

Analysis of the Soladey TiO₂ Semiconductor Toothbrush Performance

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Recently there has been some media talk about [1] a toothbrush that uses a light activated TiO₂ semiconductor to decrease dental plaque and eliminate the need for toothpaste. The toothbrush known as the Soladey-2 has a dedicated website [2,3] with testimonials and dentist endorsement. Despite heavy advertisement, the question posed before buying such a device is how well it stacks up against a conventional toothbrush. Fortunately, the Soladey site offers links to research and clinical trials proclaiming triumph over the conventional toothbrush. However, despite a thorough reading and analysis of the research and clinical trials, more questions are raised about the overall effectiveness of the Soladey-2 than are answered.

Oral Hygiene is the practice of keeping the mouth clean to prevent dental decay. Cleaning the teeth is the process of removing both dental plaque and tarter. Dental plaque is a thin biofilm that mainly consists of streptococcus mutans bacteria. Streptococcus mutans contribute toward tooth decay. A build up of streptococcus mutans leads to tarter, and furthers plaque build up on tarter surfaces. Prolonged plaque and tarter presence increases the likelihood of cavities, gum diseases, and gingivitis.

The need for good oral hygiene is obvious and is achieved mostly through brushing the teeth with a fluoride treated toothpaste and toothbrush. Presently, there are hundreds of toothbrushes on the market. Distinctions between toothbrushes are made mainly by varying cuts, materials, and conditions of the bristles (soft, medium, and hard). Additionally, the shape and material (flexible or inflexible) of a toothbrush's handle play a role in effective plaque removal. [6]

Despite the many existing toothbrush varieties, most handles are made with a type of plastic and nylon brush assembly hereinafter the conventional toothbrush. The Soladey-2 toothbrush differs from conventional toothbrushes by utilizing a TiO₂ semiconductor to accomplish the plaque removal assistance of toothpaste. The powdered TiO₂ semiconductor is activated by light and wetness that triggers negative electrons to enter the mouth and mix with saliva. The negatively charged saliva interacts with the teeth and removes positive hydrogen ions from dental plaque by attraction forces. The hydrogen ion removal in turn prompts plaque and tarter decomposition. [1].

In the lab, TiO₂ has been proven to work at killing *Streptococcus mutans* [4]. The process involves mixing

TiO₂ in a solution containing the bacteria and shining a 100W mercury light directly into the mixture. A cooling system is implemented to negate the heating effects of the light. This study, reported on Soladey's website, resulted in a "markedly decrease" in the number of bacteria after 40 minutes and a 99% kill of the bacteria after 80 minutes.

The Soladey-2 site offers two published clinical trials of its toothbrush [5,6] Both trials lasted over a three week period with a focus on dental plaque removal between a conventional toothbrush and the Soladey-2.

One trial, in Japan, saw no significant difference in dental plaque removal between a conventional toothbrush and the Soladey-2 when university students were used in the study and progress was checked every week. A clinical trial in Canada remarked that the Soladey toothbrush had significant reduction in plaque over a conventional toothbrush in the front portions of the mouth, but the removal effects on other areas were similar in comparison.

Based on varying limited available clinical trials, the Soladey-2 toothbrush's plaque removal performance is questionable. The very test showing that TiO₂ works as a bacteria remover took 40 minutes to decrease bacteria under a high intensity lighting situation. This test is unlike normal five minute low lighting brushing situations. At the very least, the Soladey-2 toothbrush will function as a conventional toothbrush with additional plaque removal force in frontal areas of the mouth.

References

- [1] Cohen, Joyce. "Brushing Innovations, Built on Titanium." The New York Times 13 Nov. 2007. 13 Nov. 2007
http://www.nytimes.com/2007/11/13/health/13teet.html?_r=1&oref=slogin
- [2] <http://www.soladey-usa.com/>
- [3] <http://www.soladey.com/>
- [4] Morioka et al. Antibacterial Action of Powdered Semiconductor on a Serotype g *Streptococcus mutans*. *Caries Research* 20. 230-231 1988.
- [5] Hoover et al. Clinical evaluation of a light energy conversion toothbrush. *J. Clin. Periodontal.* 19: 434-436 1992)
- [6] Niwa et al. Clinical study on the control of dental plaque using a photo energy conversion toothbrush equipped with a TiO₂ semiconductor. *Shigaku Vol.* 77 No. 2 August 1989