). Data were analyzed with Wilcoxon- and Mann-Whitney U-Tests (SPSS 17.0).



Marginal gap between enamel and luting composite (group 3; SEM, 200x magnification).

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Results

The results of the marginal gap analysis are shown in the following table:

Pretreatment regimen					Results of the marginal gap analysis			
Etching technique	Adhesive/Primer + luting composite	Phosphoric acid in enamel	Phosporic acid in dentin	Seperate light-curing of Adhesive/ Primer	Perfect margin enamel initial % (SD)	Perfect margin enamel TML % (SD)	Perfect margin dentin initial % (SD)	Perfect margin dentin TML % (SD)
Self-Etch	**Visalys**® Tooth Primer + **Visalys**® CemCore				87 (5) ^{B}	78 (7) ^{C}	100 ^{A}	78 (7) ^{A}
	Adhese Universal + Variolink Esthetic			x	90 (7) ^{B}	84 (5) ^{B}	100 ^{A}	83 (7) ^{A}
	Panavia V5 Tooth Primer + Panavia V5				85 (6) ^{B}	73 (9) ^{D}	100 ^{A}	80 (6) ^{A}
	Scotchbond Universal + RelyX Ultimate				90 (8) ^{B}	93 (8) ^{B}	93 (8) ^{B}	70 (9) ^{C}
	Multilink Primer + Multilink Automix				84 (6) ^{B}	66 (10) ^{E}	90 (8) ^{C}	66 (8) ^{D}
	RelyX Unicem				84 (10) ^{B}	64 (8) ^{E}	100 ^{A}	79 (7) ^{A}
Selective-Etch	**Visalys**® Tooth Primer + **Visalys**® CemCore	x			100 ^{A}	92 (5) ^{A}	100 ^{A}	80 (6) ^{A}
	Adhese Universal + Variolink Esthetic	x		x	100 ^{A}	93 (4) ^{A}	100 ^{A}	80 (9) ^{A}
Total-Etch	**Visalys**® Tooth Primer + **Visalys**® CemCore	x	x		100 ^{A}	91 (5) ^{A}	94 (7) ^{B}	72 (7) ^{B}
	Adhese Universal + Variolink Esthetic	x	x	x	100 ^{A}	94 (4) ^{A}	100 ^{A}	77 (6) ^{A}
	Syntac + Heliobond + Variolink Esthetic	x	x	x	100 ^{A}	91 (6) ^{A}	100 ^{A}	74 (9) ^{B}

Tab. 1: Results (identical superscript letter within the columns: $p>0.05$, Mann-Whitney U-Test). **The portion of gaps and irregularities between ceramic and luting resin were <1 % and therefore not further statistically evaluated.**
If the letters within the columns are the same, no statistically significant differences can be detected between the respective samples compared with each other.

Conclusion

The results of the marginal integrity analysis show the following issues for the adhesive performance of **Visalys**® CemCore:

- Chewing simulation leads to significant adhesive fatigue ($p<0.05$). 100 % perfect margins did not occur so far, so the estimation of the present values is very good.
- Selective enamel etching improves enamel margins in all groups ($p<0.05$).
- Etch-and-rinse in dentin is detrimental for both initial and long-term dentin bonding in all groups ($p<0.05$), however, still being on a good level.
- **In self-etch mode, Visalys® CemCore revealed excellent sealing properties, and in general a similar adhesive performance compared to Variolink Esthetic.**
- **Altogether, Visalys® CemCore + Visalys® Tooth Primer is comparable to Variolink Esthetic + Adhese Universal as well as Variolink Esthetic + Syntac + Heliobond regarding marginal integrity of ceramic inlays.**

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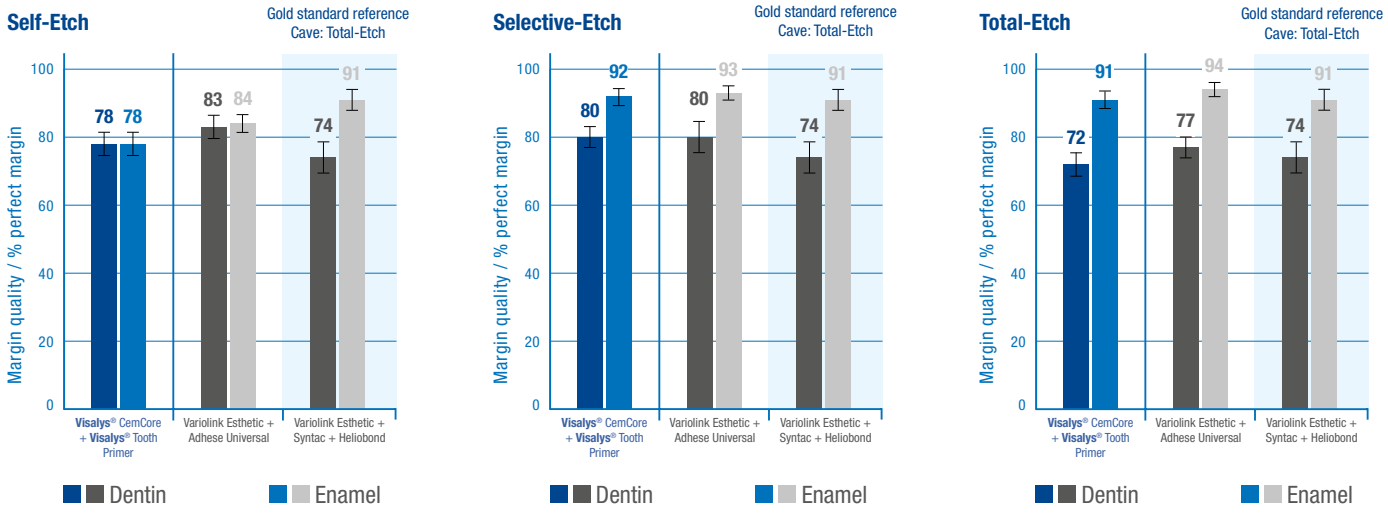
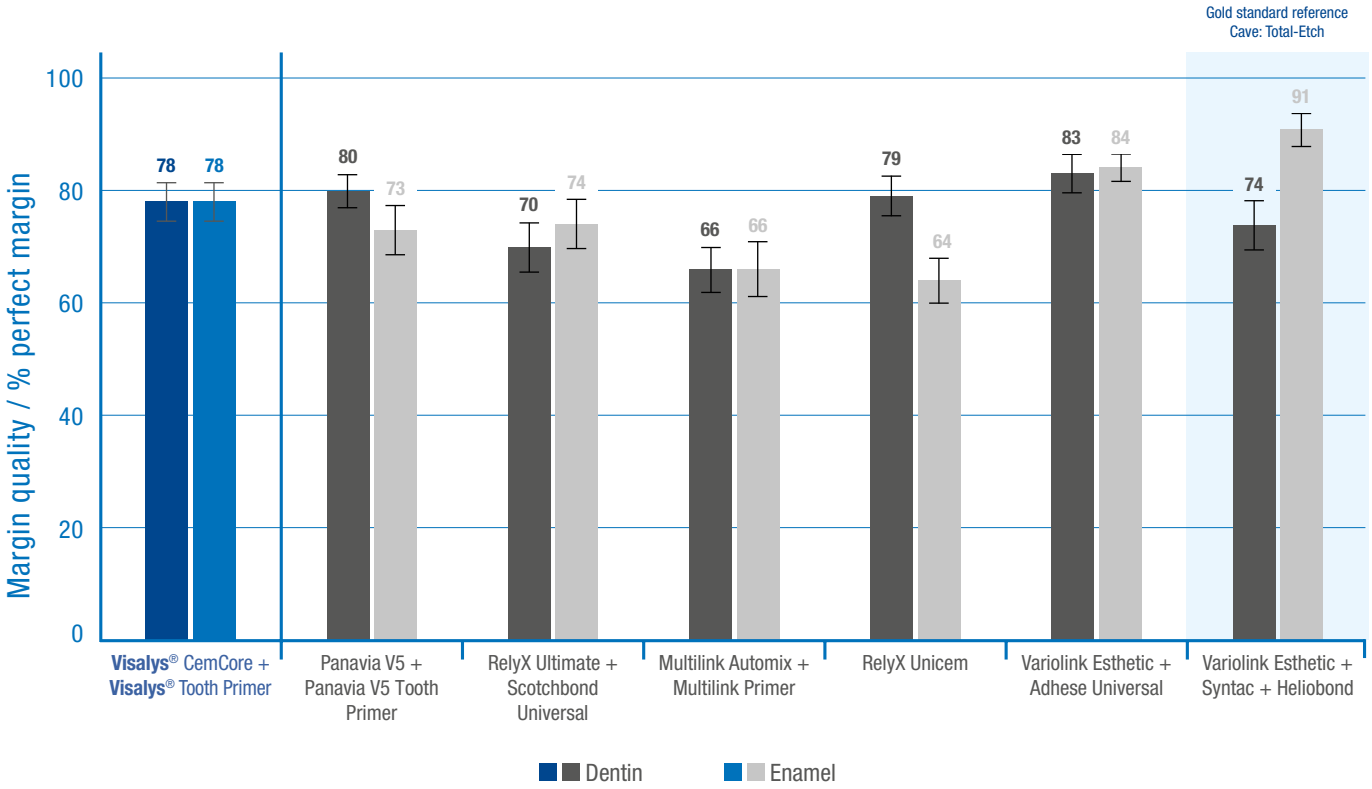
Results of marginal integrity



Results of marginal integrity

in self-etch mode after thermomechanical loading compared to other materials



- **Visalys**® CemCore revealed excellent sealing properties even without additional etching (total-etch or selective-etch).
- **Visalys**® CemCore + **Visalys**® Tooth Primer is comparable to Variolink Esthetic + Syntac + Heliobond (multi-component LC adhesive system - „Gold standard“) regarding marginal quality

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