

Clinical evaluation of a light energy conversion toothbrush

Jay N. Hoover, David L. Singer,
Punam Pahwa and Kunio
Komiyama

College of Dentistry, University of
Saskatchewan Saskatoon, Saskatchewan,
Canada S7N 0W0

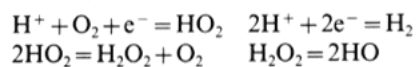
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Abstract. A blind, two-way crossover clinical trial was carried out to compare the effectiveness of plaque removal between a new, light energy conversion toothbrush incorporated with a semiconductor of TiO₂ (test) and a similar toothbrush without the semiconductor (control). The study was completed by 73 school children aged 13–15 years. Each toothbrush was used for a period of 3 weeks. The mean differences between baseline plaque scores and after subjects used the test and control brushes were analyzed by the paired *t*-test. The Soladey 2 toothbrush showed significantly more reduction of plaque on the buccal surfaces of all teeth than the control brush. There was no significant difference in the plaque removing ability of the two brushes on the lingual aspects of the mandible and on the lingual surfaces of the maxillary posterior sextant. As the buccal surfaces are more likely to allow light to reach the semiconductor during brushing than the lingual areas, it is possible that the reported photocatalytic property of the semiconductor may be involved in some way in the observed reduction of plaque.

Key words: evaluation; light energy; toothbrush.

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A new toothbrush called Soladey 2[®] has been recently introduced and is claimed to have better plaque removing potential than conventional toothbrushes due to a photo-electro-chemical effect it has on dental plaque (Weiger 1987). The basic difference between the Soladey 2 and the conventional brush is the incorporation of an N-type semiconductor of Titanium dioxide (TiO₂) at the neck of the brush. In the presence of light, saturated low energy electrons in the wet semiconductor are transformed into high energy electrons resulting in a reduction reaction as shown below.



This reaction results in the reduction of H⁺ ions from the organic acid in the plaque causing its decomposition. The reaction could also have an effect on plaque formation (Kusunoki et al. 1986, Niwa & Fukuda 1989). There is also evidence that the powdered TiO₂ semiconductor irradiated with visible light has a bactericidal effect against *Escherichia coli* and *Streptococcus mutans* (Morioka et al. 1988).

The aim of this study was to compare the plaque removing ability of the Soladey 2 toothbrush, with a similar brush, but *without* the semiconductor. 80 high school students, (males 43, females 37)

aged 13–16 years participated in the study. To be selected, subjects had to meet the following criteria: have at least 24 teeth excluding third molars; have relatively healthy oral tissues; not receiving local or systemic antimicrobials at the time of the study, no orthodontic or extensive restorative treatment at the start or during the study. The purpose of the study was explained to the subjects and an informed consent obtained.

The two brushes used were (i) Soladey 2 with the semiconductor (TiO₂) bar and (ii) the Soladey 2 with an imitation bar made of synthetic resin (control brush). Both brushes were made to appear alike. Plaque was assessed on the buccal and lingual surfaces of all teeth present (excluding third molars) according to the plaque index developed by Quigley & Hein (1962) and modified by Turesky et al. (1970).

The experiment was designed as a randomized two-way cross-over study with the examiner being blind. Prior to the start of the trial, the plaque scores were recorded to provide base line data. Plaque was assessed, after a thorough application of disclosing solution (Red Cote[®]) to all teeth. The subjects were divided into 2 groups of 40 each, age- and sex-matched.

The 1st group (A) was given the test brushes, and the 2nd group (B) was

given the control brushes. The examiner was not aware of this allocation. The same dentifrice was provided to all subjects who were requested to use only this dentifrice during the trial. Both groups were advised to use the brushes according to the manufacturer's instructions for a period of 3 weeks and were also provided with written instructions. The instructions were as follows: wet the bristles and the 'rod' before use; brush the teeth in the usual manner but always in a bright area; use only a small amount of the given toothpaste. No further instructions were provided and the subjects were free to carry out oral hygiene procedures as usual. This was done on purpose to mimic a real life situation as far as possible. At the end of the 3rd week, plaque scores were recorded. Group A was then provided with the control and group B the test brushes. At recall, 3 weeks later, plaque was again assessed. At the end of the experiment, the teeth of all subjects were scaled by a hygienist. To test the examiner variability, 10 children were randomly selected from among 13–15 year old children attending the pedodontic clinic, College of Dentistry. The subjects were examined 2 × for plaque using the selected index, with an interval of 20 min between examinations. The intra-examiner variability was calculated by