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Clinical evaluation of an ionic tooth brush on oral hygiene status, gingival status, and microbial parameter

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Abstract

It has long been recognised that the presence of dental plaque leads to gingivitis and periodontal disease, as well as dental caries. Today tooth brushing is the most widely accepted method of removing plaque. Hence this present clinical study was undertaken to evaluate the effectiveness of an ionic toothbrush on oral hygiene status. For this study, 20 dental students in the age group of 18-20 years were included. All the subjects after undergoing dental prophylaxis were then provided with ionic toothbrushes, either active (equipped with lithium battery) or inactive (without lithium battery). Plaque index and gingival bleeding index were examined at 7th, 14th, and 21st day. Microbial assessment was done for detection of colony forming units (CFU) from the plaque samples which were collected on 0 day and 21st day, both before brushing and after brushing. Results shown a significant reduction in all the parameters and the reduction was more significant in active and inactive ionic toothbrush users. It was concluded that both active and inactive ionic toothbrushes reduced the plaque index and gingival bleeding index scores significantly and active ionic tooth brushes were more effective as compared to inactive ionic toothbrushes. There was no soft tissue trauma following the use of both type of toothbrushes, which showed that ionic toothbrushes were equally safe for regular long-term use.

Keywords: Ionic toothbrush, plaque control, microbial parameter

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Introduction

Periodontal disease and dental caries, both plaque related diseases are recognized as two of the most common diseases world wide and it has long been recognized that the presence of dental plaque leads to gingivitis and periodontal disease, as well as caries [1]. Today tooth brushing is the most widely accepted method of removing plaque and has a very high degree of social acceptability [2]. Tooth brushes now come in bewildering range of styles and varieties accomplished by complex product descriptions and scientific design theories, but no research team has yet come up with conclusive proof that one brand performs better than other.

Ionic toothbrush works on the principle of polarity that every element in nature has a positive or negative charge. So far only few studies have been undertaken to assess efficiency of ionic toothbrush and have revealed inconsistent results. Hence this present clinical study is undertaken to evaluate the effectiveness of ionic toothbrush on oral hygiene status including clinical parameters such as plaque index and bleeding index. Additionally, microbial colony count was assessed from plaque taken before brushing and after brushing for groups using active tonic tooth brush.

Principles of the ionic action mechanism

The bonding between the pellicles and bacteria is mediated by Ca^{2+} bridge formation. The anions, supplied by the lithium battery inhibits the bonding between the bacteria and Ca^{2+} 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 perse.

Materials and methods

For this study, 20 dental students from College of Dental Sciences, Davangere were selected.' The students fell into the age group of 18-20 years among which 15 males and 5 females were enrolled for this double blind study which was divided into two study trials i.e. study trial land study trial It.

Volunteers were screened at the out patient department of Periodontics and those who m *et al* l the criteria were selected accordingly. The inclusion criteria included a plaque score ranging from 2-3 of Tureskey-Gilmore-Glickman modification of Quigley Hein plaque index, healthy subjects who had the presence of more than 20 natural teeth excluding plaque retentive areas such as grossly carious teeth or orthodontically bonded abutments, absence of major hard and soft tissue oral lesions and maintenance of oral hygiene by brushing the teeth once daily.

The exclusion criteria were if patient had taken antibiotic or underwent dental prophylaxis one month prior to the inclusion in the study, pregnant and lactating females, those with grossly neglected oral hygiene and with any physical limiting manual dexterity.

The following clinical parameters were recorded.

- Plaque index [Turesky Gilmore-Glickman modification of Quigley Hein Plaque Index 1970]
- Gingival bleeding index (Ainamo and Bay 1975)

Microbial assessment was done for detection of colony forming units [CFU] from the plaque samples which were collected on 0 day and 21 st day both before brushing and after brushing. The samples were suspended in 0.3 ml of 0.9 % sterile sodium chloride solution and in order to minimize dumping of samples they were processed within one hour of collection. Plaque samples were transferred to culture media [blood agar] with the help of sterile platinum loop in a streaky manner and incubated at 37°C temperature maintained fm48 to 72 Ins.

Study Trial I [0-21 days]

Following a review of the subjects' dental and medical history by the principal investigator at baseline (0 day), the subjects were examined at the end of the week i.e. 7th, 14th and 21 st day. The principal investigator assessed the plaque index [Turesky Gilmore Glickman modification of Quingley Hein plaque index 1970] and gingival bleeding index [Ainamo and Bay 1975]. The coinvestigator allotted the ionic tooth brushes either in active or inactive state at the beginning of both the experimental periods. Additionally an evaluation of bleeding was performed according to gingival bleeding index (Ainamo and Bay 1975). All the subjects then underwent a dental prophylaxis consisting of supragingival scaling and rubber cup polishing. Each of the subjects were then provided with an ionic toothbrushes, (hyG ionic tooth brush, Hukuba Dental Corporation, Japan) either active [equipped with lithium battery] or inactive [without lithium battery] according to double blind method. The inactive ionic toothbrush served as the control. Subjects were instructed to brush their teeth twice daily using only the assigned ionic toothbrushes and dentifrice (colgate dental cream) provided to them, using roll method for atleast 3 rain. Verbal and written instructions were given regarding manipulation of ionic tooth brush so that their moist fingers touched the metal band during tooth brushing. On 7th, 14th and 21 st day, the subjects were asked to refrain from brushing 12 to 14 Ins prior to their evaluation time, so as to allow overnight plaque formation and the assessment of plaque scores was made before and after using the ionic toothbrushes in the outpatient department. The intraoral tissues were examined at each visit of the subject and any changes in oral soft tissues including lacerations or any other pathology was noted. Study trial-I was completed on 21 st day.

Washout period (21st 28thday)

All the subjects were requested to resume their normal oral hygiene measures for following one week according to their own way using regular or conventional type of manual tooth brushes to counteract any carry over effects, until the start of the study trial-II.

Study trial-II (28th to 49th day)

Study trial-II was started on 28th day. The subjects were provided with ionic toothbrushes contrary to the study trail-I period according to double blind method. All the steps of study trail-I were repeated on 28th, 35th, 42nd and 49th day. After 49th day clinical examination, study trialII was concluded.

Results

Out of 20 volunteers, 19 completed the study. One volunteer was excluded from the study because he took antibiotics. The results of various clinical parameters are presented (Table 1)[Table - 2][Table - 3][Table - 4][Table 5).

Mean plaque index for active ionic tooth brush group at baseline was 2.09±0.07 and on 21st day the mean value was 0.36±0.14 showing a reduction of 1.72 ± 0.15 i.e. 82% from baseline which was highly significant (P<0.001) [Table - 1]. The mean bleeding index scores for group using active ionic toothbrush at baseline was 20.87±7.88 and mean bleeding index on 21st day was 0.6±1.3 with reduction of 20.3±8.3 i.e. 97%, which was highly significant (P < 0.001) [Table - 2].

Mean plaque index for inactive ionic toothbrush group at baseline (28th day) was 1.16±0.31 and on 49th day the mean value was 0.93±0.24 showing a reduction of 0.23±0.35 i.e. 20% from baseline which was highly significant (P < 0.01)

[Table - 1]. The mean bleeding index scores for inactive ionic tooth brush group at baseline was 8.6±2.2 and 5.8±2.7 on 49th day showing a reduction of 2.8±1.7 i.e. 33%, which was highly significant (P<0.001) [Table - 2].

Mean reduction of plaque score for group using active ionic tooth brush was 1.72±0.15 i.e. 82.5% reduction and for group using inactive toothbrush mean reduction was 0.23±0.35 i.e. 20% which is highly significant (P < 0.001). Mean reduction of bleeding index for group using active ionic toothbrush was 20.3±3.3 i.e. 97% reduction and for group using inactive ionic toothbrush was 2.8±1.7 i.e. 33% reduction, which was highly significant (P < 0.001) [Table - 3].

Mean percentage reduction in plaque score, before brushing and after brushing on 7th day and 35th day for group using active ionic toothbrush was 75.1±14.0 % and for group using inactive ionic toothbrush was 65.5±5.9%. This shows a significant reduction in plaque score after brushing in active ionic toothbrush group compared to inactive ionic toothbrush group (P<0.05). Mean percentage reduction in bleeding index, before brushing and after brushing as on 21 st and 49th day, for group using active ionic toothbrush was 78.5±6.5 % and for group using inactive ionic toothbrush was 50.1±15.7 % which is a highly significant (P<0.001) [Table - 4].

The mean percentage reduction in colony forming units, before brushing and after brushing for active ionic toothbrush group was 89.4 and 25.4 with a highly significant difference of64.0(P<0.001) [Table - 5].

The colony forming units assessed before and after brushing using active ionic toothbrush demonstrated significant difference (P <0.001).

Discussion

The effect of bacterial plaque on periodontium plays a vital role in the initiation of periodontal disease. The studies of Loe and his associates (1965) have clearly demonstrated that bacterial plaque is a major etiologic factor in inflammatory periodontal disease.

In both active and inactive ionic tooth brush groups, there was highly significant reduction of plaque and bleeding index scores from baseline to end of study trial period similar to earlier studies [3],[4].

There was highly significant differences between two groups i.e. active and inactive group with respect to mean plaque scores (active group: 82% reduction, inactive group: 20% reduction)(P<0.01) and bleeding index (active group: 97% reduction; inactive group: 33% reduction) (P<0.001). The above results show that active brushes are most effective in plaque removal than inactive brush and improving gingival status. The difference in plaque score before and after brushing between the groups was highly significant (P < 0.001).

To assess the efficacy of plaque removal at given point of time (without any interval period i.e. 1 week) the percentage reduction in plaque score for active brush group was 75.1 % on 7th day 78.5% on 21 st day. However, the percentage reduction in plaque score for inactive brush group was 65.5% and 50.1 % for the inactive brush group. There was highly significant difference between two groups in before brushing and after brushing reduction in mean plaque score (P < 0.001). These findings are similar to previous studies [5],[6]. Hiroshi Otani *et al* [6] weighed the amount of plaque left on teeth surfaces after brushing. By weighing quantitatively the plaque, he found that the active ionic tooth brush removed significantly higher amount of plaque when compared to inactive ionic toothbrush. They also compared the dried weight of plaque collected after brushing which was correlated with the plaque index. Yoshinobu Maki *et al* [5] also observed that active ionic toothbrush removes plaque efficiently. They attributed it to ionic action mechanism, wherein they proposed that plaque accumulation is reduced because the anions (-ve charge) continuously supplied from the tips of bristles of ionic toothbrushes prevent the mild electrostatic bonding between the bacteria and tooth surfaces or between bacteria itself.

Summary and conclusion

From the observations of this study the following conclusions were drawn from this study:

- There was statistically significant difference in plaque index and bleeding index scores for both the groups i.e. active ionic toothbrush group and inactive ionic toothbrush group during the study trials.
- Both active and inactive ionic toothbrushes reduced the plaque index and bleeding index scores significantly.
- On comparison between the active ionic toothbrush and inactive ionic toothbrush over both the study trials, there was significant difference noted in plaque removal efficiency of active ionic toothbrush.
- There was no soft tissue trauma following the use of both type of toothbrushes, which shows that ionic toothbrushes are equally safe for regular long term use.

As evident from the present study, it can be concluded that active ionic toothbrush is both safe and effective in the removal of plaque and reduction of gingival bleeding. Further long-term clinical and microbiological studies are recommended to evaluate the efficacy of ionic tooth brushes and to support the principles of ionic action mechanism.

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Tables

[Table - 1], [Table - 2], [Table - 3], [Table - 4], [Table - 5]

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