Assessment of Plaque Removal Comparing Examiners and Digital Analysis

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ABSTRACT

Objective: To compare plaque removal determined from digital images captured before and after brushing with Blend-a-med Pro-Expert Gums Protection (GP) and Elmex Anti-Caries (EAC) in a crossover design using examiners grading with the modified Quigley-Hein (mQH) index to Digital Plaque Image Analysis (DPIA).

Method: In a 5-day double-blind, 2-treatment, 3-period crossover plaque study incorporating lingual-only brushing comparing GP with EAC, images were recorded before and after a final brushing of 40 s on all dental surfaces. These white light images of subjects' erythrosine disclosed plaque on anterior facial dentition were transferred into software for examiner plaque grading. Three experienced plaque examiners independently assessed the images using the mQH index blinded to treatment identity and in a randomised order. DPIA was also used to measure plaque area coverage of the tooth surfaces. Mean plaque removal for the two toothpastes was compared for each of the 3 examiners and for DPIA using general linear mixed modelling. **Results:** Thirty-one subjects participated in the research. For each examiner and for DPIA, results demonstrated that the mean plaque removal from a single brushing for GP was significantly ($p<0.0005$) greater than EAC. Amongst the 3 examiners mean plaque removal ranged from 0.98 to 1.13 for GP compared to 0.48 to 0.62 for EAC. For DPIA, mean plaque removal was 7.44% tooth area coverage for GP relative to 4.01% for EAC. The ratios of plaque removal between GP and EAC were 2.04, 2.11 and 1.82 for the 3 examiners and 1.86 for the DPIA method, **Conclusion:** The 1.82-2.11 times greater plaque removal observed for GP compared to EAC provided a suitable dynamic range to demonstrate the consistency of 3 mQH examiners and DPIA. This further suggests that categorical plaque grading scales may be employed either remotely and/or retrospectively from digital images.

INTRODUCTION

Examiner assessment of disclosed plaque has been used extensively to measure performance of oral care products in plaque removal and prevention. A restriction on the use of examiner assessment however, is the need for the examiner(s) to be physically present to examine the teeth of each of the subjects being studied. This may pose logistical and financial obstacles particularly when multiple examiners are required. Additionally, retrospective assessment is not possible using examiner assessment.

The principal objective of this study was to investigate the reliability of remote examiner assessment of images obtained from before and after brushing with two treatments via both intra-examiner comparison and comparison to the established digital plaque image analysis (DPIA) method. The two treatments involved brushing with toothpastes found to have different abilities to remove plaque: Blend-a-Med Pro-Expert Gums Protection and Elmex Anti-Caries.

MATERIALS AND METHODS

Thirty-six subjects were randomly assigned to sequence in a double-blind, 2-treatment, 3-period cross-over plaque removal study. In each period of 5 days subjects brushed lingual surfaces only with assigned toothpaste followed by rinsing with a slurry of the assigned toothpaste. Treatments involved brushing with either Blend-a-Med Pro-Expert Gums Protection toothpaste or brushing with Elmex Anti-Caries both used with a Oral-B P35 Indicator medium toothbrush. Images were recorded using the Digital Plaque Image Analysis technique described in previous research.

Image analysis

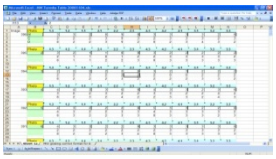
Three plaque examiners, experienced in use of the modified Quigley-Hein scale, graded digital images of erythrosine disclosed plaque on anterior dentition through specially developed software. The software (illustrated below) allowed the examiners, with recorders, to grade the digital images displayed in randomized order blind to subject and treatment identity. Digital Images were also analysed by the standardized plaque area algorithm described in previous research.

Statistics

Separately for each examiner grading of plaque images and for DPIA, the change in plaque levels between the Day 5 pre-brush and post-brush images was analyzed using analysis of variance (ANOVA) for crossover studies. The general linear mixed model included subject as a random effects and period, treatment and the Day 5 pre-brush plaque level as fixed effects. Statistical comparisons were two-sided with a significance level of 0.05.

Test Products

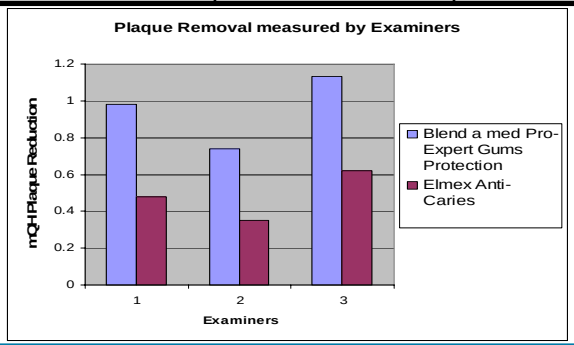
Viewing screen

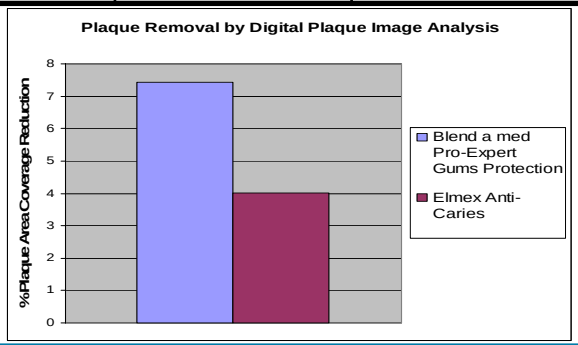


Recording screen

RESULTS

Comparison between Examiner Graded Plaque Removal and DPIA Plaque Removal as reduction in Tooth Surface Area Coverage				
Treatment	**Examiner 1 Adjusted mean mQH removal score (SE)**	**Examiner 2 Adjusted mean mQH removal score (SE)**	**Examiner 3 Adjusted mean mQH removal score (SE)**	**Adjusted Mean % Tooth surface area coverage reduction from DPIA (SE)**
GP	0.98 (0.091)	0.74 (0.104)	1.13 (0.111)	7.44 (0.901)
EAC	0.48 (0.093)	0.35 (0.108)	0.62 (0.114)	4.01 (0.928)
2-Sided P-value	<0.0001	0.0004	<0.0001	0.0002
Ratio of GP:EAC	2.04	2.11	1.82	1.86





CONCLUSIONS

- **Examiner assessment of disclosed plaque from digital images was successfully employed to reproducibly measure differences in plaque removal performance**
- **Brushing with Blend-a-Med Pro-Expert Gums Protection resulted in significantly greater plaque removal than with Elmex Anti-Caries, plaque removal ratio of GP:EAC ranging from 1.82-2.04**

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