

1766. *In Situ* Investigation of Dentine Tubule Occlusion

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Introduction

Toothpastes are used routinely for the treatment of sensitive teeth. Depending on their formulations, they can work via occlusion of the dentinal tubules¹ (Figure 1), hence reducing the hydrodynamic conductance of dentine and associated pain response. To gain an understanding of how well occluding toothpastes perform in an orally relevant environment, an *in situ* model has been developed as an alternative and scientifically valuable option to study tubule patency².

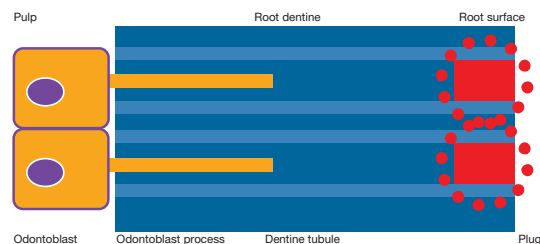


Figure 1. Mechanism of dentine tubule occlusion.

Objectives

- **Primary:** to determine the validity of the *in situ* model for investigating dentine tubule occlusion by comparing the performance of a known occluding control toothpaste with that of a toothpaste that provides sensitivity relief via a nonoccluding mechanism.
- **Secondary:** to evaluate the extent of tubule occlusion offered by two experimental toothpaste formulations compared with positive and negative controls.

Methods

Clinical design

- A single-blind, 4-day, four-cell, split-mouth, crossover design was employed. A total of 12 subjects wore two removable lower buccal appliances (Figure 2), each holding four human dentine slabs.
- Test products were:
 - Product A: Sensodyne Mint (marketed occluding desensitizing toothpaste)
 - Products B and C: experimental toothpaste
 - Product D: Sensodyne Total Care F (marketed nonoccluding desensitizing toothpaste).
- Each group of four dentine slabs underwent twice-daily brushing, performed *ex vivo*, with one of the study pastes. One dentine slab was removed from each side of the appliance at daily intervals.



Figure 2. Lower buccal appliance containing dentine specimens.

Analytical method

- To determine the degree of tubule occlusion, the dentine surface was analyzed using scanning electron microscopy (SEM) dentine replica analysis³.
- Reproduction of the dentine surface was achieved using an ultralight-consistency and low-viscosity siloxane impression material (Aquisil Ultra LV, Dentsply Caulk).
- As the replica is a negative of the original surface, occluded and nonoccluded tubules would be imaged as short or long tags protruding from the surface, respectively.
- SEMs for each replica were then assessed for the extent of occlusion by four examiners in a blinded, independent manner according to the occlusion classification index (Figure 3).
- Mean occlusion classification scores were analyzed by an analysis of variance model with factors for subject, treatment, period, and side (right/left).

Results

- Analyses revealed significantly more occlusion with Product A compared with all other pastes at Day 4 (Figure 4 and Table 1). Product C produced significantly more occlusion than Product B ($p = 0.0096$ at Day 4). No other treatment differences achieved statistical significance.

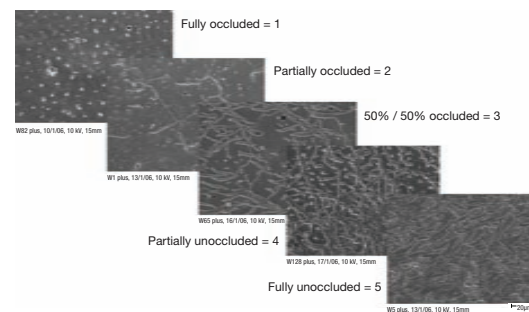


Figure 3. Occlusion classification index.

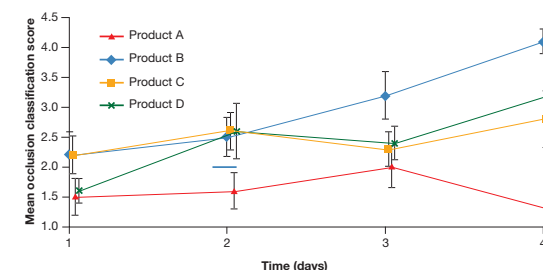


Figure 4. Mean occlusion classification score over time, by treatment. (Error bars represent \pm one standard error.)

Table 1. Summary of Results of Mean Occlusion Classification Score at Day 4

Comparison	Difference*	95% CI	p value
Product A vs Product D	-1.86	-2.89, -0.83	0.0007
Product B vs Product A	2.84	1.81, 3.86	<0.0001
Product B vs Product D	0.98	-0.02, 1.98	0.0555
Product C vs Product A	1.49	0.46, 2.52	0.0055
Product C vs Product D	-0.37	-1.37, 0.64	0.4630
Product C vs Product B	-1.35	-2.35, -0.34	0.0097

CI, confidence interval
*Difference is first named treatment minus second named treatment such that a negative difference favors the first named treatment.

Conclusion

- This *in situ* method combining SEM replica analysis was shown to differentiate successfully between a recognized occluding antisensitivity toothpaste and nonoccluding control. The experimental occluding toothpastes were not found to be more effective than the nonoccluding toothpaste in this model.
- This study provides a valuable new *in situ* methodology for determining tubule patency.

References

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3. Pereira JC, Martinelli AC, Tung MS, 2002. Replica of human dentin treated with different desensitizing agents: a methodological SEM study *in vitro*. *Braz Dent J* 13:75-85.

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