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Effectiveness of Mouthrinsing over Night Brushing on Plaque and Gingivitis - A Randomized Clinical Study

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Abstract

Introduction: Twice a day tooth brushing is proved to be the most effective way for preventing gingival or periodontal diseases. Mouth rinses are also one of the safest and effective methods in preventing gingivitis. Even though it is known that twice a day tooth brushing is better, people do not practice it, usually at night.

Aim: The present study was conducted to evaluate the effectiveness of morning brushing and night mouth rinsing with that of two times tooth brushing in terms of plaque and gingivitis reduction.

Methodology: This randomized, examiner blind, parallel 2-cell study was conducted among 76 adult subjects, 20-49 years of age, over a period of one month at 15 days interval. Gingival and plaque scores were recorded at each visit using Loe and Silness Gingival index and Turesky, Gilmore, Glickman modification of Quigley Hein plaque index respectively. After a week of washout period, on the day of baseline visit study subjects were randomly allocated into 2 groups: **Group 1**: twice a day tooth brushing group and **Group 2**:once a day tooth brushing (in the morning) and night mouth rinsing group based on their baseline gingival score. Respective products i.e.,Colgate MaxFresh toothpaste and a medium bristled Colgate tooth brush, also group 2 received chlorine dioxide mouthrinse (Freshchlor) were provided to all the subjects, who were subsequently recalled after 15 days and 1month for gingival and plaque examinations using the above mentioned indices.

Results: At the end of 1 month, the overall percentage reduction in gingivitis and plaque in twice a day tooth brushing group was **39.1%** and **28.23%** respectively

compared to which, the night mouth rinsing group contributed to **32.14%** of gingivitis and **22.88%** of plaque reduction. The difference was statistically significant (P<0.05).

Conclusion: The findings suggest that tooth brushing at night cannot be replaced by mouth rinsing. But if people do not brush at night, if they practice mouth rinsing then it will be more effective than not brushing.

Keywords: Plaque, Gingivitis, Night Mouth Rinsing, Tooth Brushing.

Introduction

Oral health may be defined as standard of health of the oral and related tissues which enables an individual to eat, speak and socialize without active disease, discomfort or embracement and which contributes to general wellbeing. Oral health is essential to general health and quality of life. Out of all the oral health problems, dental caries and periodontal disease are two of the most common problems. Primary prevention of caries can be achieved, in large part, by the application of community and mass measures requiring little, if any, individual activity or behavior change. Prevention of periodontal disease, on the other hand, requires active participation by the individual with an acceptance of responsibility for maintaining oral cleanliness. [31]

Gingivitis is the most common form of gingival disease. The cause of gingival inflammation is bacterial plaque.[32] Dental plaque is a living, organized community of microorganisms, consisting of numerous species embedded in an extracellular matrix. It undergoes growth and maturation with the passage of time by cumulative additions of gram negative, anaerobic and filamentous microorganisms.[1] Although, acquired bacterial coatings have been demonstrated to be the major etiologic factor in periodontal disease, the presence of calculus is of great concern to the clinician. Calculus is attached to dental plaque that has undergone mineralization.[32] The central role played by bacteria colonizing the teeth in the initiation of dental caries and periodontal diseases is well established and removal of plaque is therefore, most important to maintain periodontal health.[1]

It has been seen that improving oral hygiene and gingival health helps in reduction of the periodontal disease. Therefore, plaque control is the main factor in primary and secondary prevention of periodontal diseases.[4] Plaque control is the removal of microbial plaque and the prevention of its accumulation on the teeth and adjacent gingival surfaces. It is an effective way of treating and preventing gingivitis. To date, the most dependable mode of plaque control is mechanical cleaning with a toothbrush and other oral hygiene aids. Mechanical plaque control remains the primary method used to prevent dental diseases and maintain oral health.[32]

Stanmeyer(1957) stated that as the frequency of brushing increases, gingival inflammation decreases but that the benefits appear to reach their peak with two brushings a day.[14]

The role of the plaque biofilm in the etiology of gingivitis and the findings of the studies indicating that the majority of people fail to maintain an adequate level of plaque control provide a clear rationale for incorporating effective antimicrobial measures, such as use of an antimicrobial mouthrinse, into daily oral hygiene regimens.[2]

Many chemical antiplaque agents in various formulations have also been tried for improving oral health. Mouthwashes, a safe and effective delivery system for antimicrobials, have been evaluated for antiplaque properties and have been the subject of considerable research.[1]

The finding that twice daily rinsing with 10 ml of 0.2% chlorhexidine gluconate almost completely inhibited the development of dental plaque, calculus and gingivitis in the human model for experimental gingivitis.[32]

Mechanical plaque control by a toothbrush and toothpaste is the most dependable oral hygiene measure. However, most patients are not able to achieve sufficient plaque removal by performing oral hygiene measures at home.[3] Factors that limit the effectiveness of tooth brushing are lack of dexterity and individual motivation.[1]

Although twice a day tooth brushing have the potential to maintain adequate levels of oral hygiene, clinical experience and population based studies demonstrate that such methods are not being employed sufficiently by large numbers of the population.[5] It may be because they do not have enough knowledge about it or even if they are aware, they may not practice it, as it is more time consuming and they might be tired after a day's long work. The need for additional help in controlling bacterial plaque provides the rationale for patient's using antimicrobial mouthrinses as adjuncts to their mechanical oral hygiene regimens.[5] Mechanical mode of plaque removal, particularly the toothbrush, even though is the most effective method for preventing and controlling dental diseases, it has some limitations. There is paucity in the studies evaluating the effectiveness of mouthrinsing over nightbrushing. This study was conducted to evaluate the effectiveness of morning brushing and night mouth rinsing with that of two times tooth brushing in terms of plaque and gingivitis reduction.

Aim of the study

To evaluate the effectiveness of morning tooth brushing and night mouth rinsing with that of two times tooth brushing in terms of plaque and gingivitis reduction.

Objectives of the study

1. To determine the baseline mean plaque scores using Turesky Gilmore and Glickman modification of Quigley Hein Plaque Index and the baseline mean gingival scores using Loe and Silness gingival index of the two study groups (i.e., twice a day tooth brushing group and morning tooth brushing and night mouth rinsing group)
2. To determine the mean plaque and gingival scores among the two study groups using the same above mentioned indices at 15 days and 1 month follow up intervals
3. To compare percentage changes in the mean plaque and gingival scores among the two groups at each visit.

Materials and Method

The present study was a randomized, 2-cell parallel design, conducted to evaluate the effectiveness of morning brushing and night mouth rinsing with that of two times tooth brushing in terms of plaque and gingivitis reduction.

Ethical clearance

Prior to the start of the study, a protocol of the intended study was submitted to the Ethical Review Committee, S.D.M. College of Dental Sciences and Hospital, Dharwad. Ethical clearance was obtained for the present study by the above mentioned Ethical Review Committee.

Study population

Source and number of subjects

The present study was conducted in Dharwad city. 76 healthy subjects, belonging to both the genders, 20-49 years of age, who met the inclusion/exclusion criteria and who signed an informed consent form were taken into the study and their demographics were recorded.

Inclusion criteria

1. Scorable facial and lingual surfaces of a minimum of 20 sound natural teeth
2. People who are capable to read, understand and sign the informed consent form
3. 20-49 years aged male and female subjects in good general health
4. Subjects with not more than 4 pockets and pockets <6 mm.
5. A Gingival Index score of ≥1.0
6. A Plaque Index score of ≥1.5
7. Availability of subjects for the entire study duration

Exclusion criteria

1. Destructive periodontal disease
2. Significant soft tissue pathology, severe gingivitis/systemically related gingival enlargement
3. History of diabetes, hepatic, renal disease or other serious medical condition and transmissible disease
4. Orthodontic appliance or any kind of fixed or removable appliances
5. History of allergies to dental products or their ingredients
6. Pregnant and breast feeding women
7. History of adverse habits like smoking and tobacco chewing
8. Patients under antibiotics, steroid therapy or any anti inflammatory drugs in the previous month.
9. Oral prophylaxis in the preceding month or periodontal treatment in the preceding 3 months or participation in any other plaque and gingivitis clinical study involving oral products within the last 30 days

Sample size determination

Sample size is calculated using the formula

$$n_0 = \frac{Z^2\sigma^2}{e^2}$$

Z = Standard variate value (1.96 at 5% and 2.58 at 1% level of significance)

e = Acceptable error (0.05)

σ = SD of the sample/population

A study was done to evaluate the relationship between frequency of mechanical removal of plaque (MRP) and gingival inflammation. The standard deviation (SD) of the mean plaque score at 30 days interval in 12hr group (i.e., **SD=0.13**) was considered to determine the sample size.[17]

$$n_0 = \frac{(1.96)^2 \times (0.13)^2}{(0.05)^2}$$

$$= 25.95$$

Sample size for the present study was 52 (26 subjects each in the two groups)

Study design

Configuration: The present study was a randomized, 2-cell parallel design clinical study. A total of 90 subjects were examined for the present study. 76 of them were selected, since 14 of them did not meet the inclusion criteria. For the standardization purpose all the subjects who were selected underwent a washout period for 7 days. All were given similar washout toothpaste and a toothbrush (Colgate Maxfresh Toothpaste and a medium bristled Colgate Toothbrush) for the purpose of uniformity and were asked to use it for 7 days and were recalled on the 7th day for the baseline visit. On the day of baseline visit, their gingival and plaque scores were recorded using Loe and Silness gingival index (modified) and Quigley and Hein plaque index (1962) modified by Turesky et al (1970) respectively. Subjects were randomized into two study groups (Group 1: Twice a day toothbrushing group (i.e., once in the morning and once at night) and Group 2: Once a day toothbrushing i.e., in the morning and night

mouthrinsing group) based on their baseline mean gingival scores. Their washout toothpastes and toothbrushes were taken back and were issued their respective study products (i.e., Colgate MaxFresh toothpaste and a medium bristled Colgate toothbrush for twice a day tooth brushing group and for once a day toothbrushing and night mouth rinsing group in addition to Colgate MaxFresh toothpaste and a medium bristled Colgate toothbrush they were also issued a 200ml and a 100 ml (i.e., a total of 300 ml) of freshchlor mouthrinse) and all the subjects were instructed regarding the usage of their respective products. The weight of the issued toothpaste and the mouthrinse were noted. To check the compliance of the subjects, they were asked to get their products during their future visits. Subjects were recalled after 15 days for the first visit, on that day gingival and plaque scores were recorded using the above mentioned indices and also to check for the product usage the toothpastes and the mouthrinses were weighed. Subjects were recalled after 30 days of their baseline visit for their final visit. Gingival and plaque scores were recorded using the above mentioned indices and also toothpastes and the mouthrinses were weighed to check the compliance of subjects.

Compliance

During the study period, all the subjects were given a reminder regarding the usage of their products and their visits through a phone call and through text messages at certain interval. Subjects were also asked to get their respective products during each visit, and the products were weighed. It is compared with actual weight of the product, so that we get to know the amount of product the subject has used. If it was found that the subject has not used the product in required amount or has not followed the instructions then again he will be instructed regarding the usage, so that he will follow it in future. The investigator considered the subjects as drop out if they did not follow the instructions.

Study duration

The present study was conducted over a period of one month from March 2017 to April 2017 in Hubli Dharwad City

Study products

Before the start of the study, letters were mailed to various consumer products companies requesting for the provision of samples of dentifrices, tooth brushes and mouth rinses. The Colgate Palmolive Company responded positively by giving the samples of tooth pastes. Tooth brushes and mouth rinses were purchased by the investigator.

For the washout period, all the subjects received the same toothpastes and toothbrushes. Toothpaste used was Colgate MaxFresh with Sodium Fluoride 0.24% and the toothbrush used was a medium bristled Colgate toothbrush.

After the washout period, the study products were issued to the subjects. Both the Groups received toothbrushes and toothpastes. The dentifrice used was Colgate MaxFresh with Sodium Fluoride 0.24% being active ingredient. The toothbrush was a medium bristled Colgate toothbrush. The bristle ends were rounded and polished made of nylon. The mouthrinse group received stabilized chlorine dioxide containing Freshclor mouthrinse in addition to the above mentioned toothpaste and toothbrush.

Prohibited / allowable medications or precautions

The use of any other mouth rinse, dentifrice or oral hygiene devices other than the test materials during the study period was not allowed. The subjects were not forced to stop using any other products or any medications but they have to inform the study investigator regarding the usage, so that the investigator

can drop out the subject from the study, or else the usage of such materials may interfere with the study results

Study product administration

The commercially available products were supplied in their original containers to the subjects by the personnel not involved in the subject evaluation

Instructions to subjects

1. For the purpose of standardization, a common brushing technique, i.e., modified Bass technique was taught to all the study subjects.
2. The subjects were asked to use the assigned products regularly as per instructions.
3. The subjects were instructed not to use any other type of oral hygiene aids during the period of the study. In case they are using then they have to inform the investigator and they will be considered as drop out from the study.

Instructions to use mouth rinse

The subjects of the mouthrinse group were asked to rinse with 10ml of chlorine dioxide mouthrinse(Freshchlor) for 30 seconds at night. During this study, subjects were instructed to refrain from using other commercial mouth rinses and any other medications. Further, the subjects were informed that, any loss of the issued mouth rinse has to be reported to the personnel on their subsequent visit, so that it can be re issued.

Infection control: all the instruments used for oral examination were sterilized in the Central Sterile Supplies Department (CSSD), S.D.M college of Dental Sciences and Hospital, Dharwad.

Subject Progress and Discontinuation:

Subjects were considered to have completed the study if they were followed up throughout the duration of the study. Subjects were considered lost to follow up if no contact had been established by the time the study was completed such that there was insufficient information to determine the subject's status. A genuine effort was made to determine the reasons of dropout. Subjects could be dropped out if any of the following occurred.

Subjects failed to substantially comply with the protocol requirement.

Subject failed to report for a scheduled examination

Subjects received emergency dental or medical treatment or any medication that may interfere with the parameters under study.

Subject developed serious adverse reactions

Subject chose to terminate participation in the study

Subject discontinued treatment or relocated

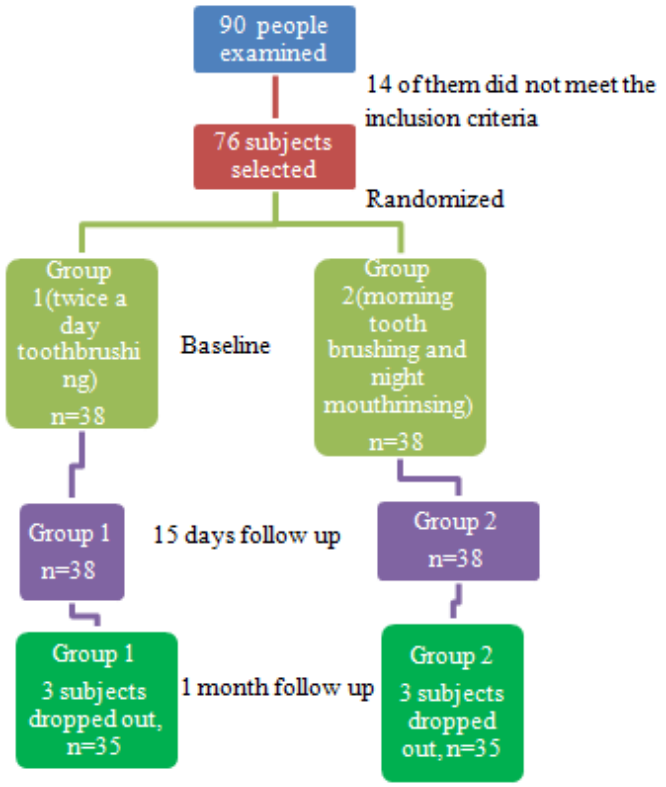
Statistical Analysis

The gingival and plaque scores of the subjects at each visit were entered into the computer (MS-Office 2007, Excel data sheet).The data was subjected to statistical analysis using the statistical package (SPSS version 20).

Inter-group comparison of the plaque and gingival index scores among the 2 groups, were done using unpaired t test. Statistical significance was recorded if the P-value was 0.05 or less.

The mean plaque and gingival scores of the baseline, 15 days and one month were compared within the same group by paired t test. Statistical significance was recorded if the P-value was 0.05 or less.

Consort flow diagram showing the distribution of study subjects



Results

This Randomized Clinical Study was conducted among 76 subjects for a period of 4 weeks. Table 1 shows the random allocation of study subjects into two groups of 38 subjects each. Group 1: Twice a day tooth brushing (once in the morning and once at night); Group 2: Once a day tooth brushing (in the morning) and night mouth rinsing. The subjects were followed for a period of 4 weeks after issuing the respective products (Group 1-Colgate Maxfresh Toothpaste, Group 2-Colgate Maxfresh Toothpaste and Freshchlor Mouthwash). At the end of the study period, a total of 70 subjects were available for the follow up, 35 subjects in each group with an overall attrition rate of 7.89% (n=6). The number of dropouts were 3 (7.89%) in both the groups.

Table 2 shows the baseline gingival and plaque scores. The mean baseline gingival scores ranged from **1.0557±0.0646** for Group 1 and from **1.0550±0.0445** for Group 2. The mean baseline plaque scores ranged from **3.0640±0.365** in Group 1 and from **3.0262±0.3257** in Group 2. Independent t test was applied which showed that there was no statistically significant difference in baseline gingival and plaque scores between the two groups (**P>0.05**)

Table 3 shows the gingival and plaque scores on the 15th day recall visit. The mean gingival scores reduced from 1.0557±0.0646 to **0.7871±0.1319** in twice a day tooth brushing group and from 1.0550±0.0445 to **0.8498±0.1296** in night mouth rinsing group and the mean plaque scores reduced from 3.0640±0.365 to **2.4811±0.2661** in twice a day tooth brushing group and from 3.0262±0.3257 to **2.6174±0.0429** in night mouth rinsing group. The Independent t test was applied which showed that there was a significant difference in the mean plaque and gingival scores among the two groups at 15 days follow up (**P<0.05**).

Table 4 shows the gingival and plaque scores on the recall visit again after the15 days (i.e., 1 month from baseline). The mean gingival scores reduced from 1.0557±0.0646 to **0.6428±0.1145** in tooth brushing group and from 1.0550±0.0445 to **0.7159±0.0875** in night mouth rinsing group. Mean plaque score reduced from 3.0640±0.365 to **2.1987±0.2057** in tooth brushing group and from 3.0262±0.3257 to **2.3336±0.0329** in night mouth rinsing group. The Independent t test was applied which showed that there was a significant difference in the mean plaque and gingival scores among the two groups at 1 month follow up (**P<0.05**).

Discussion

Dental caries and periodontal disease are the most commonly occurring diseases affecting mankind. Dental plaque is a very important factor in the causation of these diseases.[17] Evidence from different fields of dental research has shown that oral deposits play a major role in the development of periodontal disease.[18] These

diseases can be controlled through various personal and professional oral hygiene measures.

One of the most commonly used aids for maintaining oral hygiene is tooth brushing. A study done by Stanmeyer(1957) stated that as the frequency of toothbrushing increases, gingival inflammation decreases but that the benefits appear to reach their peak with two brushings a day.[14] Twice a day tooth brushing is recommended by most of the dentists to improve plaque control. However, most of the people fail to achieve sufficient plaque removal at home, especially through night brushing, this might be because of lack of awareness or even though they know twice a day toothbrushing is better they may not practice, since it is time consuming or due to various other reasons.

Control of plaque to reduce the oral microorganisms by antimicrobial mouthrinses as an adjunctive to mechanical plaque control has been considered to be an effective method of preventing dental diseases.[19] Mouthrinses are solutions or liquids used to rinse the mouth for a number of purposes: (a) Prevent the biofilm formation (b) inhibition of early microbial colonization on tooth surfaces (c) the alteration of pathogenic plaque into nonpathogenic plaque, and (d) to have a therapeutic effect by relieving periodontal infections or preventing dental caries.[20]

A systematic review of the literature on the effects of a post toothbrushing rinsing on plaque and parameters of gingival inflammation was done. A clear effect was observed, indicating that different mouthrinses (chlorhexidine, probiotic, herbal, essential oil mouthrinse) when used as an adjunct to mechanical means of oral hygiene, provides an additional benefit with regard to plaque and gingivitis reduction as compared to a placebo or control.[4]

Based on these findings, it was noticed that mouthrinsing used as an adjunct to tooth brushing has an additional benefit in the reduction of plaque and gingivitis. But there is paucity in the studies showing whether mouthrinsing can be replaced to tooth brushing. So this randomized, examiner blind, parallel 2-cell study was undertaken to find whether night brushing can be replaced by night mouthrinsing which is also proved to be an effective aid in reducing the bacterial load of the oral cavity and also it is less time consuming and easier to practice as compared to tooth brushing. If the results are found to be favorable, then it can be recommended to the public regarding Mouthrinsing at night.

The products required for the study were toothpastes, toothbrushes and mouthrinse. Prior to the start of the study, letters were mailed to various consumer products companies requesting for the provision of samples of dentifrices, tooth brushes and mouth rinses. The Colgate Palmolive Company responded positively by giving the samples of tooth pastes. Tooth brushes and mouth rinses were purchased by the investigator.

The dentifrice used was Colgate MaxFresh with Sodium Fluoride 0.24% being active ingredient. The toothbrush was a medium bristled Colgate toothbrush. The bristle ends were rounded and polished made of nylon. The mouthrinse group received stabilized chlorine dioxide containing Freshclor mouthrinse. Even though Chlorhexidine is considered as a “gold standard” of antimicrobial rinses, it has a side effect that it causes staining of the teeth when used on a long term basis. Hence, here we used Freshclor mouthrinse which causes no staining of the teeth and is recommended for daily use.

The study was conducted in Dharwad city among 76 healthy subjects, 20-49 years of age, who met the inclusion/exclusion criteria and who signed an informed

consent form. After reviewing the relevant literatures a total sample size of 52 (26 per group) was determined. Since it was a follow up study and drop outs were inevitable, a total of 76 subjects were enrolled, who were selected randomly and were balanced based on their baseline gingival scores into two treatment groups of 38 each (i.e., Group 1: Twice a day tooth brushing group, i.e., in the morning and at night- 38 subjects and Group 2: Morning toothbrushing and Night mouth rinsing group- 38 subjects).

The study subjects were aged 20-49 years with the mean age of 22 years. This age group was chosen since mild to moderate forms of gingivitis occur more commonly in this age group and signs of advanced periodontal diseases like mobility, pockets, recession etc are common in those aged above 45 years. Other reasons include higher chances of developing chronic systemic diseases like diabetes mellitus and hypertension and also a reduced manual dexterity for brushing may be present in subjects above 45 years of age. Such problems usually are not seen in lower age group. Van Strydonck et al conducted similar study on subjects with age group of 20-49yrs.[22]

The two groups included in the present study were Group 1: Twice a day tooth brushing (once in the morning and once at night) and Group 2: Once a day tooth brushing (in the morning) and night mouth rinsing.

The examiner was blinded in the present study to eliminate bias. All examinations were performed by a single examiner, so as to eliminate inter examiner variation. The assignment of the subjects to groups was done by a person other than the chief investigator, who also dispensed the products and provided the instructions to all the study participants. Since the products were dispatched in their original containers, it was not possible to blind the subjects from the product allocation. However, the dispensing of the products and provision of the instructions were undertaken in a place that was away from the examiner who was examining the subjects for plaque and gingivitis scores. This ensures that the examiner and the recorder were not aware as to which group the study subjects were allotted to.

After the recruitment of subjects for the study, for the purpose of uniformity, all the subjects underwent washout period and all were given similar toothpaste and a toothbrush and were asked to brush with it twice a day for 1 week using modified bass technique for 2 minutes. Standardization is necessary because the subjects might be using different oral hygiene aids which might mask the effect of the study products which will be issued to them or it might interfere with the study results. That is why to minimize this; all were given a similar toothbrush and toothpaste.

After a week of washout period on the seventh day, the subjects came to the clinic with their washout toothpastes for baseline visit. Toothpastes were collected back and were also weighed to check for their compliance. The baseline gingival and plaque scores were recorded using Loe and Silness gingival index (modified) and Quigley and Hein plaque index (1962) modified by Turesky et al (1970) respectively. Randomization was done based on their baseline gingival scores and the subjects were divided into 2 groups (Group 1: Twice a day toothbrushing group (i.e., once in the morning and once at night) and Group 2: Once a day toothbrushing i.e., in the morning and night Mouthrinsing group). Respective products were issued to them. Subjects in the Groups 1 were asked to brush twice a day with the given toothpaste and toothbrush for 2 minutes using modified bass technique. Whereas subjects in the Group 2 were asked to brush once a day

(i.e., only in the morning) using the given toothpaste and toothbrush for 2 minutes using modified bass technique and in addition to this, they received instructions to rinse daily at night for 30 seconds with 10 ml of their assigned rinse and not to eat or drink for at least 10 minutes after rinsing. And they were recalled after 15 days (first visit) to check the amount of reduction in the plaque and gingival scores and also to check the compliance of the subjects. Toothpaste and mouthrinse were weighed and the gingival and plaque scores were recorded and the subjects were again recalled after 15 days (i.e., 30 days from the baseline visit) for the final visit, same procedures which was done in the initial visit were done during their final visit, (i.e., weighing of the products and gingival and plaque score recording).

The daily oral hygiene procedures were not supervised. Reinforcement regarding the use of oral hygiene products was provided every week. The compliance of study subjects were monitored at the follow up visits by weighing the amount of toothpastes and mouthrinses left. Throughout the course of the investigation the compliance was further monitored and reinforced with phone calls and messages to each subject between examination visits.

The duration of the present study was 4 weeks and the reasons restricting the duration of the study were availability of study subjects, compliance and limited resources like the availability of products. There were also other studies conducted on antiplaque and antigingivits role of various oral hygiene products in which the subjects were followed for 2-3 weeks. [23, 24, 25]

There were no side effects reported by the study subjects

At the end of the study period, there were 6 dropouts as shown in table 1 (3 subjects from twice a day toothbrushing group and 3 subjects from night mouth rinsing group). 4 subjects were not available for the follow up visits and 2 subjects were not following the instructions properly, hence dropped out. Results were tabulated and analyzed excluding the data of these subjects.

The plaque index of Quigley and Hein (1962) modified by Turesky et al (1970) was used for quantification of dental plaque due to the number of scores of the index. This allowed the evaluation of slight changes in the amount of dental plaque and has been used extensively in various trials evaluating the efficacy of oral hygiene regimens.[26.27,28] The gingival inflammation was assessed according to the Loe and Silness gingival index (modified) since it is the most widely accepted and used gingival index due to its documented validity, reliability and ease of use.

Since two groups were involved in the study, Independent t test was used to compare the mean gingivitis and plaque scores of these groups. There was a statistically significant difference in the mean gingival and plaque scores among the two groups at 15 days. Results of paired t test showed that both the groups showed significant reductions in the gingival and plaque scores from baseline to 15 days with percentage gingivitis reduction of **25.43%** and plaque reduction of **19.02%** in twice a day toothbrushing group and that in once a day toothbrushing and night mouth rinsing group being **19.44%** of percentage gingivitis reduction and plaque reduction of **13.51%** from baseline to 15 days.

The percentage change in each index was calculated for each group by dividing the difference in means (follow up – baseline mean values) by the baseline mean values (times 100 to express as percent). Percentage change in each index from baseline to each follow up was evaluated for statistical significance

using paired t test.

From 15 days to 1 month the percentage reduction in the gingival and plaque scores was **18.33%** and **11.37%** respectively for twice a day toothbrushing group and **15.75%** and **10.84%** reduction in the gingival and plaque score respectively for once a day toothbrushing and night mouth rinsing group. There was a significant reduction in both the gingival and plaque scores in both the groups from 15 days to 1 month.

The gingival and plaque score reduction from baseline to 15 days was more as compared to 15 days to 1 month in both the groups, this might be because during the first 15 days the plaque maturation was not completed and it could be easily removed whereas in the next 15 days the plaque was fully matured and difficult to remove [33] or it might be because patient compliance might have reduced during the second visit.

The overall percentage reduction in the gingival and plaque scores from baseline to 1month were 39.1% and **28.23%** respectively in twice a day toothbrushing group and 32.14% and 22.88% gingival and plaque reduction in night mouthrinsing group. An additional **6.96%** and **5.35%** reduction in the gingivitis and plaque respectively were seen in twice a day tooth brushing group. Independent t test was applied which showed that there was a significant difference in the mean gingival and plaque scores among two groups at 1 month follow-up. This might be because of the mechanical advantage of two times toothbrushing. Although, mouthrinse has antimicrobial property which reduces the plaque formation and gingival inflammation, but two times brushing reduce the gingival inflammation through gingival massage and mechanical plaque reduction.[14] The final findings of the present study suggest that tooth brushing cannot be replaced by mouth rinsing. But in people who brush once, if they practice Mouthrinsing at night then it will have a better effect than not brushing.

Limitations of the study

1. If the study was done for a longer duration then it would have given a more coherent picture related to gingivitis reduction
2. Future studies can be done by using a different mouthrinse containing different active agent which is more effective than the active agent of the mouthrinse which was used in the present study.

Table 1: Duration of the study and number of drop outs

Group	Subjects at the beginning of the study	Duration of the study (weeks)	Number of study subjects at the end of study period (n)	Number of drop outs	Percentage of drop outs
Group 1 (twice a day toothbrushing)	38	4	35	3	7.89%
Group 2 (once a day toothbrushing and night mouth rinsing)	38	4	35	3	7.89%
Total (N)	76	4	70	6	7.89%

Table 2: Mean gingival and plaque scores among the two groups at the **initial visit** (Baseline visit)

Study Groups	No. of subjects	Gingival scores Mean ± SD	Plaque scores Mean ± SD
Group 1 (twice a day tooth brushing)	35	1.0557±0.0646	3.0640±0.3651
Group 2 (once a day tooth brushing and night mouth rinsing)	35	1.0550±0.0445	3.0262±0.3257
P Value	70	0.650	0.959

SD- Standard Deviation

Table 3: Gingival and plaque status among the two groups at **15 days** follow up

Study Group	Baseline		15 days	
	Gingival Index Mean±SD	Plaque Index Mean±SD	Gingival Index Mean±SD	Plaque Index Mean±SD
Group 1 (twice a day tooth brushing)	1.0557±0.0646	3.0640±0.3651	0.7871±0.1319	2.4811±0.2661
Group 2 (once a day tooth brushing and night mouth rinsing)	1.0550±0.0445	3.0262±0.3257	0.8498±0.1296	2.6174±0.0429
Sig. (2-tailed)	0.650	0.959	0.049	0.032

SD- Standard Deviation

Table 4: Gingival and plaque status among the two groups at **1 month** follow up

Study Group	Baseline		1 month	
	Gingival Index Mean±SD	Plaque Index Mean±SD	Gingival Index Mean±SD	Plaque Index Mean±SD
Group 1 (twice a day tooth brushing)	1.0557±0.0646	3.0640±0.3651	0.6428±0.1145	2.1987±0.2057
Group 2 (once a day tooth brushing and night mouth rinsing)	1.0550±0.0445	3.0262±0.3257	0.7159±0.0875	2.3336±0.0329
Sig. (2-tailed)	0.650	0.959	0.004	0.006

SD- Standard Deviation

Conclusion

The present study was conducted to evaluate whether tooth brushing and mouth rinsing (i.e., morning tooth brushing and at night mouth rinsing) is effective to twice a day toothbrushing (i.e., toothbrushing both in the morning and at night) in terms of plaque and gingivitis reduction

1. Twice a day tooth brushing showed a significant reduction in the plaque and gingivitis compared to morning tooth brushing and night mouth rinsing
2. The findings suggest that twice a day tooth brushing is better than morning brushing and night mouth rinsing
3. Even though it is proved that twice a day tooth brushing is better, people who do not brush at night, if they practice mouth rinsing, which is easier to practice and less time consuming, then it will be more effective than not brushing

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