

# Ionic vs Manual Toothbrushes: Effect on Plaque and Oral Hygiene Status in Children

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## ABSTRACT

**Introduction:** The foundation for healthy permanent teeth in children and teenagers is laid during the first few years of life. Toothbrushing should be presented as a habit. A wide array of toothbrushes is available in the market, which differ in size, design, length, hardness, arrangement of bristles. This present clinical study is undertaken to evaluate the effectiveness of ionic toothbrush on oral hygiene status and plaque removal.

**Materials and methods:** A total of 30 children aged 6 years to 12 years were selected in this study. The children were divided into two groups, 15 children were given HyG ionic toothbrush, were instructed how to use product according to manufacturer's instructions, 15 children were assigned to use manual toothbrush, instructed to brush their teeth in usual manner. All subjects used the same commercially available dentifrice throughout the study.

**Results:** The results were evaluated at each visit day 0, day 15 and day 30 following 12–18 hours of no oral hygiene. The subjects brushed their teeth twice daily for 1 minute under supervision. The result showed that there was significant difference in all the mean values in all the parameters. It may be concluded from the present study that though the ionic toothbrush was insignificantly superior to the manual toothbrush, both the toothbrushes are clinically effective in removing plaque and improving the gingival conditions.

**Keywords:** Children, Ionic toothbrush, Oral hygiene status, Toothbrushing.

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## INTRODUCTION

Health is a universal human need for all cultural groups. Oral health is essential to general health and quality of life. It is a state of being free from mouth and facial pain, oral and throat cancer, oral infection and sores, periodontal (gum) disease, tooth decay, tooth loss, and other diseases and disorders that limit an individual's capacity in biting, chewing, smiling, speaking, and psychosocial well-being. General health cannot be attained or maintained without oral health. The mouth is regarded as the mirror of the body and the gateway to good health.<sup>1</sup>

The foundation for healthy permanent teeth in children and teenagers is laid during the first few years of life. It is essential to establish a proper oral hygiene routine early in life to ensure the development of strong and healthy teeth. Younger children, in particular, may have difficulties with motivation and dexterity. Parents, as consistent role models, are key for setting a daily routine and to make their children understand the importance of oral hygiene. Toothbrushing should be presented as a habit.<sup>2</sup> MacGregor and Rugg-Gunn, however, reported that the average time spent brushing by unsupervised 13-year-olds was only 1 minute. In another study, they reported that unsupervised 5-year-old children spent an average of 58 seconds brushing, with only 5% of that time spent on brushing the lingual surfaces of their dentition.<sup>3</sup>

Up to now, the toothbrush still remains the most efficient of all cleaning devices. A wide array of toothbrushes is available in the market, which differ in size, design, length, hardness, arrangement of bristles; however, an ideal toothbrush is the one that efficiently eliminates microbial plaque.<sup>4</sup> Studies have demonstrated that under control conditions and accurate supervision, well-trained individuals were able to remove all the visible plaque, but the majorities of the subjects usually fail to do so.<sup>5</sup>

Ionic toothbrush works on the principle of polarity that every element in nature has a positive or negative charge.<sup>6</sup> So far,

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only few studies have been undertaken to assess the efficiency of ionic toothbrush and have revealed inconsistent results.<sup>7</sup> Hence, this present clinical study is undertaken to evaluate the effectiveness of ionic toothbrush on oral hygiene status and plaque removal.

## MATERIALS AND METHODS

A total of 30 children aged 6–12 years were selected into a single-blinded, randomized, parallel design study. The criteria for selection includes good general health, willingness to abstain from all other oral hygiene procedures, no current active orthodontic treatment, grossly carious teeth, oral lesions, patient on antibiotics, or

underwent oral prophylaxis one month prior to the study and those with any physical limiting manual dexterity.

Oral hard and soft tissues were evaluated at baseline. Any change in color, texture, soft tissue abrasion, and any irregularities were recorded. The oral hygiene status was assessed using oral hygiene index simplified to evaluate debris and calculus. Plaque was assessed using the Turesky modification of Quigley–Hein plaque index. Plaque was assessed on or at the gingival margin of the buccal and lingual surfaces of all the fully erupted permanent and primary teeth. Dental disclosing solution was to disclose the plaque.

Selected children were abstained from all oral hygiene for the previous 12–18 hours. The children were divided into two groups. 30 children were given HyG ionic toothbrush and were instructed how to use the product according to the manufacturer’s instructions. 30 children were assigned to use manual toothbrush and instructed to brush their teeth in usual manner. All subjects used the same commercially available dentifrice throughout the study.

The results were evaluated at each visit day 0, day 15, and day 30 following 12–18 hours of no oral hygiene. The subjects brushed their teeth twice daily for 1 minute under supervision using the assigned toothbrushes and toothpaste. Parents were instructed to monitor toothbrushing and no oral hygiene period and encourage compliance.

**Statistical Analysis**

The software used for the statistical analysis was SPSS (Statistical Package for Social Sciences) version 21.0 and Epi-info version 3.0.

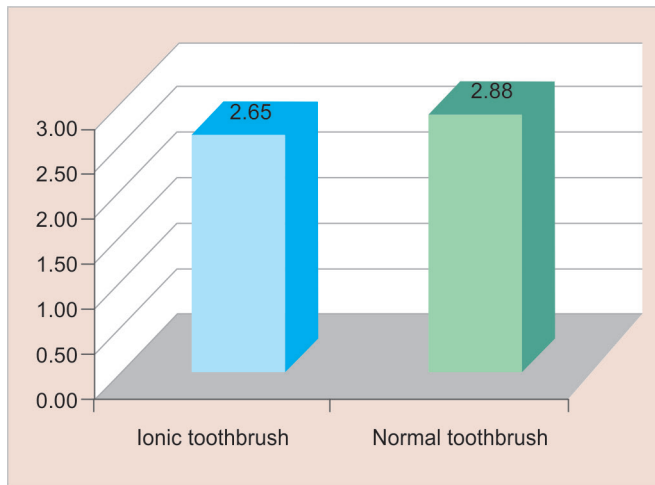
The Shapiro–Wilk test was used for testing the normality of the data (uniformity of the distribution of the data). The statistical tests used were: unpaired or independent *t* test is used for comparison of mean value between 2 groups when the data follow normal distribution. Repeated measures ANOVA (analysis of variance) test was used for comparison of more than 2 mean values obtained from a same group or a obtained from the same sample when the data follow normal distribution. The *p* value was taken significant when less than 0.05 ( $p < 0.05$ ) and confidence interval of 95% was taken.

**RESULTS**

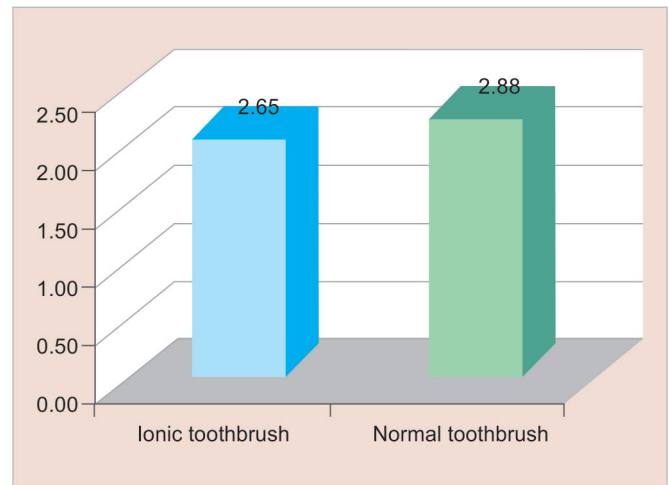
The mean OHI-S at baseline was compared between ionic toothbrush and normal toothbrush using the unpaired *t* test. There was no significant difference in the mean OHI-S at baseline between ionic toothbrush and normal toothbrush (Table 1, Fig. 1)

The mean plaque index at baseline was compared between ionic toothbrush and normal toothbrush using the unpaired *t* test. There was no significant difference in the mean plaque index at baseline between ionic toothbrush and normal toothbrush (Table 2, Fig. 2).

The mean OHI-S at baseline was compared between ionic toothbrush and normal toothbrush at baseline, at 15 days, and at 30 days using the unpaired *t* test. There was no significant difference in the mean OHI-S at baseline between ionic toothbrush and normal toothbrush. The mean OHI-S at 15 days and 30 days was significantly more among normal toothbrush in comparison with ionic toothbrush (Table 3). The mean plaque index at baseline was



**Fig. 1:** Comparison of OHI-S at baseline among assigned toothbrushes



**Fig. 2:** Comparison of plaque index at baseline among assigned toothbrushes

**Table 1:** Comparison of OHI-S at baseline among assigned toothbrushes

Groups	OHI-S at baseline				
	Mean	Std. deviation	Mean difference	<i>t</i> test value	<i>p</i> value
ionic toothbrush	2.65	0.83	-0.23	-0.908	0.369
Normal toothbrush	2.88	0.77			

**Table 2:** Comparison of plaque index at baseline among assigned tooth

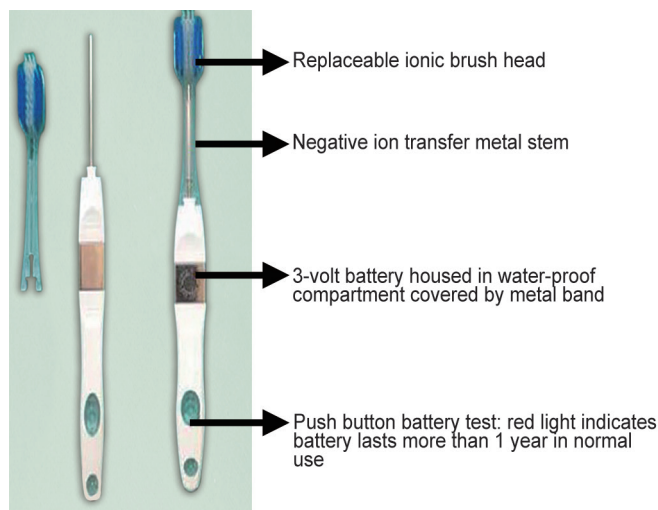
Groups	Plaque index at baseline				
	Mean	Std. deviation	Mean difference	<i>t</i> test value	<i>p</i> value
ionic toothbrush	2.20	0.62	0.050	0.246	0.807
Normal toothbrush	2.15	0.67			

**Table 3:** Comparison of reduction in OHIS among both the groups

OHI-S	Ionic toothbrush		Normal toothbrush		Mean difference	t test value	p value
	Mean	Std. deviation	Mean	Std. deviation			
Baseline (1)	2.65	0.83	2.88	0.77	-0.23	-0.908	0.369
At 15 days (2)	1.43	0.29	1.95	0.54	-0.51	-3.761	0.001
At 30 days (3)	0.89	0.31	1.53	0.48	-0.64	-5.011	<0.001
p value	<0.001		<0.001				
Post hoc Bonferroni test	3 > 2 > 1		3 > 2 > 1				

**Table 4:** Comparison of reduction in plaque index among both the groups

Plaque index	Ionic toothbrush		Normal toothbrush		Mean difference	t test value	p value
	Mean	Std. deviation	Mean	Std. deviation			
Baseline (1)	2.20	0.62	2.15	0.67	0.05	0.246	0.807
At 15 days (2)	1.05	0.22	1.40	0.50	-0.350	-2.845	0.007
At 30 days (3)	0.55	0.51	1.15	0.67	-0.600	-3.183	0.003
p value	<0.001		<0.001				
Post hoc Bonferroni test	3 > 2 > 1		3 > 2 > 1				



**Fig. 3:** Detail description of HyG ionic toothbrush and its specification

compared between ionic toothbrush and normal toothbrush using the unpaired *t* test. There was no significant difference in the mean plaque index at baseline between ionic toothbrush and normal toothbrush. The mean plaque index at 15 days and 30 days was significantly more among normal toothbrush in comparison with ionic toothbrush (Table 4).

## DISCUSSION

An adaptation of good oral hygiene habit in childhood is important to limit or help prevent the development of dental carries and periodontal diseases. Methods that motivate children to adopt regular and effective oral hygiene practices and which improves toothbrushing technique and effectiveness are extremely important. Hukaba Dental Corporation Private Limited, Japan, has made ionic brushes which come in two colors, pink and blue; technique to use is very simple and method of brushing is same

like we use for manual brushing. Ionic toothbrush was more like any other manual toothbrush, though with different mechanism of action. The specifications of HyG ionic toothbrush is written below (Fig. 3).

- Number of tufts ⇒ 17
- Filament per tufts ⇒ 28(±2)
- Total number of filament ⇒ 17 × 28(±2) (but our R&D person says it is about “480”)
- Number of rows ⇒ 3 (2 at the tip)
- Weight ⇒ 20.8 g (handle), 2 g (brush head)
- Handle length ⇒ 17.4 mm (entire length)
- Head size ⇒ 17.2 mm × 8 mm (area of filament arrangement)
- Filament length ⇒ 7.5 mm (height)
- Filament materials ⇒ polyester 100%

Use of devices with ionic action in the oral cavity is not a new concept. The terms iontophoresis, electrophoresis, and electrolyzing have been used in dentistry for many years. Ionic toothbrush is similar to manual toothbrush, with replaceable brush heads, and works on the principle of changing surface charge of tooth to repel plaque even from inaccessible areas of teeth. The bonding between the pellicles and bacteria is mediated by Ca<sup>2+</sup> bridge formation. The anions supplied by the lithium battery inhibit the bonding between the bacteria and Ca<sup>2+</sup> and prevents the bacteria from adsorbing to the pellicles. Hence, the plaque accumulation is reduced because the above-mentioned anions continuously supplied from the tips of the bristles of the ionic toothbrushes prevent the mild electrostatic bonding between the bacteria *per se* (Fig. 4).

HyG ionic brush uses a lithium power source, encased in the toothbrush handle, to repel plaque. The brush head is negatively charged and has a wrapped metal band to enhance the plaque removal. With the assistance of saliva, when the bristles contact the teeth, a repelling ionization is created when a circuit and active lithium power source are created. Battery must be tested periodically for effectiveness. The brush has a power tester on the lower end of the handle. The battery is sealed inside the handle to keep it

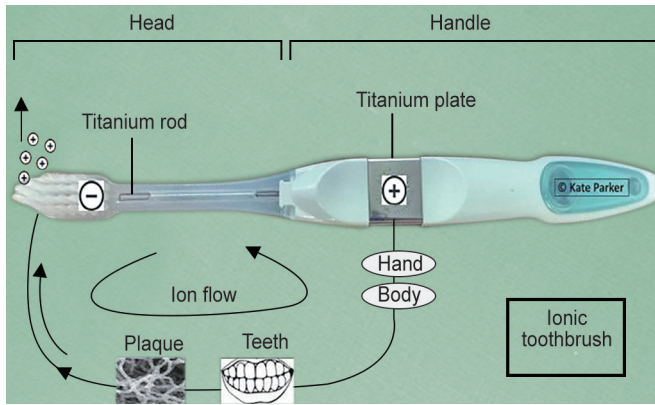


Fig. 4: Mechanism of action of HyG ionic toothbrush

waterproof, and when the battery is worn a new handle is required for continuing the ionic action. The heads are interchangeable and come in small sizes for children.

In a short-term clinical study, many different factors such as duration of toothbrushing, manual dexterity, motivation, frequency of toothbrushing, technique and thoroughness of toothbrushing, type of dentifrice being used, regularity and punctuality of follow-up appointments, and “novelty-effects”<sup>8</sup> may interfere with results. On the contrary, lack of interest on the part of participants and increased number of dropouts in case of long-term studies can lead to frustration of examiners and an overall effect on the results.<sup>9</sup>

Brushing twice daily at 10–12-hours interval has been advised, since early plaque is more vulnerable to mechanical most linear monotonic effect on plaque reduction, which may vary between 30 seconds and 8 minutes.<sup>10</sup> As a result, the possible differences between toothbrushes may be obscured. Hence, we decided to standardize the minimum brushing time for optimum plaque removal, that is, 1 minute twice daily as suggested by Pader.<sup>11</sup>

Results from this study also show that it is safe and significantly more efficient than manual toothbrush, and there was no gum or tooth abrasion reported during the study. This indicates that HyG ionic toothbrush is as safe for use in children. The oral hygiene status has also improved in case of HyG ionic toothbrush, and the mean OHI-S has significantly increased from day 0 to day 30 in comparison with manual group.

The plaque removing efficacy of HyG ionic brush was shown significantly greater than conventional manual toothbrush. There was statistically significant reduction in mean plaque index from day 0 to day 30, but not in manual toothbrush. This conclusion is reinforced by the fact that not much improvement was seen in manual group, indicating lack of Hawthorne effect. These results are similar to the previous studies done by Maki et al.<sup>12</sup> and Van Swol et al.<sup>13</sup>

## CONCLUSION

As evident from this study, ionic toothbrush is both safe and efficient in the removal of plaque and improving oral hygiene status. It also has potential to increase compliance with daily brushing.

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