



# Assessing the Efficacy of Sonic Toothbrush in Reducing the Plaque Pathogens in Comparison with Manual Brushing

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## Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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## ABSTRACT

**Introduction:** The bacteria present in dental plaque are the main cause of caries, gum disease, and periodontal disease. Regular brushing will remove plaque build up and maintain the oral health. An ultrasonic toothbrush is an electric toothbrush which is designed for daily home use which operates by generating ultrasound waves to help in removing plaque and rendering plaque bacteria harmless.

**Aim:** The aim of the present study is to assess the effect of sonic toothbrush in reducing the plaque pathogens in comparison with the normal brushing.

**Materials and Methods:** Volunteers who use sonic toothbrushes were selected as a study population. The swab samples were collected before and after brushing. The collected swabs were inoculated on BHI agar and the total CFU count was checked.

**Results and Discussion:** The percentage reduction in case of ultrasonic toothbrush was more (86.82%) when compared to the manual brushing making it efficient in reducing plaque pathogens.

**Conclusion:** The present study concludes that the ultrasonic or the sonic toothbrush is efficient on plaque pathogens on the tooth surface.

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## 1. INTRODUCTION

Caries, gum disease, and periodontal disease are all caused by bacteria found in dental plaque. As a result, plaque removal is required for the prevention and treatment of these diseases [1]. Despite the fact that there are many methods for removing plaque, including mechanical and chemical methods, the toothbrush is the most effective and commonly used. However, its effectiveness is based on a variety of factors, including the type of toothbrush used, brushing technique, optimum brushing time, and whether or not adjuvants like dental floss or mouthwash are used [2]. One of the most significant advances in oral hygiene was the invention and widespread use of the plastic-handled, nylon-bristled toothbrush in the 1930s. Since then, in developing countries, the manual toothbrush has been the mainstay of oral hygiene practices [3].

The invention of the nylon-bristled toothbrush with a rubber handle in the 1930s was without a doubt one of the most significant developments in oral hygiene [4]. Since then, the manual toothbrush has become the most popular method of oral hygiene in developed countries. Dental plaque is made up of complex microbial species that are bound to the surface of hard tooth tissues in a highly structured manner [5]. The clinical and biological importance of oral biofilms in the production of various diseases of the oral cavity and throat, such as caries, periodontal diseases, endodontic infections, tonsillitis, and alveolitis, among others, is determined by studying this system [5,6].

Brushing your teeth with a manual toothbrush can be very effective. The type of toothbrush, personal encouragement, brushing movements, and manual agility all play a role in this ancient method of brushing. It is right to say that manual toothbrushing is reliable, but ultrasonic cleaning can outperform it if the acoustic action is combined with mechanical movements [7]. Driven toothbrushes are suitable for patients with reduced physical dexterity or for making self-care oral hygiene easier. The difficulty of brushing mainly comes to the orthodontic patients, due to which manual brushing becomes difficult.

Their methods of action are extremely varied. The brush head travels laterally in a side-to-side action mode, in a counter-oscillation mode where each group of bristles rotates in opposite directions, and in a rotational oscillation mode where the entire brush rotates in the same direction [8]. Powered toothbrushes are very useful for the patients who lack manual dexterity or for simplifying self-performed oral hygiene. Our team has extensive knowledge and research experience that has translated into high quality publications [9-20].

The aim of the present study is to assess the effect of sonic toothbrush in reducing the plaque pathogens.

## 2. MATERIALS AND METHODS

### 2.1 Study Setting

An in vitro original study on the effect of ultrasonic toothbrush in reducing the plaque pathogen is done. The study was done in the department of microbiology, Saveetha dental college and hospitals. The study was non-invasive and easy to perform without much inconvenience to the volunteers. The Type of population in the present study are the volunteers using ultrasonic toothbrushes and volunteers using manual toothbrushes (control samples). However the sample size was limited. Prior to the initiation of the study, clearance was obtained by the Scientific Review Board. The number of samples or swabs collected were 20 (n=20). The swabs were collected in an unbiased manner using randomized sampling. Then the swabs which are collected are inoculated on BHI agar and then incubated for 24 hours and checked for the total CFU (Table 1, Table 2).

### 2.2 Sampling

**Sample size:** Group 1 (Ultrasonic brushing - 10) and Group 2 (manual brushing -10)

**Sampling method:** finding volunteers using ultrasonic toothbrush and collection of the samples and samples collected from the volunteers using manual toothbrush (control samples).

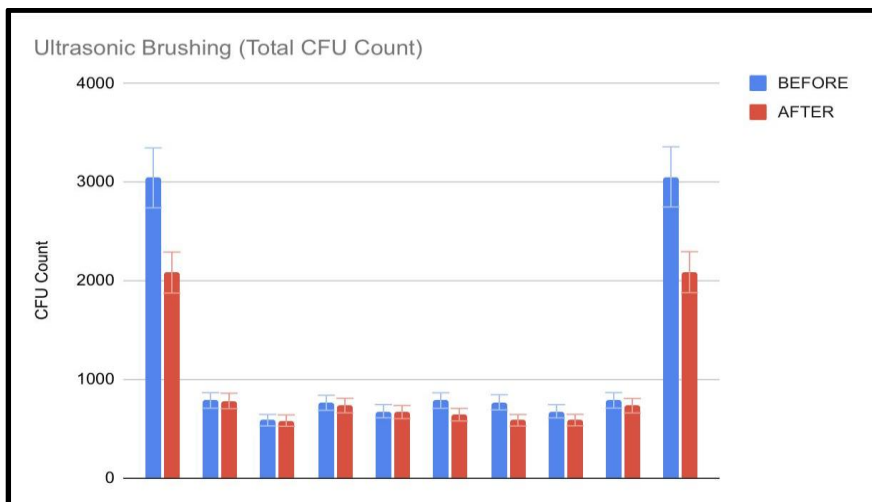
**Table 1. Depicts the total CFU count of the bacterial plaque pathogens before and after ultrasonic brushing and the percentage reduction values**

Ultrasonic Brushing		
Before	After	Percentage Reduction
3040	2080	68.42%
784	779	99.36%
584	580	99.31%
760	732	96.31%
675	666	98.66%
783	640	81.73%
765	583	76.20%
674	585	86.79%
785	731	93.12%
3050	2084	68.32%
Mean = 1190	Mean = 946	Mean = 86.82%

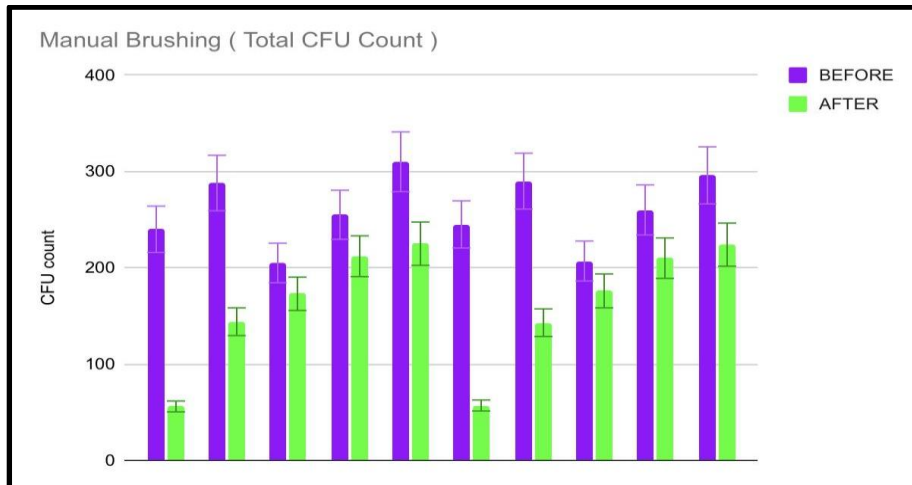
**Table 2. Depicts the total CFU count of the bacterial plaque pathogens before and after manual brushing and the percentage reduction values**

Manual Brushing			
Before	After	Percentage Reduction	
240	56	23.33%	
288	144	50%	
205	173	84.39%	
255	212	83.13%	
310	225	72.58%	
245	57	23.26%	
290	143	49.31%	
207	176	85.02%	
260	210	80.76%	
296	224	75.67%	
Mean = 259.6	Mean = 162	Mean = 62.75%	

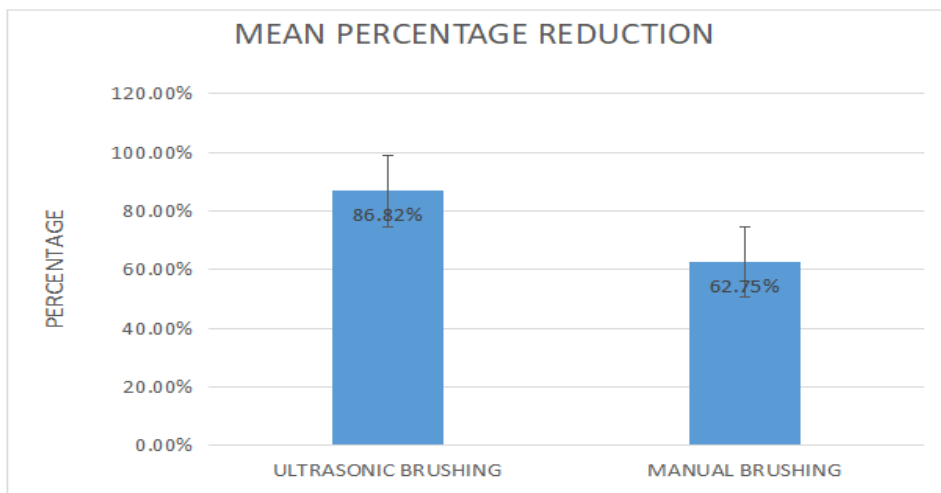
### 3. RESULTS



**Graph 1. The graph denotes the total CFU count of bacterial plaque before and after using an ultrasonic toothbrush. Blue denotes before brushing and red denotes after brushing. X axis represents the before and after ultrasonic brushing and the Y axis represents the CFU count. The mean total CFU count before brushing was 1190 and the mean total CFU count after brushing was 946**



**Graph 2.** The graph denotes the total CFU count of bacterial plaque before and after using a manual toothbrush. Purple denotes before brushing and green denotes after brushing. X axis represents the before and after manual brushing and the Y axis represents the CFU count. The mean total CFU count before brushing was 259.6 and the mean total CFU count after brushing was 162



**Graph 3.** Graph depicts the comparison of mean percentage reduction between ultrasonic brushing and manual brushing. X axis represents the type of brushing and the Y axis represents the mean percentage. The chi square test was done, with a P value 0.002, which is statistically significant ( $P < 0.05$ )

#### 4. DISCUSSION

In the present study, the efficacy of the ultrasonic toothbrush and the manual toothbrush in reducing the plaque pathogens was assessed. From the present study, graph 1 explains the total CFU count before and after brushing with the ultrasonic toothbrush where the mean value before brushing was 1190 and the mean value after brushing was 946. The percentage reduction was also calculated and the mean reduction percentage was estimated to be

86.82% (Graph 1). From the present study, graph 2 explains the total CFU count before and after brushing with the manual brush, where the mean value before brushing was 259.6 and the mean value after brushing was 162. The percentage reduction was estimated to be 62.75% (Graph 2).

The comparison of percentage reduction of plaque pathogens between ultrasonic and manual brushing, shows that ultrasonic reduction has a good efficiency of reducing the plaque

pathogen with the percentage reduction of 86.82% (Graph 3).

An ultrasonic toothbrush is an electric toothbrush which is designed for daily home use which operates by generating ultrasound waves to help in removing plaque and rendering plaque bacteria harmless [4]. Powered or the electric toothbrushes are useful for patients who lack manual dexterity or for simplifying self-performed oral hygiene. Dental plaque is an essential factor which mainly causes periodontitis, caries and gingivitis [21]. The prevention of these diseases essentially requires maintenance of the oral cavity hygiene and the proper manner of brushing. The main technology of the ultrasonic toothbrush is the ultrasound induced vibration of the bristles. The mechanical energy transferred from the piezoelectric element leads to the vibration of the bristles. Additionally, ultrasonic waves, high velocity flows of oral fluids and additional acoustic microstreaming indicates a better removal of dental biofilm than the manual brushing techniques. In general, the efficiency of brushing depends on the type of brushing and the type of brush used. While there are various ways of reducing dental plaque formation, the best and suitable way is by brushing [22]. In the previous study done by bianco et al. [23] showed that the manual toothbrush removed the dental plaque better as compared to the sonic toothbrush, but there was no particular difference in the *S.mutans* count, which was similar to the present study. In a study done by Aggarwal et al. [24] showed that the manual as well as the ultrasonic toothbrush were having an equal efficacy in the reduction of plaque pathogens. In the present study, according to the percentage reduction graph, the manual brushing technique showed a good reduction percentage and provides evidence for reduction in plaque pathogens. The limitation of the present study includes limited sample size. With further research and greater sample size, the effect of ultrasonic toothbrush in reducing plaque pathogens.

## 5. CONCLUSION

According to this study, it is found that ultrasonic brushing has an added advantage in reducing the plaque pathogens when compared with the regular manual brushing technique. As this study was done in volunteers who have the practise of using ultrasonic toothbrushes was selected, it is found that their oral or salivary bacterial count is found to be reduced compared with the control

group. A proper guidance and validation is needed in case of ultrasonic toothbrush users.

## DISCLAIMER

The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

## CONSENT

As per international standard or university standard, patients' written consent has been collected and preserved by the author(s).

## ETHICAL APPROVAL

As per international standard or university standard written ethical approval has been collected and preserved by the author(s).

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## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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