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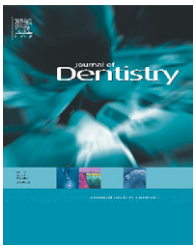

# Evaluation of a new silica whitening toothpaste containing blue covarine on the colour of anterior restoration materials *in vitro*

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ABSTRACT

*Objectives:* The aims of this study were to evaluate the effects of a novel silica-based blue covarine whitening toothpaste on the colour of anterior restoration materials.
*Methods:* Restoration materials (three glass ionomers, three resin composites) were cast into disks (10 mm diameter, 2 mm thick) using cylindrical moulds. Specimens were immersed in pooled whole saliva prior to exposure to staining materials via one of two protocols. CIELAB colour measurements were taken at baseline and after each stage of the procedures. In one protocol, specimens were brushed with 10 ml of 33% (w/w) silica whitening toothpaste containing blue covarine slurry in water four times, for 10 min each time, with control specimens being immersed in water or red wine for the same period. Disks were re-immersed in saliva for 2 h between cycles. In the other protocol, specimens were immersed in 20 ml of water, red wine or silica whitening toothpaste containing blue covarine slurry for 96 h with colour measurements being taken afterwards. The second protocol disks were then brushed for 2 min using a non-whitening silica paste and further colour measurements made. Colour differences were then calculated.
*Results:* At the end of both protocols the disks treated with silica whitening toothpaste containing blue covarine were not significantly different from the water controls ($p > 0.1$) in contrast to those treated with red wine. Even prior to brushing in the second protocol, there was no significant staining from the new toothpaste compared to the water control ($p > 0.1$).
*Conclusions:* There was no significant staining by the silica whitening toothpaste containing blue covarine on any of these materials.



## 1. Introduction

The market for tooth-whitening products has been growing dramatically over the last few years, particularly in the United States and Western Europe.[1] Growth has occurred in all formats, but the most commonly used oral format in developed markets is still toothpaste.

Current whitening toothpastes rely on optimised abrasive and chemical components to maximise stain removal and prevention.[2] During brushing, abrasive particles become

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temporarily trapped between the toothbrush and the stained tooth surface and abrade away the stain. Chemical components may also be used, usually in conjunction with abrasive particles, and include calcium chelators, polymers, surfactants, enzymes, polymers and oxidising agents.[2]

A new whitening toothpaste[3] has been developed that contains an optimised silica abrasive system and blue covarine as a novel optical approach to tooth whitening. On brushing with this toothpaste, blue covarine is deposited onto the tooth surface, where it is able to change the optical effects of the tooth surface, and enhances the measurement and perception of tooth whiteness.[4,5] This toothpaste is intended to produce an instant, temporary tooth-whitening effect that can be reapplied as frequently as desired, as it contains no harsh chemicals, but is not intended to produce any permanent changes to colour of the teeth.

As many patients and consumers have teeth that contain fillings or restorations, it is important to ensure that the new toothpaste will not produce permanent or heavy staining of restoration materials that could prove unsightly. While a small decrease in $\Delta b^*$ for these materials would be acceptable (or even desirable), given that the surrounding teeth should also experience similar effects from the new toothpaste,[4,5] large, irreversible changes in $\Delta b^*$ could be problematic, as they could potentially lead to unsightly "blueing" of restoration materials that could result in them becoming more visible. The aims of the current *in vitro* study were to investigate the propensity of this new silica-based blue covarine whitening toothpaste to stain common anterior restoration materials, and, if any staining were to occur, the ability of a standard, non-whitening toothpaste to remove it under realistic brushing conditions.

## 2. Materials and methods

### 2.1. Specimens and treatments

The anterior restoration materials used in this study are shown in Table 1. All materials were cast into disks of diameter 10 mm and thickness 2 mm using moulds made of stainless steel washers lubricated with a thin film of silicone spray. No manual compression was required. For the resin composites, the base and catalyst were mixed in equal quantities, and curing occurred after 30 s in intense blue light. For the glass ionomers, the manufacturers' instructions were followed for the relative quantities of the two components. The Ketac-Fil glass ionomer self-cured within 5 min, whereas the other two glass ionomers were light-cured.

Specimens were stored in demineralised water prior to testing, and immersed in sterilised (gamma irradiated), pooled whole saliva for 24 h to generate an initial salivary pellicle layer. Six disks of each material were then assigned to one of three treatments under two protocols, as described below. Treatments were: silica whitening toothpaste containing blue covarine paste (33% (w/w) slurry in demineralised water); red wine (Wolf Blass Yellow Label Cabernet Sauvignon, 2005, containing 13.5% alcohol by volume) and demineralised water.

Protocol A, designed to simulate brushing conditions, required disks to be brushed for 10 min at 150 cycles per minute in 10 ml of a 33% (w/w) slurry of the silica whitening toothpaste containing blue covarine slurry using a modified Martindale brushing machine (Goodbrand–Jeffreys Ltd., Stockport, UK) with flat trim toothbrushes (0.20 mm diameter filaments) and a load of 175 g. Four brushing cycles were employed, with disks being immersed in saliva for a further 2 h between cycles. Control disks were immersed in 10 ml of either water or red wine solution for 10 min on four occasions, and were also immersed in saliva for 2 h between cycles.

Protocol B, designed to create extreme exposure conditions, required specimens to be immersed in 20 ml of either red wine, water or a 33% (w/w) slurry of silica whitening toothpaste containing blue covarine toothpaste in water for 96 h. After 96 h, all disks were brushed for 2 min using a 33% (w/w) slurry of a non-whitening silica toothpaste in water, in order to see if any staining that was generated could be easily removed. Brushing was done on the modified Martindale brushing machine as described above.

### 2.2. Colour measurement

A Minolta CR321 chromameter (Minolta Camera Company Limited, Japan) operating in CIELAB mode was used to measure $L^*$, $a^*$ and $b^*$ values. Measurements were made on all disks after the initial pellicle layer had been generated. For protocol A, further measurements were made after each of the four brushing/soaking cycles. For protocol B, measurements were made after 96 h, and again after brushing.

As red-wine staining predominantly affected the red–green ($a^*$) colour axis, while the silica whitening toothpaste containing blue covarine affected the blue–yellow ($b^*$) axis, differences ($\Delta$) in $L^*$, $a^*$ and $b^*$ values were calculated for each treatment and converted into $\Delta E$ values (where $\Delta E$ is the square root of the sum of the squares of $\Delta L^*$, $\Delta a^*$ and $\Delta b^*$). $\Delta E$ is the distance between two points in colour space, and allows comparisons to be made between different treatments. However, the purpose of this study was to ensure that the new toothpaste does not produce noticeable staining of restoration materials.

**Table 1 – Details of anterior restoration materials used in this study**

| Material | Manufacturer | Location | Description |
|---|---|---|---|
| Charisma | Heraeus–Kulzer | Hanau, Germany | Microhybrid composite |
| Filtek A110 | 3M ESPE | St. Paul, MN, USA | Microfilled anterior composite |
| Herculite XR | Kerr Hawe | Bioggio, Switzerland | Hybrid resin composite |
| Fuji II | GC | Leuven, Belgium | Resin reinforced glass ionomer |
| Ketac-Fil | 3M ESPE | St. Paul, MN, USA | Glass ionomer cement |
| Vitremer | 3M ESPE | St. Paul, MN, USA | Resin modified glass ionomer |