

Introduction

As Computer-Aided Design and Computer-Aided Manufacturing (CAD/CAM) technologies and zirconia products become increasingly prevalent in modern dentistry, numerous products and fabrication techniques have evolved to fulfill the esthetic demands of both clinicians and patients. Over the years, extrinsic surface staining by brushing a thin layer of metal-oxide stains to the outer most layer of the ceramic restoration along with the application of glazes to aid in the characterization of the restoration has gained popularity, particularly for high-esthetic cases. Since this layer is subjected to mechanical wear from mastication, toothbrush abrasion, and oral habits, the desired color and esthetic effects may be altered over time.



Figure 1: Extrinsically stained zirconia sleeve on metal titanium framework and extrinsically stained zirconia resin-bonded fixed dental prosthesis.

Purpose

This in-vitro study aimed to assess the color stability of monolithic zirconia extrinsically stained with two different post-sintering color systems post artificial aging via toothbrush simulation.

Disclaimer

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CONFLICT OF INTEREST: No conflict of interest to disclose.

Materials and Methods

3 mol% yttrium-stabilized zirconium oxide 10x10x3.0mm, A2 n = 20 	System I	Tooth shade A shade n = 5	A	
		Gingival shade E19 Essence n = 5	B	
	System II	Tooth shade A shade n = 5	C	
		Gingival shade Flamingo n = 5	D	

Table 1: Groups of specimen used in the study



Figure 2: Shade coordinates (CIELAB color space) were measured with a spectrophotometer. The CIELAB color space expresses color as three values: L* for perceptual lightness and a* and b* for the four unique colors of human vision: red, green, blue and yellow.²

Baseline shade coordinates were obtained for each specimen with a spectrophotometer. The specimens were mounted in a toothbrush simulator and subjected to simulated toothbrushing of a five-year duration (50k cycles). The toothpaste slurry was replaced after every 5k cycles. The accelerated artificial aging process was completed using linear brushing motion (10 mm linear motion and 2 Hz frequency) at 300g of force.

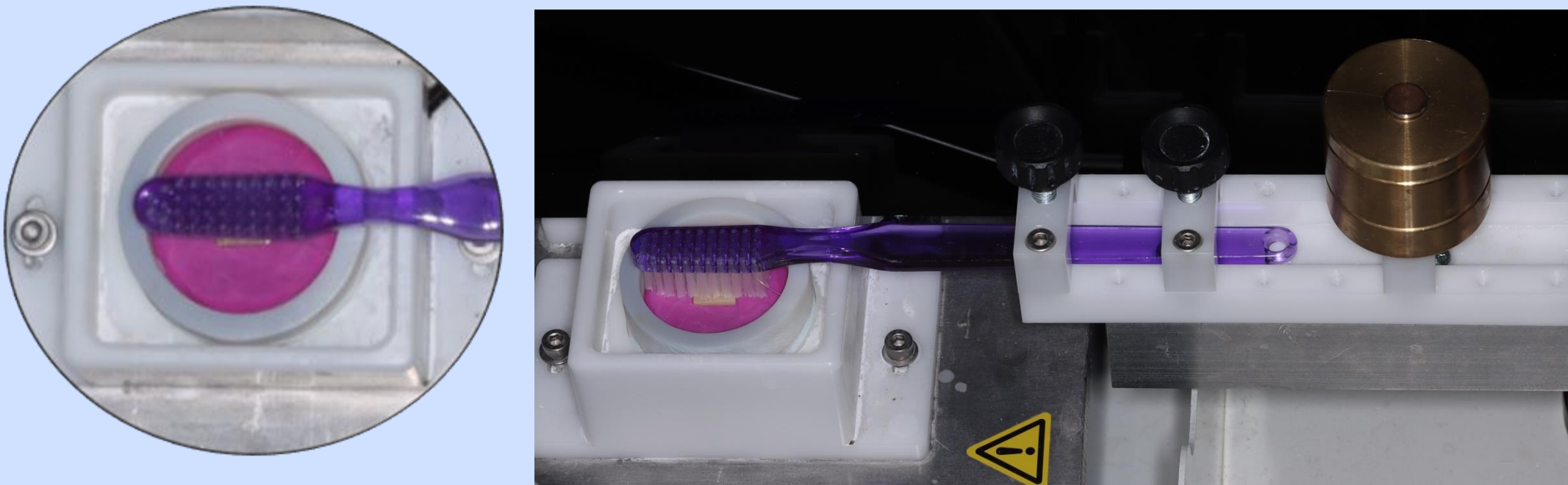


Figure 3: A soft bristle toothbrush was mounted to the appropriate holder, placing the bristles directly over the specimen surface.

The shade coordinates were measured for each specimen with the spectrophotometer at 5k, 10k, 20k, 30k, 40k, and 50k, which were equivalent for 6-month, 1-year, 2-year, 3-year, 4-year and 5-year interval. The color parameters recorded at each interval were compared to the baseline parameters and analyzed to determine the CIEDE2000 (ΔE_{00}) after mechanical aging.

Results

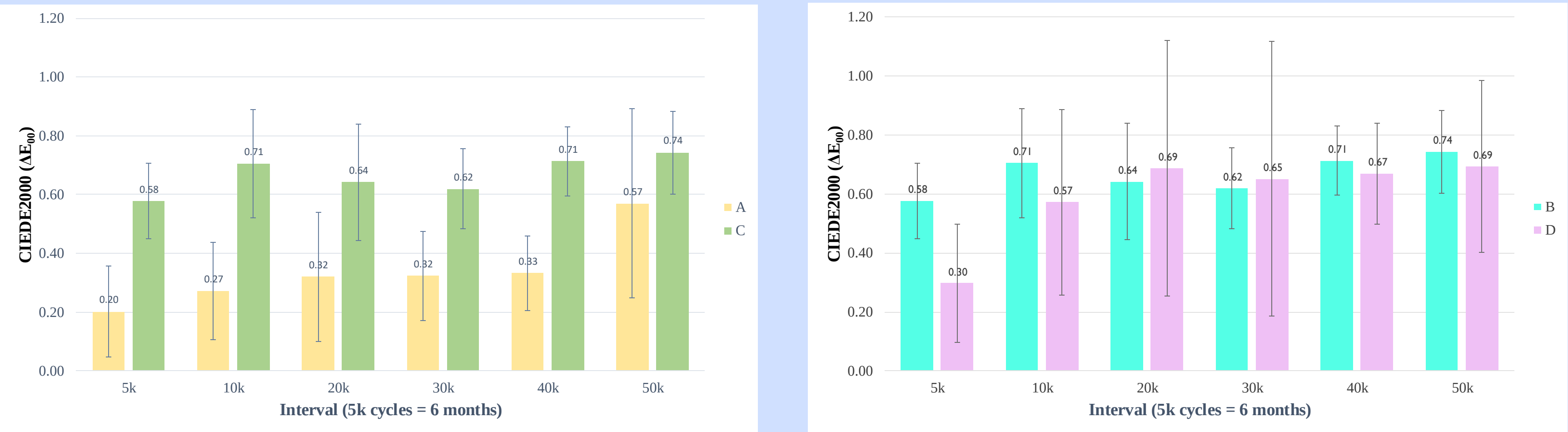


Figure 4: Mean and SD change in color (CIEDE2000) of different stained ceramics based on number of cycles using regular toothpaste. Calculated using Sharma et al.⁴ excel spreadsheet.

All tooth color specimen (A and C) had ΔE_{00} below the perceptibility threshold (PT) and acceptability threshold (AT) at all measured intervals; all gingival color specimen (B and D) displayed ΔE_{00} below the AT.

After 5k (6 months) and 50k (5 years) cycles, ΔE_{00} for all specimen groups (A, B, C, D) were significantly different from baseline ($p < 0.05$).

Interestingly, only group A specimens demonstrated a significant linear increase in ΔE_{00} through all cycle intervals ($p = 0.01$). Specimen D’s ΔE_{00} values increased significantly from baseline to 5K ($p = 0.03$) and then from 5k to 10k ($p = 0.04$) but plateaued between 20k and 50k cycles.

There was no significant difference in ΔE_{00} between gingival color specimen groups (B and D) at each cycle interval ($p > 0.05$).

Conclusion

When using tooth colored stains, System I performed better up to equivalent of 4 years of mechanical aging. When using gingival color stains, both Systems behaved the same throughout the study. A future study is recommended to confirm the findings with a larger sample size.

Extrinsic staining of sintered zirconia can be a predictable method of obtaining high esthetic results. Mechanical abrasion from toothbrushing may affect its long-term color stability; however, it can still be clinically acceptable.

References

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