Stain Removal and Abrasivity of Various Commercial Dentifrices in Vitro

Introduction:
In recent years, dentifrice companies have emphasized stain-removal properties in their marketing, adding various terms such as “cleaning” or “whitening” to product tradenames, while also citing product gentleness and polishing ability.

Objective:
To examine the relationship between stain-removal effectiveness and abrasivity of representative commercial dentifrices that have a variety of compositions and are marketed for cleaning, whitening, and/or polishing capabilities.

Methods:
20 commercial dentifrices, purchased through retail outlets or online, were tested against American Dental Association (ADA) calcium pyrophosphate reference standard (1.5 vs. 0.5% CMC in glycine-water).
ADA reference standard assigned value of 100 for calculating ratio to test material.

Pellicle Cleaning Ratio (PCR) (Stockey et al., J Dent Res 61:1028, 1982)
Squares (4 mm x 4 mm) cut with diamond disk and mounted with labe1 enamel exposed in clear orthodontic repair resin.
Bromine specimens stained using coffee, tea and chromogenic bacteria broth.
Baseline and final diffuse reflectance absorbance readings of tooth specimens in triplicate with Microview 55-503 spectrophotometer equipped with targeting mark.
Specimens (n=16) balanced across groups to provide statistically equivalent baseline L*a*b* values.
Treatments on V4 cross-brushing machine using dentifrice slurries (5:8 ratio with water) and ADA nylon-bristle toothbrushes at 150 gm pressure for 800 strokes.
Equation: PCR = Dentifrice sample ΔE / ADA reference sample ΔE x 100.

Specimen (n=8) placed in neutral flux under controlled ADA conditions.
Specimens mounted in dental acrylic blocks to fit in V4 cross-brushing machine.
Specimens preconditioned for 1500 strokes with ADA reference standard.
Treatments on V4 cross-brushing machine using dentifrice slurries (5:8 ratio with water) and ADA nylon-bristle toothbrushes at 150 gm pressure for 1500 strokes.
Delta values (μm) assigned a 0-100 scale that provided an equivalent, mixed and immediately placed in sonication counter and counts per minute (cpm) determined.
Equation: RDA = cpm of test sample + cpm of reference standard x 100.

Cleaning Efficiency Index (CEI) (Schmahorn et al., J Dent Res 71:559, 1992)
Equation: CEI = RDA / (PCR - 50) / RDA

Results:
All dentifrices removed extrinsic stain and produced some dentin abrasion, but scores ranged widely (from 25 to 138 for PCR and from 36 to 268 for RDA). The majority contained hydrated silicas, and those with high PCR scores often, but not always, had higher RDA values. Products containing other abrasives (e.g. dicalcium phosphate, sodium bicarbonate, and calcium carbonate) generally had lower RDA values and usually lower PCR values. There were exceptions (e.g. refined kaolin) that had high PCR values and low RDA values. The Cleaning Efficiency Index indicated that other ingredients (e.g. peroxides) also affect stain removal.

Conclusions:
Stain-removal ability and abrasivity of dentifrices, especially those containing silicas, were highly variable, and the relationship between these two factors was not necessarily direct. With some exceptions, dentifrices marketed as “whitening” products were more abrasive than other products.