

# **A double-blind trial comparing the plaque removal ability of a bamboo toothbrush and a plastic toothbrush**

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## **Abstract**

A randomised controlled trial was carried out to see if a new-to-market bamboo toothbrush (*Bamboo Buddy Adult Toothbrush*) has the same ability to reduce plaque scores as an established plastic toothbrush (*Colgate 360 Soft Toothbrush*). A sample size of 100 patients seen in private practice ranging in age from 9 years to 77 years were used. All were instructed not to brush their teeth for exactly 24 hours before attending their appointment. Baseline plaque scores were taken on sites 16 and 31 using a modified Quigley & Hein Index. A toothbrush was assigned, and the participant was asked to brush for 1 minute. After 1 minute, plaque scores were retaken. The results showed there was no significant difference between the change in plaque scores at either site. Thus, this study shows that this bamboo toothbrush can clean teeth as effectively as a plastic toothbrush. The public should have confidence therefore that the environmental benefits of bamboo toothbrushes are not at the compromise of their oral hygiene.

## **Introduction**

There is an increasing movement across the world to see a reduction in carbon emissions and reliance upon single-use plastic items; and a general movement towards sustainability<sup>1,2</sup>. It is estimated that over 4.7 billion toothbrushes are produced each year and these taken between 700-1000 years to decompose. More organisations and individuals are both actively and subconsciously undertaking life cycle assessments (LCA) is used to measure the environmental impact of different services or products.<sup>3,4</sup> Also referred to as a cradle-to-grave analysis, LCA considers all aspects of a product along its life cycle, including raw materials, manufacture, use, transport and disposal. With this in mind, the market for sustainable health (including oral health) products have increased significantly over the last decade. The increased supply and demand for bamboo products is evident in shelves of supermarkets and stores across the western world. One such product are toothbrushes. A belief held by many members of the public are that bamboo toothbrushes are more akin to a one-time use product and cannot stay the 3-month expected lifetime of a normal plastic toothbrush. Another belief is that they cannot clean teeth as well as a traditional plastic manual toothbrush. There is a lack of research in this space to give consumers the information they require in the efficacy of these toothbrushes. So, this study has been designed to compare the plaque removal ability of a bamboo toothbrush against a plastic toothbrush.

## **Materials and Methods**

The study was carried out at All Saints Dental Group, which is a private practice located in WA, Australia between November 2020 and February 2021. Fifty (50) new adult bamboo toothbrushes (Bamboo Buddy, Kaderis Pty Ltd; see figures 5 & 7) and 50 new Colgate 360 Soft Toothbrushes (Colgate-Palmolive; see figures 6 & 8) were individually placed into a sealed opaque envelope and shuffled in a large box.

The reception staff were asked to identify 100 patients from the age of 9 upwards, who were already booked in for an examination and clean with the researcher. For inclusion into the study, their charts

and history were checked to ensure that they had the 16 (upper right first permanent molar) and 31 (lower left first incisor) teeth present; and that they had not attended the practice for any scaling in the 3 months prior (item codes 114/115/222 (16) 222 (31)) under the Australian Dental Association codes). These patients were contacted by telephone and instructed not to brush their teeth for 24 hours prior to attended the practice. The rationale of this was to ensure that they had a reasonable baseline of plaque present on their teeth. They did not have to be the same, as we measuring the change in plaque score. On arrival to the practice, the patients were given a disclosing tablet to chew upon a single plaque disclosing tablet (CareDent Disclosing Tablets) and then spit out. The plaque scores were calculated using the Turesky et al. modification<sup>5</sup> of the Quigley and Hein<sup>6</sup> plaque index (Figure 1). An example of what this looks like with scores below the teeth are shown in figure 2.<sup>7</sup> The plaque score was only recorded on buccal surface of teeth 16 and 31. Only whole numbers (discrete) values were recorded.

SCORE	CRITERIA
0	No plaque
1	Separate flecks of plaque at the cervical margin of the tooth
2	A thin continuous band of plaque at the cervical margin of the tooth
3	A band of plaque wider then 1mm covering less than 1/3rd of the crown of the tooth
4	Plaque covering at least 1/3rd but less then 2/3rd of the crown of the tooth
5	Plaque covering 2/3 <sup>rd</sup> or more of the crown of the tooth

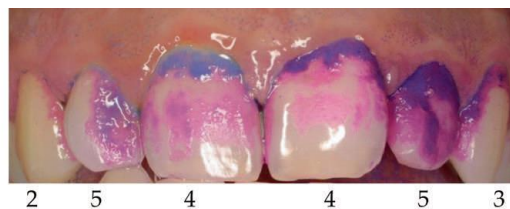


Figure 1

Figure 2

The patient was then given a sealed bag at random. They were sent to another room that was not visible to the researcher. Instruction was given to brush with that toothbrush with a pea-sized amount of supplied Colgate Total Toothpaste for exactly 1 minute without the aide of a mirror. After 1 minute, they were told to put the brush in the bag and return immediately back to the researcher's room to have the plaque score re-tested. After the second score was recorded, the type of toothbrush used was revealed to the researcher and this was recorded.

The data was tabulated and analysed using a two-tailed T-test on Microsoft Excel; to establish if there was any significant difference in the performance of the two toothbrushes at both sites.

## Results

The null hypothesis was that there should be no significant difference between the change in plaque score with Toothbrush 1 (TB1= Bamboo Toothbrush) and Toothbrush 2 (TB2 =Plastic Toothbrush) at either site.

Figure 3: Comparison of Toothbrush Site 16

	<i>TB1 Site 16</i>	<i>TB2 Site 16</i>
<b>Mean change in plaque score</b>	<b>-1.94</b>	<b>-2.04</b>
Variance	1.363673	1.426939
<b>SD</b>	<b>1.167764</b>	<b>1.194545</b>
Observations	50	50
Pooled Variance	1.395306	
Hypothesized Mean Difference	0	
<b>P(T&lt;=t) two-tail</b>	<b>0.673013</b>	

Figure 4: Comparison of Site 31

	<i>TB1 Site 31</i>	<i>TB2 Site 31</i>
<b>Mean change in plaque score</b>	<b>-2.04</b>	<b>-2.12</b>
Variance	0.651429	1.005714
<b>SD</b>	<b>0.807111</b>	<b>1.002853</b>
Observations	50	50
Pooled Variance	0.828571	
Hypothesized Mean Difference	0	
<b>P(T&lt;=t) two-tail</b>	<b>0.661314</b>	

The P value is >0.05 at both site 16 (figure 3) and site 31 (figure 4), so the null hypothesis can be accepted.

### Discussion

The objective of this study was to look at two manual toothbrushes and determine if a new-to-market bamboo toothbrush was as effective as a current established plastic toothbrush at plaque removal.

The two sites chosen were the 16 and 31 (that is the upper right first molar and lower left first incisor). The rationale for this was to measure the plaque removal ability on both an anterior tooth and a posterior tooth in both the maxillae and the mandible. These two teeth are also the earliest teeth that appear in the permanent dentition, so that allowed the age range of the sample to be maximised. Ideally, more tooth sites could have been used, but due to time constraints of the environment in which we were working, this was not feasible.

The Modified Quigley & Hein scale used had the generated discrete data rather than continuous. This meant that a change of 5 to 3 was of the same weighting as 3 to 1. There was a (albeit very tiny-and would be due to researcher error if it did occur) chance that the score could go up, hence why a two-tailed analysis was performed. If percentage of plaque covering the surface was used instead, it would be more accurate in determining actual change. This could have been done by disclosing, taking photographs of the teeth and using a program/matrix overlay to determine plaque levels. This could and should be considered for future studies.

The closer the P value is to 0.5, the higher to confidence we can have that the results from the two samples are similar. The P value for both tooth sites was around 0.6 and that the similarity of the samples is due to the similar performance of the toothbrushes.

Bamboo toothbrushes are made from natural bamboo that has been dried, shaped and then bristles added to it. Plastic toothbrushes are made from multiple oil-based hydrocarbon plastics. The increased interest in bamboo products in recent times has been driven by a worldwide increase in desirability to reduce our reliance on fossil fuels and use more sustainable produce.

The bristles on this particular bamboo toothbrush (Bamboo Buddy, Kaderis Pty Ltd) are nylon and so are not biodegradable. The disposal instructions state to remove the bristles first with a pair of pliers, then the handle can be composted. This represents a 95% reduction in non-biodegradable plastics compared with the plastic toothbrush; which has no biodegradable features. Many new products (both dental and non-dental) made of Corn-starch PLA or bioplastics. Caution should be given to these products; which although are produced from plant oils, are not very recyclable across the world at the moment. And these certainly do not biodegrade as rapidly as a bamboo handle.

A move towards fully natural and biodegradable bristle is virtuous, but not currently feasible. The rounded profile of these filaments combined with the inability to withstand vigorous wet/dry/friction forces associated with brushing teeth, means that they are not able to perform consistently over a typical 3-month life span that one would expect. (That is approximately twice a day x 90 days x 2 minutes = 6 hours of use). Further research should be done to assess the long term performance of these toothbrushes and other biodegradable oral health products.

This research shows that the public should have confidence in the performance that this bamboo toothbrush.

*Disclosure: The author of this paper has an interest in Bamboo Buddy and funded the study. However, they were blinded to any knowledge of what toothbrush was used until after the second plaque score was taken such to remove any biasing effect.*

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Figure 5: Bamboo Toothbrush packaging



Figure 6: Plastic Toothbrush packaging



Figure 7: Bamboo Toothbrush



Figure 8: Plastic Toothbrush

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