

# In Vitro Interproximal Access Efficacy Comparison of Four Different Toothbrushes

D.W. Volpenhein<sup>1</sup>, M.A.A. De Bruyne<sup>2</sup>, L.C. Marten<sup>2</sup>, R.M.H. Verbeek<sup>2</sup>

<sup>1</sup>Procter & Gamble Co., Mason, OH, USA; <sup>2</sup>University of Gent, Belgium

## SUMMARY SENTENCE

An *in vitro* study of a "new wave" profile manual toothbrush with raised perimeter bristles showed superior interproximal penetration relative to two popular flat profile brushes marketed in Belgium.

## BACKGROUND

Mechanical scrubbing of the tooth surface via the action of toothbrush bristles is essential for the removal of plaque. However, effective plaque removal interproximally can be difficult with traditional "flat profile" manual toothbrushes. Manufacturers have been striving to develop improved bristle tuft designs to facilitate better plaque removal in these hard to reach areas. One such toothbrush has recently been developed which utilizes a "wave profile" bristle pattern and raised bristles on the perimeter of the brush head.

This new "wave profile" brush was evaluated by Dr. de Bruyne in an *in vitro* penetration model relative to two flat profile brushes sold in Belgium, as well as an existing "wave profile" brush that does not have the raised perimeter bristles. The *in vitro* model was developed by Volpenhein (1994, *J Clin Dent*) to measure the interproximal penetration effectiveness of various toothbrush bristle designs.

## PRODUCTS TESTED

The new "wave profile" brush (blend-a-dent<sup>®</sup> Professional) was tested relative to another "wave profile" or rippled brush, blend-a-dent<sup>®</sup> Complete, which has been commercially available for a number of years. Two flat profile brushes sold in Belgium, Sensodyne<sup>®</sup> and Oral B<sup>®</sup>, were also tested. Overall interproximal penetration was measured.

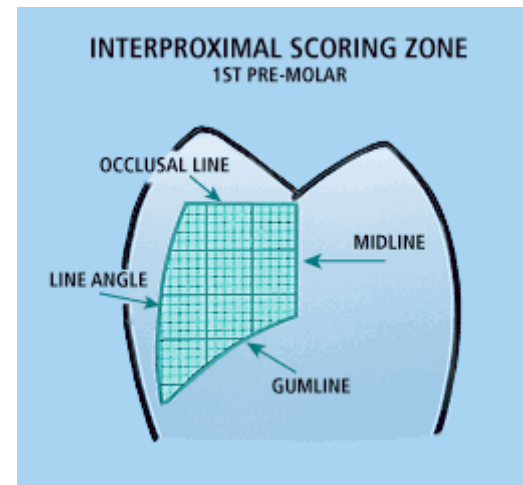
## PROTOCOL

Tooth numbers 12, 13, 14 and 15 from the maxillary left quadrant of a Columbia Dentofrom (Model #R861) were coated with artificial plaque solution, then placed in the dentofrom, which was secured to a brushing machine.

The brushes were wetted and fastened to the brushing arm of the machine at the desired angle. Teeth were wetted with 0.1 ml of water, brushed for 10 seconds, rinsed with 5 ml of water, then allowed to dry. The teeth were removed from the dentofrom, and each of the six interproximal surfaces (mesial of the second molar-tooth #15, distal and mesial of the first molar-#14, distal and mesial of the second premolar-#13, and distal of the first premolar-#12) was evaluated. *In vitro* penetration was measured using four different brush strokes (back-and-forth at 45° and 90°, and up-and-down and circular at 90°).

A Windows-based image analysis system (Optimas) was used to measure bristle penetration on the interproximal surfaces. Each tooth was secured in a holder for consistent repositioning and an image of the appropriate surface was captured. Macros were created to calibrate, generate masks, and acquire and store measurement areas. Masks are areas of interest within which the analysis occurs for each image. The area of interest for each interproximal surface was defined as the area bordered by the gumline, the line-angle, the occlusal surface and the midline of the tooth (Figure 1). Contrast between areas with and without stain was used to quantify the degree of penetration/cleaning. This was done both for the overall interproximal area, as well as for a 1 mm wide band above the interproximal gumline. Results are based on the average interproximal area penetrated for the six interproximal surfaces (tested with each of the four brush strokes). A two-way ANOVA and Neuman-Keuls Multiple Range Test were used to determine significant differences among the brushes.

Figure 1: Area of Interest



RESULTS\* Overall Interproximal Penetration (sq. in. X 10<sup>-4</sup>)

Stroke	blend-a-dent Professional	blend-a-dent Complete	Sensodyne	Oral-B
back-and-forth 90°	68	63	58	28
vertical 90°	137	124	101	77
circular 90°	134	119	113	91
back-and-forth 45°	104	105	92	70
<b>Average</b>	<b>111</b>	<b>103</b>	<b>91</b>	<b>70</b>

A two-way ANOVA and Neuman-Keuls' Multiple range test at the 95% confidence level, gives the following rankings: blend-a-dent Professional = blend-a-dent Complete > Sensodyne > Oral-B

Figure 2: Blend-a-dent<sup>®</sup> Professional



Figure 3: Oral B<sup>®</sup>



#### CONCLUSION

This testing shows that the rippled, or "wave profile" design of the blend-a-dent<sup>®</sup> brushes provides significantly greater interproximal penetration relative to flat profile toothbrushes. This greater ability to penetrate interproximally should translate to better interproximal cleaning for the blend-a-dent<sup>®</sup> toothbrushes relative to flat profile brushes.