

Comparison of Plaque Removal Efficacy of Toothbrush with Bristle Containing Neem and Charcoal for Maintaining Oral Hygiene: A Randomised Clinical Trial

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ABSTRACT

Introduction: To facilitate good oral health, plaque control by toothbrushing is of utmost importance. The poor oral hygiene leads to accumulation of plaque and calculus. It is the primary aetiological factor for gingival diseases.

Aim: To compare the plaque removal efficacy of toothbrush bristles containing neem and charcoal to assess the effect on oral hygiene.

Materials And Methods: This was a double-blind, randomised clinical trial conducted among 30 participants of age group between 33 to 44 years, who reported to the Outpatient Department of Sharad Pawar Dental College and Hospital, Maharashtra, India, for 21 days, in June 2021. Neem and charcoal toothbrushes were given to allotted participants and

plaque index was measured at baseline, 7th day, and 15th day. For intergroup and intragroup comparison Independent t-test and repeated measures Analysis of Variance (ANOVA) tests were used.

Results: The mean plaque index score of neem toothbrush and charcoal toothbrush at baseline was 2.13 and 2.18 and, on day 7th was 1.79 and 1.48, respectively. No significant difference was found between the plaque scores of both the groups at baseline and seven days. However, a statistically significant difference was observed in the plaque index at 15th day between neem (1.21) and charcoal (0.61) groups with p-value=0.004.

Conclusion: It is concluded that when compared to neem toothbrushes, charcoal toothbrushes had greater plaque control efficacy for maintaining good oral hygiene.

Keywords: Charcoal toothbrush, Neem toothbrush, Oral Health, toothpaste

INTRODUCTION

Dental plaque is the origin of gingival and periodontal illness, which hampers oral status. It is also capable of reducing the pH at the enamel surface to the extent that causes dissolution of the hydroxyapatite crystals and initiates caries. Since the dawn of time, a variety of oral hygiene measures have been employed in which toothbrushes and dentifrices were frequently used to clean the teeth [1]. The use of a toothbrush and toothpaste is the most common among all available oral hygiene approaches and was regarded to be a significant aspect in maintaining oral health in the long-term. The prevention and treatment of oral diseases and maintaining oral hygiene certainly needed for the elimination of plaque [2]. In 1981, Löe demonstrated good oral hygiene at home; as a result, he concluded that optimal dental health requires strict and consistent oral hygiene [3].

All populations and almost every culture in the world have adopted oral hygiene measures since ancient times till the 21st century and it has become an integral part of a daily routine [4]. The toothbrushes were invented in China around 1000 AD and it was introduced in Europe in the 17th century. It was the latter part of that century before American dentists spoke highly of its use. It is interesting to learn that it was the outcome of a compulsory toothbrushing regimen for American warriors during World War II that they brought the habit back home. They have sparked the universal use of toothbrushing and it has become a ritual for more than half of the American population [5-7]. In the early 19th century, the toothbrush was reinvented for the first time, in which nylon bristles were introduced by Dupont de Nemours [8]. Toothbrushes are evolving day after day to conserve oral hygiene by removing debris and plaque that benefits us all [7].

The most common way for managing dental health is personal oral hygiene maintenance with a manual toothbrush. Dr. Robert Hutson invented the multitufted, flat-trimmed, end-rounded nylon filament brush in the early 1950s, which became the basis for the current conventional manual toothbrush [9]. Toothbrushing, when done correctly, has been a highly effective metric of biofilm control. A toothbrush's design, particularly in terms of size and contour should aid in the mechanical removal of plaque and debris. The effectiveness is determined by the type of brush, its design, method of brushing, and the amount of time taken for it [7,10].

Charcoal toothbrushes, a new type of toothbrush, have recently been introduced to the market. These are popular in Southeast Asian nations including, Malaysia, Singapore, and Indonesia [11] which have black colour bristles with binchotan charcoal being blended into the nylon fibres, thus, possessing antimicrobial qualities and resulting in lessen the amount of bacterial contamination by killing the bacteria and reduces halitosis [12,13]. Charcoal's deodorising characteristics help to naturally clean the oral cavity and eliminate plaque debris. The toothbrushes are intended to whiten teeth, freshen breath, reduce the growth of bacteria, and detoxify the body, remove bacteria by increasing the mouth pH level, and effectively clean the oral cavity [14].

Various parts of the neem plant have shown medicinal properties such as anti-inflammatory, antipyretic, analgesic, antimicrobial, antitumorogenic, antioxidant, antiulcer, and immunostimulant activity [15]. Neem is an omnipotent tree and nature's gift to mankind for the prevention and treatment of various health ailments. In past years extensive research on therapeutic benefits of neem in oral and dental problems had proved its efficacy as an excellent agent. Neem extracts are being incorporated in dental care products for

maintaining oral hygiene [16]. Neem toothbrushes, a new type of toothbrush, have also been introduced into the market. No study evaluating the effect of a toothbrush with neem and charcoal-infused bristles has been published in the literature. Thus, this study aimed to determine if neem extract containing bristles showed any difference in plaque removal efficacy for maintaining oral hygiene compared to charcoal-infused nylon bristles by keeping other parameters that influence oral hygiene constant following use over time.

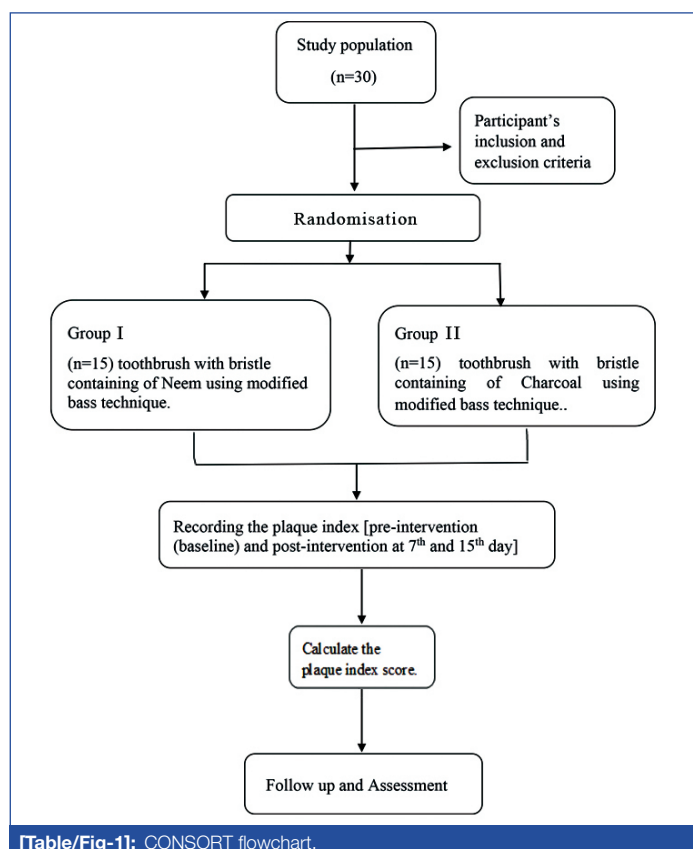
MATERIALS AND METHODS

A randomised, double-blind, clinical trial was conducted for 21 days, in June 2021 at Sharad Pawar Dental College and Hospital, Maharashtra, India. The study protocol was reviewed and ethical clearance was provided by the Institutional Ethical Committee of Datta Meghe Institute of Medical Sciences, Sawangi (Meghe) Wardha, Maharashtra, India. The study population consisted of 30 participants (male and female) and they were divided in two groups, each group had 15 participants.

Inclusion criteria: Subjects who gave consent to participate in the study, between 33 to 44 years of age, with an original plaque score recorded above 2, (by plaque index given by Silness P and Loe H, in 1964) [17] and presence of atleast twenty long-lasting natural teeth (excluding wisdom tooth, teeth with orthodontic appliances) were included in the study.

Exclusion criteria: Subjects with any physical constraints that might prevent normal oral hygiene procedures, history of sensitivity to toothpaste, use of interdental aids (interdental floss, mouth rinses, etc), pregnant or breastfeeding females, subjects under medication such as anti-inflammatory, antiepileptic and antihypertensive, medically compromised patients (systemic diseases such as cardiovascular disease, diabetes, etc), evidences of gingival or periodontal diseases or trauma at baseline, any lesion of hard and soft tissue, were excluded from the study.

Before the commencement of the trial, the investigator examined all participants and examination was done under the guidance of guide and Professor for calibration and to intraexaminer variability. The selected 30 participants were randomised into two interventional groups (Group I and II) by lottery method [Table/Fig-1].



- Groups I-15 participants were instructed to use a toothbrush with bristles containing neem.
- Group II-Other 15 participants were instructed to use a toothbrush with bristles containing Charcoal.

Study Procedure

The clinical examination of all the subjects were done by a single investigator. All the selected participants were trained with modified Bass technique [18] on tooth models for the use of neem and charcoal toothbrushes. They were advised to brush twice a day in the morning and the evening for two minutes with specific toothbrush and Colgate toothpaste, provided by the investigator. They were also instructed to avoid other oral hygiene aids during the period of study (i.e., no irrigation devices, dental floss, mouth rinses, etc). In this study the Plaque Index was measured at baseline, 7th day, and 15th day. The scores were collected before and after brushing then data was recorded and statistically analysed.

The demographic information of the patients were collected on the first visit. Participants received an intraoral examination and the plaque index score was measured. They were also instructed to follow the same brushing pattern for the next seven days. After seven days, patients were called again, and their plaque index score was recalculated. The current plaque score was compared with the prior score. The patients were checked after 15 days, and the plaque index score was remeasured. This was done to observe how effective a toothbrush was at removing plaque thus maintaining oral hygiene.

Double-blinded study was carried out, as the principal investigator and patient was not aware regarding the groups. The examiners were trained and calibrated. The teeth used for index were dried and examined visually. A sterilised explorer and a mouth mirror was used to test the tooth surface on dental units in the daytime.

STATISTICAL ANALYSIS

The authors performed power analysis with a confidence interval at 80% and the data was collected by the assistant and performed randomisation. Statistical Package for Social Science (SPSS) version 22.0 was used to analyse the data. Plaque index scores were averaged, and standard deviations were calculated. Independent t-test for intergroup and repeated measures ANOVA for intragroup comparison had been done. A p-value <0.05 was considered as significant.

RESULTS

Out of 30 participants, neem toothbrush group had six males and nine females, while the charcoal toothbrush group had seven males and eight females [Table/Fig-2]. The mean age for both the groups were 37.03±1.28 years. There were no dropouts. In group I when baseline was compared with 7th day, there was no statistically significant difference p-value=0.232. When the baseline was compared with 15th day, mean difference was found to be highly significant p-value=0.001. In group II significant difference was found in the mean plaque score between three time intervals. When baseline was compared with 15th day, the mean difference was 0.57 which was also highly significant (p-value=0.001). When 7th day was compared with 15th day the mean difference was -0.87 and statistically significant difference was p-value=0.001 [Table/Fig-3]. The difference in the values indicates the significant reduction in plaque accumulation occurring in charcoal group than the neem group.

Group	Male (n)	Female (n)	p-value
Neem	6	9	0.05
Charcoal	7	8	

[Table/Fig-2]: Gender distribution.
p-value <0.05 considered significant

Dependent variable	(I) groups	(J) groups	Mean difference (I-J)	p-value
Neem group	Baseline	7 th day	0.34	0.232
		15 th day	0.92	0.001*
	7 th day	Baseline	-0.34	0.232
		15 th day	0.58	0.019*
	15 th day	Baseline	-0.92	0.001*
		7 th day	-0.58	0.019*
Charcoal	Baseline	7 th day	0.71	0.003*
		15 th day	0.57	0.001*
	7 th day	Baseline	-0.70	0.003*
		15 th day	0.87	0.001*
	15 th day	Baseline	-1.57	0.001*
		7 th day	-0.87	0.001*

[Table/Fig-3]: Comparison of plaque score with neem toothbrush group and charcoal toothbrush group at baseline, 7th day and 15th day.

ANOVA test was used. *p-value<0.05 considered significant

[Table/Fig-4] shows the comparison of neem toothbrush group and charcoal toothbrush group with respect to total plaque scores at baseline, 7th day, and 15th day. The mean plaque score on the 15th day between the two groups showed high statistically significant difference with p-value=0.004. Thus, charcoal toothbrush was more effective in plaque removal when compared to neem toothbrushes.

	Groups	N	Mean	Std. Deviation	t-test	p-value (2-tailed)
Baseline	Neem	15	2.13	0.59	-0.24	0.80
	Charcoal	15	2.18	0.59		
7 th day	Neem	15	1.79	0.56	1.58	0.12
	Charcoal	15	1.48	0.51		
15 th day	Neem	15	1.21	0.52	3.17	0.004
	Charcoal	15	0.61	0.51		

[Table/Fig-4]: Comparison of neem and charcoal groups with respect to total plaque scores at baseline, 7th day and 15th day.

independent t-test was used, p-value <0.05 considered significant

DISCUSSION

After using the neem toothbrush and charcoal toothbrush, significant reduction in plaque score was noted from baseline to 15th day in both the groups. The results showed that neem and charcoal both preserved the oral hygiene, but charcoal reduced plaque more efficiently than neem toothbrush. Hence, incorporating herbal content to a toothbrush can improve plaque reduction [19].

A study carried out by Kaur A et al., compared Colgate sensitive and Colgate-17 X slim soft charcoal toothbrush. Colgate sensitive had a plaque score of 1.062, whereas Colgate thin soft charcoal toothbrush had a plaque score of 0.750. Therefore, they concluded that charcoal toothbrush was more effective than Colgate sensitive toothbrush [20]. The mean plaque score of charcoal toothbrush in this study also decreased from 2.18 to 0.61 from baseline to 15th day which indicates effectiveness of charcoal brush.

Bhat DS et al., conducted a study to compare the efficacy of charcoal and conventional toothbrushes to control plaque and maintain periodontal health. On observation of the study there was a reduction in the plaque score, at baseline, two weeks and one month. They concluded that while charcoal toothbrushes are useful in improving periodontal health, conventional toothbrushes are more effective in removing plaque than charcoal toothbrushes. [12]. However, in the present study, significant reduction in plaque scores were observed in charcoal toothbrush group after 15 days. The decrease in plaque score is attributed to the fact that blending charcoal into nylon bristles can reduce plaque, halitosis (as charcoal has adsorptive and non toxic properties), and also kill bacteria that may develop in the bristles during storage, reducing bacterial contamination of toothbrushes,

according to the manufacturers of these toothbrushes. It has high whitening action by eliminating discolouration and fruitful in removing oral germs, odour, and acids [14].

Iyer N et al., stated that while choosing a toothbrush, the bristles are the most significant reflection. Now-a-days a lot of variations in toothbrushes are available along with the persistent advancement of brushes [21]. Charcoal toothbrushes have also known to inhibit the microbial proliferation, reduce oral malodour and improve the efficacy of plaque removal as per a study conducted by Al-Ahmad A et al., [22].

A study conducted by Bhambal A et al., found no difference in plaque and gingival scores for different sites using neem stick and toothbrush when 30 subjects of age 18-25 years were examined using Quigley Hein Plaque Index (QHPI) [23]. The authors concluded that chewing sticks have usefulness because of their mechanical cleaning action, chemically reduction in the plaque formation and have antibacterial properties against a variety of oral bacteria [23]. In the present study also, the neem toothbrush was efficient in plaque removal.

Limitation(s)

The present study was limited by its small sample size.

CONCLUSION(S)

After evaluation, use of charcoal toothbrush reduced plaque more effectively than neem toothbrush. Accordingly, it can be concluded that plaque removal efficacy of charcoal toothbrush was higher than neem toothbrush for maintaining the oral hygiene. More studies with a larger sample size are necessary to validate the findings of this study.

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