



The Effects of Material Thicknesses and Substrates on the Translucency and Color Masking Ability of Additively Manufactured Definitive Crown Materials

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Objectives

To compare the translucency and color masking ability of varying thicknesses of two new 3D-printable materials (VarseoSmile Crown^{plus} and Flexcera Smile Ultra+) with a control (IPS e.max Press) against different substrate colors (cobalt-chromium alloy, noble alloy and zirconia).

Methods

A total of 90 square-shaped specimens of ceramic-infiltrated hybrid composite (VS) and a light-polymerizing resin (FS), and a control group lithium disilicate (LS) were fabricated at 3 different thicknesses 1.0 mm, 2.0 mm, and 3.0 mm (n = 10). Three substrates were milled from cobalt-chromium alloy, noble alloy, and tooth-colored zirconia. Color parameters were measured and translucency parameter (TP₀₀) calculated. Color differences were measured and calculated against substrates. The influence of material and thickness on translucency was analyzed and color differences compared against each substrate and between substrates for each combination.

Results

All 1mm samples were most translucent and 3mm least. For all materials the lowest dE₀₀ was between 2mm and 3mm. All material-substrate groups showed dE₀₀₂₋₃ < dE₀₀₁₋₂ < dE₀₀₁₋₃ apart from LS-ZR group (dE₀₀₂₋₃ < dE₀₀₁₋₃ < dE₀₀₁₋₂). A significant interaction between the effects of material and thickness on translucency noted. Independently, material and thickness significantly affect TP₀₀. Material, substrate, thickness, material-substrate, material-thickness and substrate-thickness significantly effected dE₀₀.

Conclusions

Regarding TP₀₀ only LS 1mm significantly differed from all other samples. LS (2mm) was statistically as translucent as VS and FS (3mm). As thickness increased masking ability improved apart from two LS groups. Color differences in most groups were beyond the threshold of perceptibility however most were within the threshold of acceptability. Based on the results the null hypothesis is rejected.

Table 1. Restorative Materials

Group	Restorative Materials	Manufacturing Technology	Chemical composition
VS	VarseoSmile Crown ^{plus} (BEGO, Bremen, Germany)	3D-printed	silanized dental glass, methyl benzoylformate, diphenyl (2,4,6-trimethylbenzoyl) phosphine oxide, inorganic fillers
FX	Flexcera Smile Ultra+ (Desktop Metal, Burlington, MA)	3D-printed	Acrylates, methacrylates, methacrylated oligomers and monomers, photoinitiators, colorants/dyes, fillers, and absorbers
LS	IPS e.max Press (Ivoclar Vivadent Inc, Buffalo, NY)	Heat-Pressed	57.0-80.0% SiO ₂ , 11.0-19.0% Li ₂ O, 0.0-13.0% K ₂ O, 0.0-11.0% P ₂ O ₅ , 0.0-8.0% ZrO ₂ , 0.0-8.0% ZnO, 0.0-5.0% Al ₂ O ₃ , 0.0-5.0% MgO, 0.0-8.0% coloring oxides

Table 2. Substrate Materials

	Substrate Materials	Manufacturing Technology	Chemical composition
Co-Cr	ArgenMill CoCr255 (Argen, San Diego, CA)	Milled	66% Co, 27% Cr, 6% Mo, <1% Si, <1% Fe, <1% Mn
Noble alloy	ArgenMill Au2 (Argen, San Diego, CA)	Milled	2% Au, 32.7% Pd, 34.5% Ag, 2.6% Zn, 28% In
Tooth-colored zirconia	Nacera Pearl Natural A1 (Dental Direkt GmbH, Spence, Germany)	Milled	3 mol% yttria-stabilized tetragonal zirconia

Figure 2. Substrate Materials

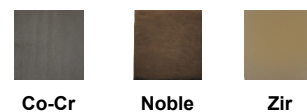


Figure 3. Results. Translucency

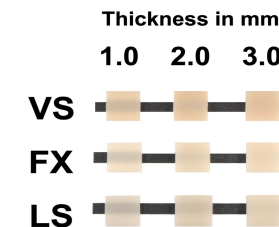


Figure 1. Results. Box Plot

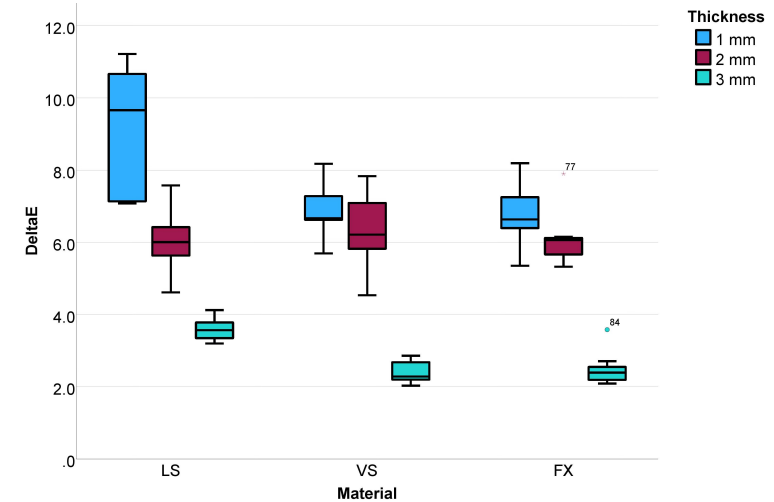


Figure 4. Results. Color Masking Example

