

Effect of surface treatment on the color stability and surface roughness of traditional dental resin composites

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INTRODUCTION & AIM

Resin composites are widely used in restorative dentistry due to their esthetic versatility, easy handling, and cost-effectiveness (1).

However, they still present limitations such as **color instability, plaque accumulation, and marginal leakage** caused by polymerization shrinkage(2).

The **color stability** and **surface roughness** of these materials are critical for their long-term performance. Discoloration can arise from **internal factors** (e.g., oxidation of monomers) or **external factors** (e.g., diet, smoking, oral hygiene) (3).

Surface roughness promotes plaque retention and staining, so proper polishing and surface sealing are essential for durability and esthetics. Although **surface sealants** and **adhesive coatings** may improve smoothness and reduce discoloration, their long-term effectiveness remains insufficiently investigated (4).

Objectives

This study aimed to:

- Evaluate** color change and surface roughness of three resin composites after immersion in different staining media.
- Compare** two surface treatments — *finished* vs. *coated*.
- Test** the null hypotheses that:
 - No significant differences exist between finished and sealed surfaces;
 - Immersion medium and time do not significantly influence color or roughness;
 - There is no correlation between color change and surface roughness.

METHOD

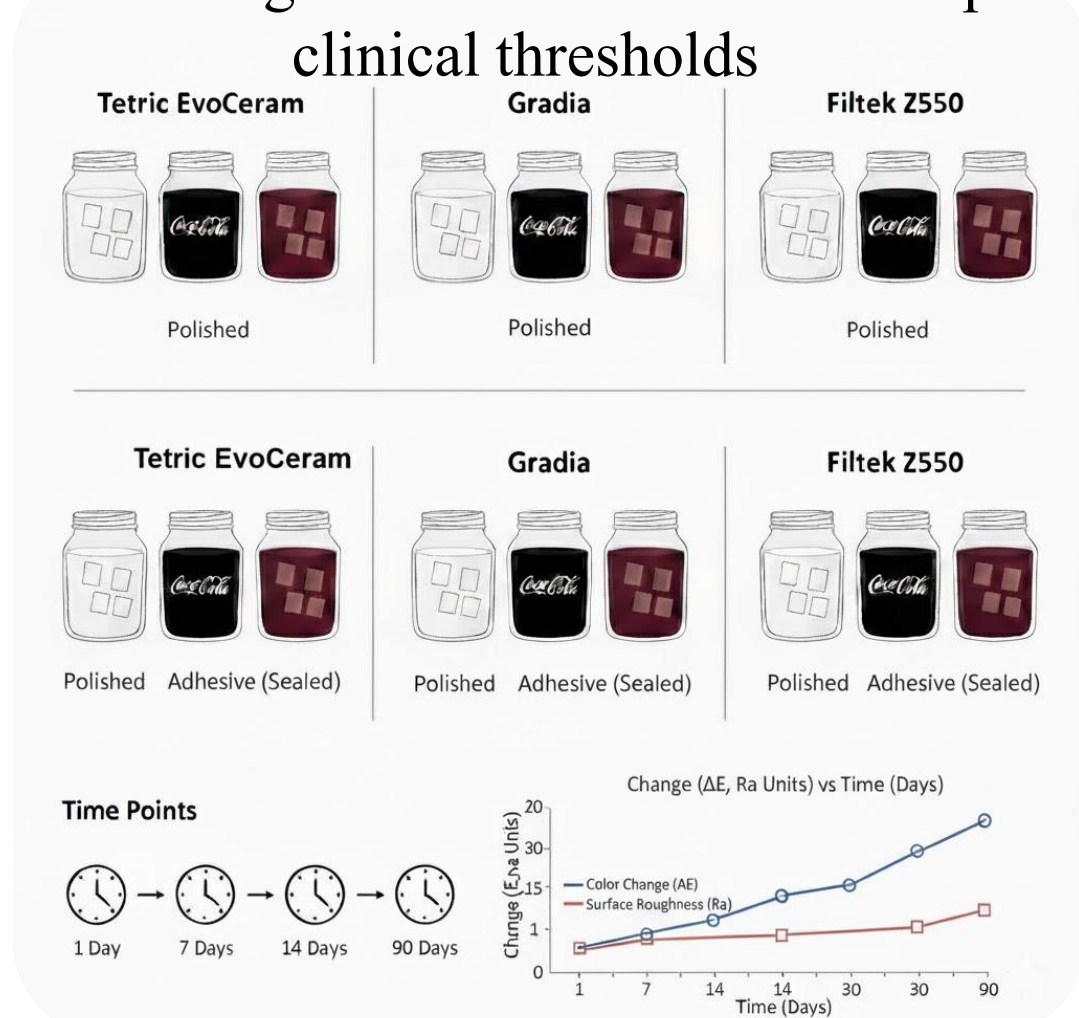
Design: In-vitro repeated-measures study of color stability and surface roughness for 3 composites: Tetric EvoCeram (TE), Gradia Direct Anterior (G), Filtek Z550 (FZ550) A2- each in polished vs polished+sealant application.

Primary parameter evaluated : ΔE_{ab} change from baseline; binary endpoint: perceptible discoloration by day 90 ($\Delta E > 2$) for Kaplan–Meier/logistic/ROC analyses.

Secondary: L, ΔE_1 - ΔE_4 , Ra/Rz, ΔE –roughness correlations.

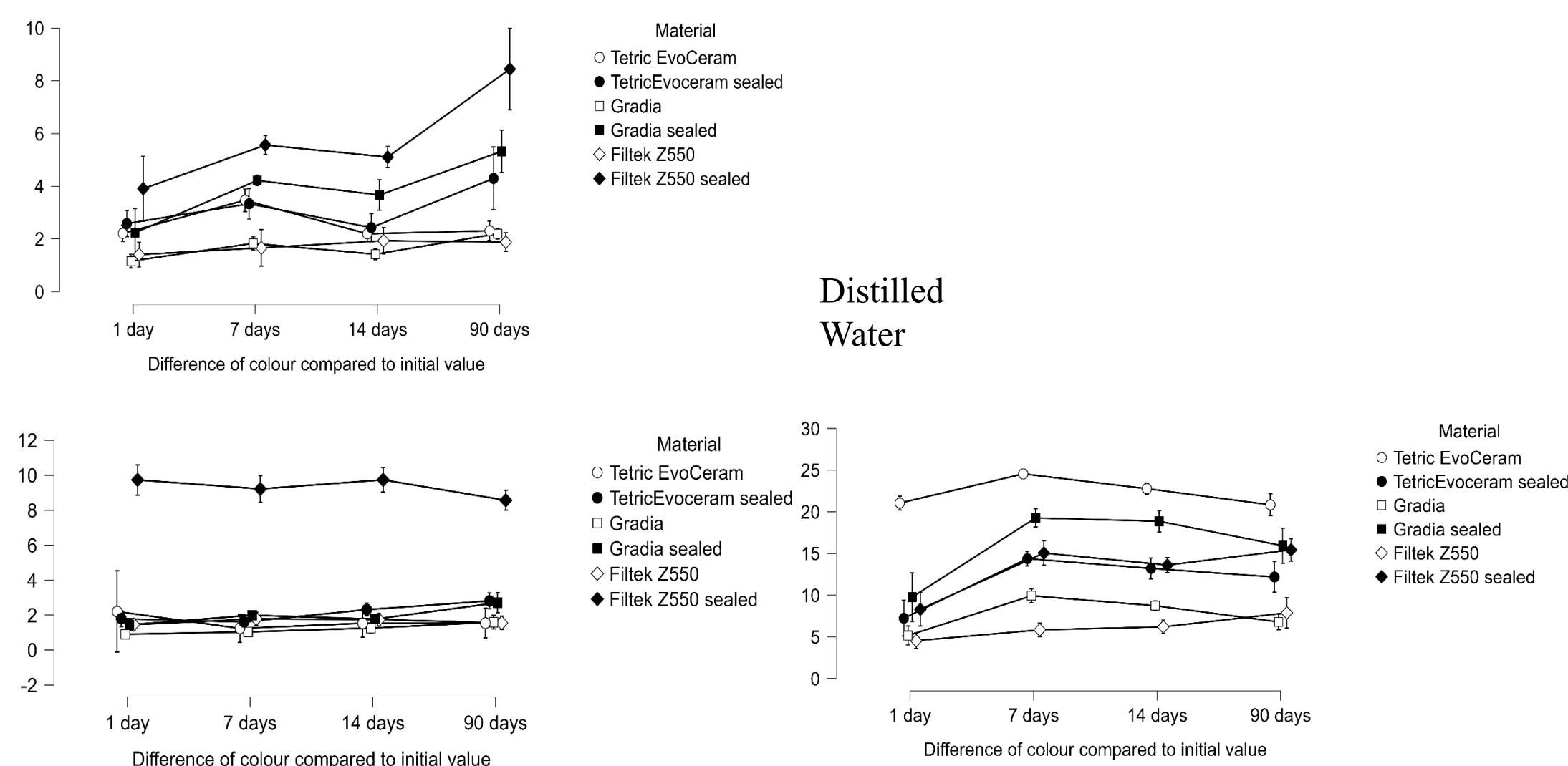
Specimens: N=180 plates (~14×10×1 mm), molded, light-cured through celluloid strips; 30 standardized finishing (grit P400→P2000+ Compo+) 30 finished+acid-etch+ Scotchbond adhesive seal, ultrasonic cleaned, divided in groups of 10 and imersed in 3 media: distilled water, Coca-Cola, red wine for 1/7/14/90 days.

Measurements: CIELab* with calibrated spectrophotometer (VITA Easyshade); ΔE^*_{ab} computed vs baseline; profilometry for Ra, Rz. ANOVA, Post-Hoc test and multilogistic regression for significant differences. Perceptibility bands defined

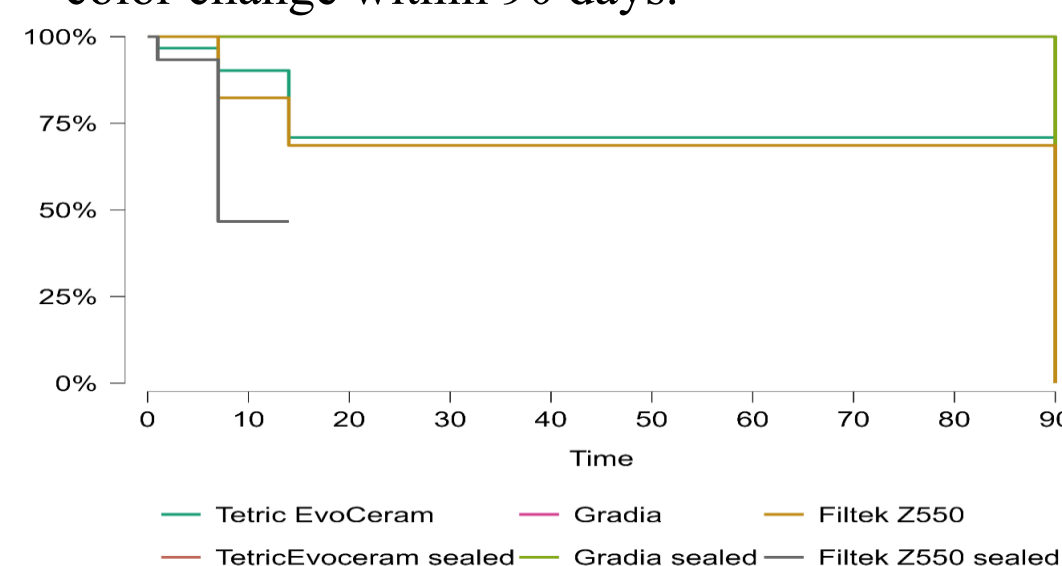


RESULTS & DISCUSSION

ΔE trajectory. Mean ΔE rose early then plateaued: 4.84 (day 1) → 6.59 (day 7) → 7.00 (day 14) → 6.80 (day 90). Significant increase up to day 14, stable thereafter. Color change (ΔE) increased over time, with discoloration becoming clearly visible and reaching a completely different shade by ΔE_4 .



Kaplan–Meier analysis showed clear differences among materials. **Sealed** composites—especially **Tetric EvoCeram**—exhibited the **highest color stability**, while **unsealed** and Filtek Z550 samples discolored earlier. Overall, sealing significantly improved resistance to perceptible color change within 90 days.



Kaplan–Meier survival curves illustrating the probability of maintaining $\Delta E \leq 2$ over 90 days, stratified by material and sealing status. Sealed composites (particularly Tetric EvoCeram sealed and Gradia sealed) maintained the highest survival, while Filtek Z550 sealed exhibited the earliest threshold crossings (median survival = 7 days).

Surface sealing generally **reduced roughness**, while **unsealed** specimens became **rougher** over time. **Long-term immersion was the main factor increasing roughness**. The **immersion medium** had only a minor effect, with few significant differences among water, wine, and Cola.

Material	Medium	0 days	1 day	7 days	14 days	90 days
Tetric EvoCeram	Water	–	–	Unsealed↑	–	–
	Cola	–	–	–	–	Unsealed↑
	Wine	–	–	–	–	Unsealed↑
Gradia	Water	–	–	Unsealed↑	–	–
	Cola	Unsealed↑	Unsealed↑	Unsealed↑	–	–
	Wine	–	Unsealed↑	–	Unsealed↑	Unsealed↑
Filtek Z550	Water	Unsealed↑	Sealed↑	–	–	–
	Cola	Unsealed↑	–	Unsealed↑	–	Unsealed↑
	Wine	Unsealed↑	–	Unsealed↑	Unsealed↑	Unsealed↑

CONCLUSION

Color stability depends mainly on material and sealing, with most color change occurring by **day 14**. **Sealed Tetric EvoCeram** and **Gradia** resisted **perceptible changes** through **90 days**. Roughness contributed little. **Cola and red wine** caused the highest discoloration, with ΔE rising sharply until day 14, then stabilizing. Surface sealing generally **reduced roughness** and improved smoothness, though its effect varied by material.

Overall, **sealing enhanced color stability** but did not completely prevent change.

FUTURE WORK / REFERENCES

Further research should include other media, polishing methods, and simulated oral conditions to better reflect clinical performance.

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