2052 Laboratory Interproximal Access Efficacy of Three Manual Toothbrushes

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Introduction

Since 1983, a primary in-vitro method used in our laboratory assesses the ability of toothbrush bristles to penetrate between simulated teeth, i.e. interproximal access efficacy (IAE), during the tooth brushing procedure[1, 2]. Both vertical and horizontal brushing motions are evaluated on simulated anterior and posterior tooth shapes. These values are then combined to determine overall efficacy of the toothbrush products evaluated. Overall efficacy in the IAE assay[1-8] has been correlated with clinical plaque removal. [3, 4, 9-14]
The purpose of this study was to evaluate three toothbrush products, the Dr Best Zwischenzahn, Oral-B ® CrossAction, and the Oral-B® Indicator toothbrushes, for efficacy in the IAE procedure.

Methods

Three toothbrush products, Dr Best Zwischenzahn, Oral-B ® CrossAction 40 medium texture, and Oral-B ® Indicator medium texture, were evaluated in this study. All toothbrushes were provided by GlaxoSmithKline Consumer Healthcare GmbH & Co. KG, Buehl, Germany. Six toothbrushes from each product group were tested four times for a total of twenty four tests on each toothbrush design. Toothbrushes were stored in the laboratory at a temperature of 67-70 °F for more than 48 hours before testing. The laboratory equipment used was fabricated to the design of Nygaard Ostby, Edvardsen and Spydevold. The tooth brushing technique involved independent evaluations of each toothbrush in a vertical and horizontal brushing motion, tooth shapes simulating anterior and posterior teeth and a brushing weight of 250 g. The brushing apparatus was set to brush 15 seconds at two strokes per second with a 50-mm stroke. The maximum width of the artificial plaque removed (Interproximal Access Efficacy, IAE) was recorded in cm using vernier calipers. The same examiner performed all evaluations. The analysis of variance (ANOVA) was performed on the mean scores for each of the toothbrush products. Significant differences between the toothbrushes were identified using two-sample t-tests.

Figure 1 + 2 Side and facial view of the tested toothbrushes

Objectives

A primary method used in the laboratory assesses the ability of toothbrush bristles to penetrate between simulated teeth and remove artificial plaque, i.e. interproximal access efficacy (IAE), during the tooth brushing procedure. Both vertical and horizontal brushing motions are evaluated on simulated anterior and posterior tooth shapes. The results are then combined to determine overall efficacy of the toothbrush products evaluated. Overall efficacy in the IAE assay has been correlated with clinical plaque removal. The purpose of this study was to evaluate three toothbrush products, Dr Best Zwischenzahn, Oral-B ® CrossAction, and Oral-B ® Indicator, for efficacy in the IAE procedure.

Results

Interproximal access efficacy on anterior or posterior shaped teeth with horizontal brushing is shown in Table I. The mean IAE is significantly ($p < 0.001$) higher for the Dr Best Zwischenzahn toothbrush than for the Oral-B® CrossAction and Oral-B® Indicator toothbrush products The Oral-B® CrossAction is superior ($p < 0.01$) to the Oral-B® Indicator on anterior tooth shapes. On posterior teeth, there is no significant difference ($p > 0.05$) in the IAE mean values for the Oral-B® products tested.

Table I Interproximal access efficacy on anterior or posterior shaped teeth with horizontal brushing

Tooth Shape	Dr Best Z	Oral-B® CrossAction	Oral-B ® Indicator
		Mean (SD) [cm]	
Anterior	1.21 (0.06)	0.89 (0.06)	0.67 (0.07)
Posterior	1.29 (0.10)	0.99 (0.10)	1.03 (0.10)

Interproximal access efficacy on anterior or posterior shaped teeth with vertical brushing is shown in Table II. On both anterior and posterior tooth shapes with vertical brushing, the mean IAE is significantly higher ($p < 0.001$) for the Dr Best Zwischenzahn product than for the Oral-B® CrossAction and Oral-B® Indicator toothbrushes. The Oral-B® CrossAction is superior ($p < 0.01$) to the Oral-B® Indicator on anterior tooth shapes, whereas the Oral-B Indicator is superior ($p < 0.001$) to the Oral-B® CrossAction on posterior tooth shapes.

Table II Interproximal access efficacy on anterior or posterior shaped teeth with vertical brushing

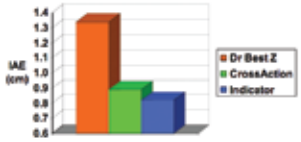
Tooth Shape	Dr Best Z	Oral-B® CrossAction	Oral-B® Indicator
		Mean (SD) [cm]	
Anterior	1.35 (0.05)	0.84 (0.08)	0.78 (0.06)
Posterior	1.50 (0.02)	0.99 (0.04)	1.03 (0.04)

Overall means combining all brushing motions and teeth shapes are shown in Table III and Figure 1. Overall means combining all brushing motions and teeth shapes are shown in Table I and Figure 1. The overall IAE mean for the SILKY product is statistically ($p < 0.001$) higher than the overall mean values for the Oral-B® CrossAction and the Oral-B® 35 toothbrushes. Overall, the Oral-B® CrossAction product is superior to the Oral-B® Indicator product ($p < 0.001$).

Table III Overall interproximal access efficacy

	Dr Best Z	Oral-B® CrossAction	Oral-B® 35 Indicator
Mean (SD)	1.34 (0.12)	0. 89 (0.10)	0.82 (0.16)

Figure 3 Overall interproximal access efficacy



Conclusions

In all of the IAE assays conducted, the Dr Best Zwischenzahn toothbrush is significantly superior ($p < 0.001$) to the Oral-B® CrossAction and Oral-B® Indicator. The Dr Best Zwischenzahn toothbrush is predicted to be more effective for clinical interproximal plaque removal than the Oral-B® products tested.

References

1. Nygaard Ostby P, Edvardsen S ,Spydevold B: Access to interproximal tooth surfaces by different bristle designs and stiffnesses of toothbrushes. Scand J Dent Res 7: 424 430, 1979.
2. Yankell SL, Nygaard-Ostby P: Evaluating cleaning efficiency of different toothbrush designs and textures. J Soc Cosmet Chem 34:151-157, 1983.
3. Yankell SL, Green PA, Greco PM, Stoller NH, Miller MF: Test procedures and scoring criteria to evaluate toothbrush effectiveness. Clin Prev Dent 6: 3-8, 1984.
4. Volpe AR, Emling RC, Yankell SL: The toothbrush a new dimension in design, engineering and clinical evaluation. J Clin Dent 3:C29 C33, 1992.
5. Yankell SL, Shi X, Emling RC: Comparative laboratory evaluations of two toothbrushes regarding interproximal access efficacy. J Clin Dent 4: D1-D4, 1993
6. Battista GW, Petrone DM: Comparison of the laboratory interproximal access efficacy of the Colgate Precision toothbrush and the Crest Complete toothbrush. J Clin Dent 4: D5-D7, 1993.
7. Yankell SL, Shi X, Emling RC, Blatz B, Biesbrock AR: Laboratory evaluations of two battery-powered toothbrushes and a manual toothbrush for efficacy and safety. J Clin Dent 13:187-190, 2002.
8. Yankell SL, Shi X, Emling RC: Laboratory evaluations of two toothbrushes for removal of artificial plaque above, around and below the gingival margin. J Clin Dent 14: 19-22, 2003.
9. Balanyk TE, Shamma NC, Galustians J: A clinical study of comparative plaque removal performance of two manual toothbrushes. J Clin Dent 4: D8-D12, 1993.
10. Singh SM, Deasy MJ: Clinical plaque removal performance of two manual toothbrushes. J Clin Dent 4: D13-D16, 1993.
11. Haun J, Williams K, Friesen L, Ferrante A, Walters PA, Bartizek RD, Biesbrock AR: Plaque removal efficacy of a new experimental battery-powered toothbrush relative to two advanced-design manual toothbrushes. J Clin Dent 13:191-197, 2002.
12. Biesbrock AR, Walters PA, Bartizek RD: The relative effectiveness of six powered toothbrushes for dental plaque removal. J Clin Dent 13:198-202, 2002.
13. Dorfer CE, von Bethlenfalvy ER, Hugel B, Pioch T: Cleaning efficacy of a manual toothbrush with tapered filaments. Oral Health Prev Dent 1:111-118, 2003
14. Sagen-Cohen HD, Vered Y: A clinical trial of the Meridol toothbrush with conical filaments: evaluation of clinical effectiveness and subjective satisfaction. J Clin Dent 16: 109-113, 2005.

Acknowledgements

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