

# Effect of Opaque Layer Application on the Color of Resin Composites Used to Fill Access Openings of Screw-Retained Implant Restorations

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The purpose of this preliminary in vitro study was to evaluate the effect of an opaque layer and application of resin composite in dual colors on the  $\Delta E$  values of resin composites used to fill access openings of screw-retained implant restorations. Sixty cylindrical nickel-chromium metal molds with a central channel simulating a posterior screw-retained, implant-supported, porcelain-fused-to-metal crown were cast. Access openings were filled with combinations of opaquer, enamel composite (A2E), dentin composite (A2B and A3B), and resilient composite.  $\Delta E$  values differed significantly among the groups ( $P < .01$ ). The combination of opaque layer and dual color resin composites of shades A2E and A3B resulted in significantly lower  $\Delta E$  values than the other groups ( $P < .01$ ). *Int J Prosthodont* 2015;28:415–417. doi: 10.11607/ijp.4190

The fabrication of screw-retained implant-supported restorations requires closure of the screw access openings, which may compromise their esthetic appearance.<sup>1</sup> The most frequently used materials include a variety of dentin and enamel resin and resilient composites.<sup>2</sup> Resin composites are relatively translucent and thus cannot completely mask the dark underlying metal layer that lines the access opening in the porcelain-fused-to-metal restorations. To minimize this background color effect, opaque shades of composite resins can be used or an opaque layer can be applied.<sup>3</sup>

The null hypothesis was that clinical applications of opaque and resin composites in dual colors would have no significant effect on the  $\Delta E$  values of resin composites used to fill access openings of screw-retained, porcelain-fused-to-metal, implant-supported restorations.

## Materials and Methods

Sixty custom-made cylindrical metal molds with a central channel were cast with nickel-chromium (Ni-Cr) dental alloy (Wiron 99, Bego) to simulate a posterior

screw-retained, implant-supported, porcelain-fused-to-metal crown with a screw access opening (Figs 1 and 2). The upper horizontal surfaces of metal molds were covered with porcelain in shade A2 (VMK Master, Vident). Then, 60 molds were randomly divided into 6 groups of 10 each. One prefabricated cotton pellet (Cotton Pellets 4.0, Roeko) was placed into each channel in all groups. Self-etch adhesive (Adper Easy One, 3M) was applied to the channels. A thin layer of opaquer (OP1, Pulpdent) was painted around the metal inner surface of the central channels in groups 1, 2, and 3, before the channel was filled with resin composite or resilient composite (Clip, VOCO).

Quantitative color ( $\Delta E$ ) measurements were performed with a spectrophotometer (Easysshade, VITA). The total color difference between the control and test groups in the three-dimensional  $L^*a^*b^*$  color space was calculated as  $\Delta E$  using the following equation:

$$\Delta E = [(\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2]^{1/2}$$

The control was a custom-made, shade A2 porcelain-fused-to-metal disk (10 mm diameter  $\times$  2 mm thickness).

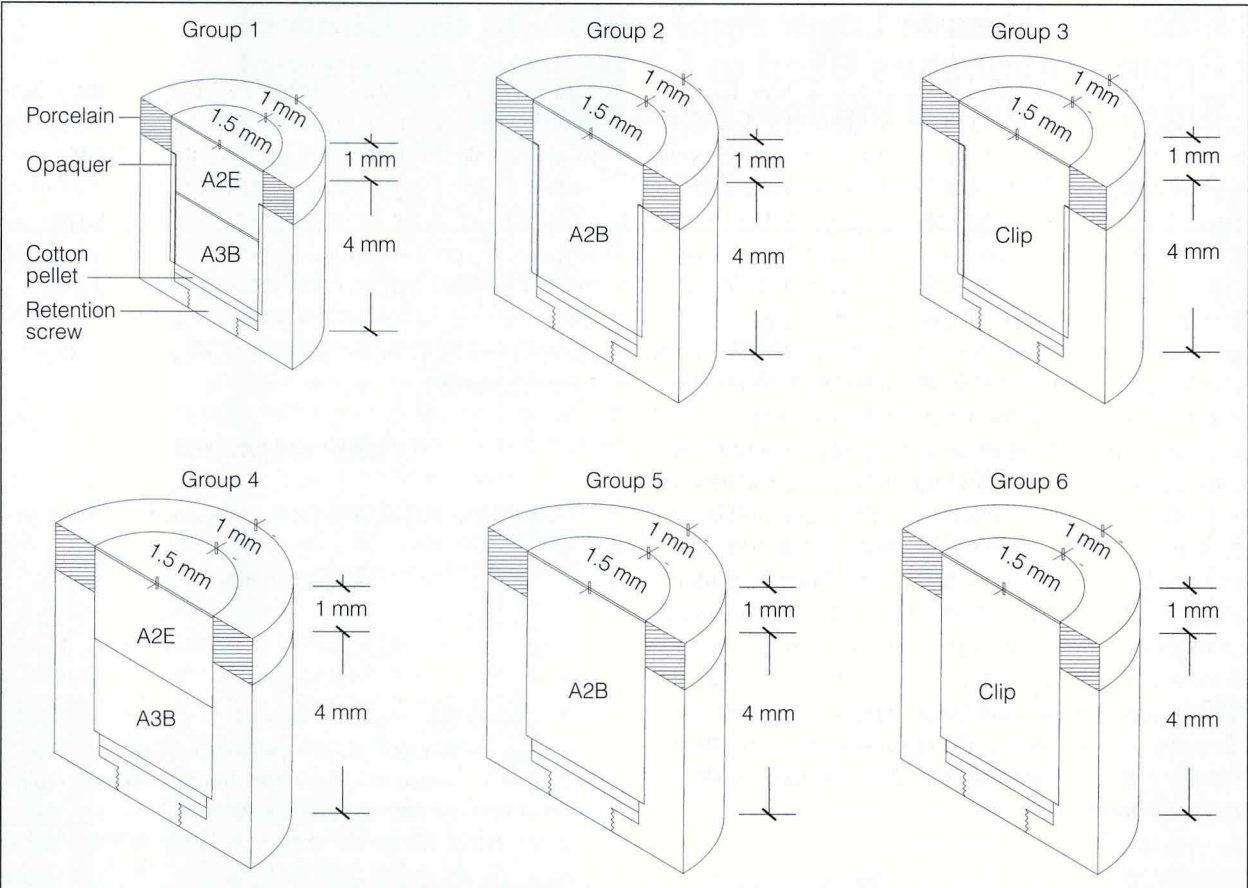
## Results

The mean and the standard deviation of  $\Delta E$  values are presented in Table 1. The mean  $\Delta E$  values of groups with opaque and resin composite application (group 1 < group 2) were lower than those of groups with resin composite application without opaquer (group 5 < group 4) and those of groups with resilient composite application with or without opaquer (group 3 < group 6). Clearly, opaquer application

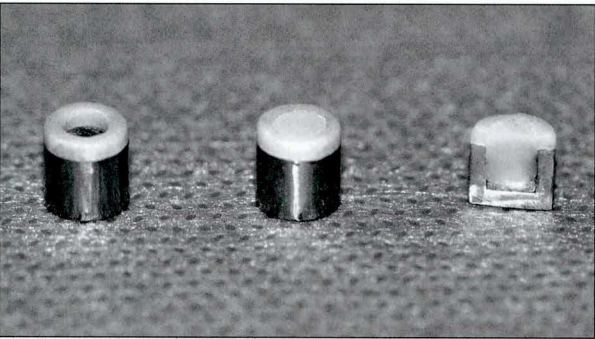
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**Fig 1** Vertical section of a cast Ni-Cr mold with a central channel simulating a posterior, screw-retained, implant-supported, porcelain-fused-to-metal restoration with a screw access opening. The screw access openings in test groups were filled either with single and dual color resin composite or resilient composite as follows: Group 1 (dual color): opaquer + cotton pellet + adhesive + resin composite (A3B) + resin composite (A2E); Group 2 (single color): opaquer + cotton pellet + adhesive + resin composite (A2B); Group 3: opaquer + cotton pellet + adhesive + resilient composite; Group 4 (dual color): no opaquer + cotton pellet + adhesive + resin composite (A3B) + resin composite (A2E); Group 5 (single color): no opaquer + cotton pellet + adhesive + resin composite (A2B); Group 6: no opaquer + cotton pellet + adhesive + resilient composite.



**Fig 2** (left) Empty Ni-Cr mold, upper horizontal surface covered with shade A2 porcelain, (center) mold with resin composite application, (right) vertical section of a sample prepared for demonstration.

**Table 1** Descriptive Statistics and Comparison of the Groups\*

	$\Delta E$	
	Mean $\pm$ SD	P
Group 1	1.66 $\pm$ 0.19 <sup>a</sup>	.001**
Group 2	3.43 $\pm$ 0.39 <sup>b</sup>	
Group 3	13.80 $\pm$ 0.54 <sup>c</sup>	
Group 4	5.13 $\pm$ 0.25 <sup>d</sup>	
Group 5	4.59 $\pm$ 0.74 <sup>d</sup>	
Group 6	15.20 $\pm$ 0.54 <sup>e</sup>	

\*The Kruskal Wallis test was used for intergroup comparisons of parameters without normal distribution and Mann-Whitney *U* test with Bonferroni correction was used to determine the group causing the difference.  
\*\**P* < .01. Same superscript letter indicates no significant difference.

and use of resin composites in dual colors reduced the  $\Delta E$  values, and use of resilient composites with or without opaquer resulted in very high  $\Delta E$  values

(*P* < .05). Between-group comparisons showed that the differences between groups were significant except for groups 4 and 5 (*P* < .05).



## Discussion

Considering that the  $\Delta E$  of group 1 was below the clinically acceptable value for color matching ( $\Delta E \leq 3.3$ )<sup>4</sup> and that the  $\Delta E$  values of groups 2, 4, and 5 were slightly above this critical level, the color mismatch of group 1 would not be clinically discernible and groups 2, 4, and 5 would be associated with slight color mismatch. However, the null hypothesis was not fully confirmed particularly due to groups 3 and 6, where high  $\Delta E$  values that exceeded the clinically acceptable level of color mismatch could be attributed to the use of resilient composites. Indeed, the combined application of an opaque layer and dual color enamel and dentin resin composites (group 1) appeared to have diminished the translucency of the enamel resin composite and blended it with the surrounding porcelain. This effect may also be attributed to visual blending, whereby materials present smaller color differences if they are observed together than if they are viewed in isolation.<sup>5</sup> Additional in vitro as well as in vivo comprehensive investigations testing translucency parameter, different opaquer, and resin composites with different thickness are needed to determine the optimum combination that yields the best esthetic results.

## Conclusion

Within the limitations of this in vitro study, the combined application of opaquer and resin composites in dual colors of enamel and dentin with the selected shade might have helped to mask the gray background color of the screw access channel of simulated screw-retained, porcelain-fused-to-metal, implant-supported crowns. The application of an opaquer may improve the esthetic outcome of resilient composite filling materials where their use is crucial for retrievability.

## Acknowledgments

The authors reported no conflicts of interest related to this study.

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## Literature Abstract

### Preoperative administration of 0.2% chlorhexidine mouthrinse reduces the risk of bacteraemia associated with intra-alveolar tooth extraction

This randomized controlled clinical study included 101 subjects who were randomly designated to 2 groups, experimental and control. The experimental group used a 1-minute 0.2% chlorhexidine mouthwash rinse prior to dental treatment, while the control group used a sterile water mouthrinse. All subjects then had intra-alveolar dental extractions under local anesthesia with blood samples for subculture and identification of isolated bacteria taken at baseline, 1 min, and 15 min after the dental extractions. The statistical analysis showed significant difference ( $P = .012$ ) in the incidence of bacteremia between the control group (52.4%) and the experimental group (27.1%), with bacteremia most frequently detected at 1 min after extraction (33.3%). Of the 30 subjects who had positive blood culture at 1 min, 8 (26.7%) had bacteremia after 15 min. *Staphylococcus aureus*, *Actinomyces naeslundii*, *Prevotella* species, *Streptococcus* spp, and *Acinetobacter iwoffii* were among the bacteria isolated. Based on this study, the authors recommended routine use of 0.2% chlorhexidine mouthwash before dental extraction to decrease the risk of bacteremia after extraction.

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