Surface Roughness of Fluoride-Releasing Resin Composites, Traditional Resin Composite, and Glass Ionomers After Simulated Toothbrushing with Different Dentifrices

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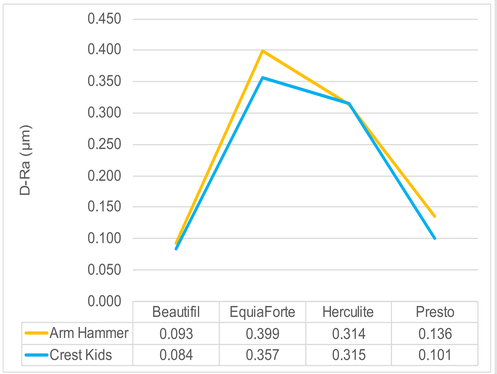
Purpose

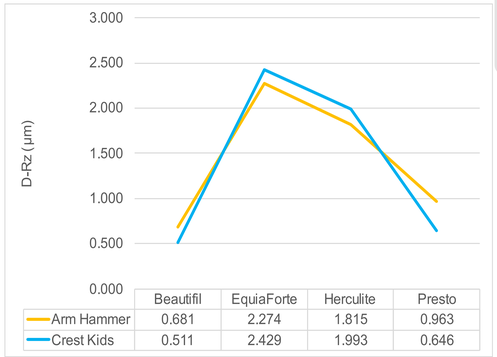
- The purpose of this study is to evaluate the changes in surface roughness of Traditional Resin Composites, Fluoride releasing Resins, and Glass Ionomer cements after toothbrushing using dentifrices with low and medium abrasive properties.

Materials and methods

- This in-vitro study evaluated the impact of mechanical toothbrushing on the surface roughness of fluoride-releasing and traditional restorative materials. A total of 64 disc-shaped specimens (10 mm diameter × 2 mm thickness) were fabricated using Beautifil Flow Plus®, EQUIA Forte™ HT Fil, Herculite XRV™, and ACTIVA™ Presto™. Each material was divided into two groups (n=8) based on the dentifrice used: Arm & Hammer® Complete Care Toothpaste (RDA 65 – low abrasivity) and Crest® Kids Toothpaste (RDA 95–105 – medium abrasivity). These dentifrices were selected based on AAPD recommendations for lower-abrasive toothpaste in children. Specimens were subjected to simulated brushing using a V8 brushing machine for 10,000 strokes to represent one year of brushing. Dentifrices were mixed with water at a 1.6:1 ratio to form a slurry, which was remixed throughout testing to prevent settling. Samples were rotated across eight brushing stations and repositioned regularly to ensure uniform abrasion. Surface roughness was measured before and after brushing using a Bruker Dektak® stylus profilometer and analyzed with MountainsMap® software according to ISO 4287 standards. Roughness parameters included Ra (average roughness), Rz (mean roughness depth), and their respective changes (ΔRa, ΔRz) post-brushing. Statistical analysis was performed using two-way ANOVA and Holm-Sidak post hoc tests (α = 0.05) via Sigma Plot to assess differences between materials and dentifrices.



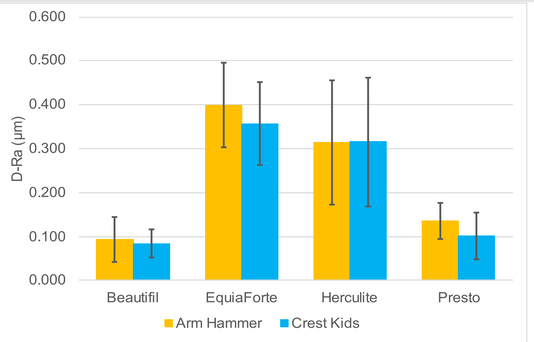
	Beautifil	EquiaForte	Herculite	Presto
Arm Hammer	0.093	0.399	0.314	0.136
Crest Kids	0.084	0.357	0.315	0.101

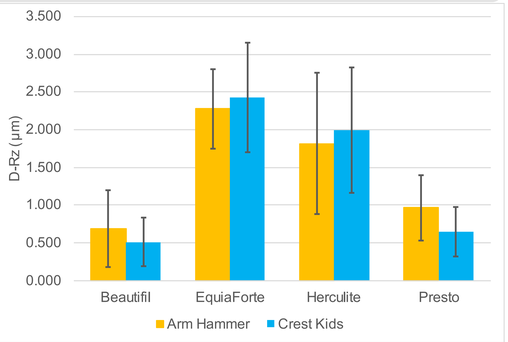


	Beautifil	EquiaForte	Herculite	Presto
Arm Hammer	0.681	2.274	1.815	0.963
Crest Kids	0.511	2.429	1.993	0.646

Results

Toothbrushing simulation revealed significant differences in surface roughness among the tested materials. EQUIA Forte™ showed the highest increase in roughness, indicating greater susceptibility to wear. Herculite XRV™ also exhibited notable roughness changes, suggesting moderate wear resistance. In contrast, Beautifil® and Presto™ demonstrated minimal surface alterations, highlighting their superior resistance to mechanical abrasion. Quantitative analysis of D-Ra values (change in average roughness) showed the highest values in EQUIA Forte™ (0.399 ± 0.097 µm) and Herculite XRV™ (0.315 ± 0.146 µm), while Beautifil® (0.084 ± 0.032 µm) and Presto™ (0.101 ± 0.053 µm) had the lowest. D-Rz values (change in peak-to-valley depth) followed a similar trend, with EQUIA Forte™ at 2.429 ± 0.729 µm and Herculite XRV™ at 1.993 ± 0.833 µm, compared to minimal changes in Beautifil® (0.511 ± 0.324 µm) and Presto™ (0.646 ± 0.327 µm). Two-way ANOVA showed statistically significant differences among materials for both D-Ra and D-Rz ($P < 0.001$), confirming that material type plays a key role in wear resistance. However, no significant interaction was found between material and dentifrice ($P = 0.895$ for D-Ra, $P = 0.600$ for D-Rz), indicating that the abrasiveness of the toothpaste had less influence than the restorative material itself. Both dentifrices—Arm & Hammer® and Crest® Kids—produced similar trends in surface changes. EQUIA Forte™ and Herculite XRV™ experienced increased roughness with both, while Beautifil® and Presto™ were largely unaffected. These findings suggest that material composition is the dominant factor in determining surface durability following mechanical toothbrushing.





Conclusion

1. Beautifil® and Presto™ demonstrated superior resistance to wear, making it a strong candidate for long-term pediatric restorations.
2. EQUIA Forte™ and Herculite™ showed significant surface roughness changes and may need additional polishing or protective treatments.
3. The differences in wear resistance underscore the importance of selecting materials based on clinical factors like roughness and wear behavior