Original article

Evaluation of the efficacy of charcoal coated toothbrush and conventional toothbrush in periodontal health: A comparative clinical study

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Abstract

Context and Design: One of the most important causes for the initiation and progression of periodontal diseases is the plaque microorganisms. The bacteria in the dental plaque can lead to an extension of inflammation to the surrounding periodontal tissues leading to periodontal breakdown, which can eventually lead to tooth loss. To overcome this and to facilitate good oral health, plaque control by tooth brushing is of utmost importance. **Aim:** To determine the efficacy of charcoal toothbrush and conventional toothbrush in maintaining periodontal health. **Methods and Material:** The study group comprised of 40 dental students in the age range of 23 – 25 years. After one month of oral prophylaxis, a double-blinded clinical study was conducted wherein all the study participants were instructed with oral hygiene techniques after which the plaque index, gingival index, oral hygiene status, probing pocket depth, and clinical attachment levels were assessed at the baseline, at the end of two weeks and one month. Friedman's test and Man Whitney U test used to evaluate the efficacy of the two brushes in plaque removal and to maintain periodontal health. **Results:** Statistical significant difference was noticed in the plaque index and oral hygiene index simplified (OHIS) at two weeks with regular brush performing than with charcoal. **Conclusions:** Conventional toothbrush was significantly more effective in plaque removal and maintaining an overall good oral hygiene status than the charcoal toothbrush.

Keywords: Dental plaque, periodontal pocket, tooth brushing, charcoal toothbrush

Key Message: When it comes to plaque removal, conventional toothbrush is better than charcoal toothbrush.

Introduction

Dental plaque is one of the etiologic factors to cause dental caries and periodontal diseases and thus, effective plaque removal is the basis and proper tooth brushing is necessary to facilitate good oral health.[1]Although an appropriate level of plaque control can be achieved by a manual toothbrush, the brushing technique and time is likely to be less than ideal and varies between different individuals.[2,3] Many studies have observed the deposits of plaque present more in the interproximal areas and the gingival margins, and thus, more emphasis has to be given to effectiveness of plaque removal.[4,5,6] Tooth brushing is the most widely used method for plaque control[7] and a wide variety of toothbrushes are available in the market, but studies comparing the efficacy of toothbrushes are less. Off- late charcoal toothbrushes have been introduced into the market that have black coloured bristles with binchotan charcoal being blended into the nylon bristles, thus, possessing antimicrobial properties and resulting in less bacterial contamination. With this background, this study aimed to investigate the efficacy of

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charcoal toothbrushes in removing the plaque and maintaining good periodontal health than that of the conventional toothbrushes.

Subjects and Methods

In the present study, a total of 40 dental students in the age group of 23 - 25 years studying in 4th year and interns with tooth brushing frequency of twice daily were included. All the students who participated in the study were manual brush users. The inclusion criteria comprised subjects willing to participate in the study with no dental caries or adverse restorations, subjects with minimum or no gingival inflammation, no history of antibiotics in the past six months, no additional plaque control aids over the previous six months, presence of a minimum of 24 teeth in the oral cavity, no adverse habits like smoking or pan chewing, and subjects with mild to moderate periodontitis.

Two toothbrushes - a charcoal toothbrush and a conventional toothbrush, i.e., one with a slender head with three rows of bristles - were used in this study. Both the toothbrushes were similar in design with a compact head, soft bristles, and a bristle tip that was less than 0.01 mm (Colgate® Slim Soft Charcoal Toothbrush). Subjects were randomly selected and divided into two groups: Group A (test) comprised of 20 subjects using charcoal toothbrush and Group B (control) comprised of subjects using the conventional toothbrush. All participants were given standard instructions on tooth brushing so as to minimise the bias in the study. The Modified Bass technique was used for both the groups, wherein the head of the toothbrush was applied at a 45-degree angle to the long axis of the tooth and directed into the sulcus. A small back-and-forth motion was performed without disengaging the bristle ends from the sulcus.[7] The subjects were instructed to brush their teeth for one minute using a distal oblique grip[8] focusing on the outer, inner, and the chewing surfaces of all the teeth. Since the participants of the study were dental students and interns, the subjects were instructed to use the specified toothbrush with toothpaste at home or hostel between the study visits and to do so throughout the study along with their daily one-minute brushing' documentation on a standardized recording sheet provided to them. Subjects were also instructed to refrain from eating, drinking, chewing gum or smoking four hours prior to their appointment time.

Clinical examination

The baseline examination included the registration of oral hygiene status by recording the debris index and calculus index, tooth decay, plaque index,[9] gingival index, and bleeding on probing.[10] The severity of periodontitis was determined using the consensus definitions published by the joint Center for Disease Control/American Association of Periodontology (CDC/AAP)[11] working groups, wherein severe periodontitis cases were had more than or equal to two interproximal sites with clinical attachment loss more than 6 mm not on the same tooth and more than one interproximal site with probing pocket depth of more than 5 mm. Moderate periodontitis cases had more than two interproximal sites with clinical attachment loss more than 4 mm or more than two interproximal sites with probing pocket depth of more than 5 mm not on the same tooth. Mild periodontitis cases had more than two interproximal sites with clinical attachment loss more than 3 mm and more than 2 mm interproximal sites with probing pocket depth more than 4 mm not on the same tooth or one site with probing pocket depth of more than 5 mm. No periodontitis was considered when there was no evidence of mild, moderate, or severe periodontitis. These criteria were applied to all the permanent teeth except for the third molars.[12] Thus, the severity of periodontitis was assessed in both the test as well as the control group at baseline, two weeks and one month. In this double-blinded study, one investigator divided the subjects into the test and the control groups while the other investigator randomly measured the clinical parameters.

Statistical Analysis

The results were subjected to statistical analysis and Friedman's test was performed so as to evaluate the efficacy of charcoal toothbrush and a conventional toothbrush.

Results

The present study included 40 dental students in which Group A (test) comprised 20 subjects using a charcoal toothbrush and Group B (control) comprised 20 subjects using a conventional

toothbrush, both the groups following a Modified Bass technique. Various periodontal parameters like the plaque index, gingival index, and oral hygiene index simplified; probing pocket depth and clinical attachment levels were assessed at baseline, two weeks and one month for both the groups. (Table 1)

Table 1: Descriptive values of various periodontal values for the two brushes

	Charcoal toothbrush			Regular toothbrush		
	N	**Mean**	**Std. Deviation**	**N**	**Mean**	**Std. Deviation**
PI-BASELINE	16	0.28	0.30	20	0.23	0.43
PI-2 WEEKS	16	0.29	0.29	20	0.14	0.23
PI-1 MONTH	11	0.08	0.18	13	0.07	0.24
GI-BASELINE	16	0.06	0.24	20	0.40	0.74
GI-2 WEEKS	16	0.07	0.24	20	0.20	0.40
GI-1 MONTH	10	0.20	0.63	14	0.21	0.57
PPD-BASELINE	16	1.87	0.5	20	1.64	0.75
PPD-2 WEEKS	16	1.62	0.80	20	1.60	0.82
PPD-1 MONTH	11	1.45	0.93	13	1.23	1.01
CAL-BASELINE	16	1.25	1	20	1.15	1.08
CAL-2 WEEKS	16	1.13	1.02	20	1	1.02
CAL-1 MONTH	11	1.09	1.04	13	0.77	1.01
OHIS	16	0.13	0.24	20	0.24	0.43
OHIS-2 WEEKS	16	0.30	0.44	19	0.03	0.09
OHIS-1 MONTH	11	0.45	1.5	13	0.03	0.13

PI – Plaque Index, GI – Gingival Index, PPD – probing pocket depth, CAL – clinical attachment level, OHIS – oral hygiene index simplified

Friedman's test between baseline, two weeks and one month, revealed a statistically significant difference in the plaque index and probing pocket depth for charcoal brush and plaque index, clinical attachment level and Oral Hygiene Index Simplified for a conventional brush.

Table 2: Comparison of various periodontal parameters using two brushes at three time intervals

	Charcoal brush		Regular brush	
	P value	Significant pairs	P value	Significant pairs
PI	**0.002***	**Baseline and 1 month**	**0.012***	**Baseline and 1 month**
GI	0.651		0.112	
PPD	**0.001***	**Between Baseline and 2 weeks And between 2 weeks and 1 month**	0.895	
CAL	0.607		**0.008***	**Baseline and 1 month**
OHIS	0.102		**0.028***	

*p<0.05

p-value Significant at $P<0.05$.

PI – Plaque Index, GI – Gingival Index, PPD – probing pocket depth, CAL – clinical attachment level,

OHIS – oral hygiene index simplified

Post hoc analysis with Wilcoxon signed-rank tests was conducted with a Bonferroni correction applied, which showed a statistically significant level.

In relation to charcoal brush, there was a reduction in plaque level found from baseline to one month and a reduction in the probing pocket depth between baseline to two weeks and two weeks to one month with a statistically significant difference. For the regular brush, a statistically significant reduction was found between baseline and one month for plaque levels and clinical attachment loss. (Table 2)

However, with respect to plaque index and oral hygiene index simplified, Man Whitney U test between a charcoal toothbrush and a conventional toothbrush showed a statistically significant

difference in plaque index and Oral Hygiene Index Simplified at two weeks with a conventional toothbrush performing better than a charcoal toothbrush. (Table 3)

Table 3: Comparison of various periodontal parameters between two brushes at three time intervals

Periodontal parameters	Time intervals	P value
PI	baseline	0.39
	2 weeks	**0.03**
	1 month	0.32
GI	baseline	0.12
	2 weeks	0.86
	1 month	0.79
PPD	baseline	0.25
	2 weeks	0.92
	1 month	0.57
CAL	baseline	0.79
	2 weeks	0.71
	1 month	0.44
OHIS	baseline	0.57
	2 weeks	**0.02**
	1 month	0.85

*p<0.05

P-value obtained by Man whitney U test, significant at $P<0.05$.

PI – Plaque Index, GI – Gingival Index, PPD – probing pocket depth, CAL – clinical attachment level,

OHIS – oral hygiene index simplified

Discussion

The present study evaluated the efficacy of charcoal toothbrush and conventional toothbrush in plaque control and maintaining periodontal health. Various periodontal parameters like the plaque index, gingival index, OHI-S, probing pocket depth and clinical attachment levels were assessed at baseline, two weeks and one month for both the brushes.

It was observed that there was a reduction in the plaque levels from baseline to one month for charcoal and conventional toothbrush. This could be attributed to the design of the brush handle and brush head bristles of both the toothbrushes, making it convenient for the user to achieve a highly effective plaque removal.[13] Moreover, the brushing technique employed in this study allows the bristles to enter into the sulcular areas with a drawing action.[7] The charcoal toothbrushes are known to have bacterial resistant and antimicrobial properties due to the infusion of the charcoal into the bristles.[14]

With respect to the charcoal toothbrush, there was a statistically significant difference in the reduction of the probing pocket depth from baseline to two weeks and two weeks to one month. This could be attributed to the property of charcoal being absorbent, neutralizing toxins, poisons, and noxious gases.[14,15]

Charcoal toothbrushes have also known to inhibit the microbial proliferation, reduce oral malodour and improve the efficacy of plaque removal.[15] A study conducted by Al-Ahmad et al., (2010)[16], Basman et al., (2016)[17] and Lee J et al., (2017)[15] concluded that there was a substantial reduction in the number of colony-forming units (CFUs) in charcoal toothbrushes when compared to non-charcoal toothbrushes after one week of usage, thus, suggesting the benefits of charcoal toothbrushes.

However, with respect to plaque index and oral hygiene index simplified, Man Whitney U test between a charcoal toothbrush and a conventional toothbrush showed a statistically significant difference in the plaque index and OHIS at two weeks with the conventional toothbrush performing better than the charcoal toothbrush. This could be attributed to the fact that although the bristles of the charcoal toothbrush claim to have antimicrobial and bacterial resistant properties, the patients tend to prefer the toothbrush they have been using for a considerable time and are more comfortable with.[7] In the present study, the subjective experiences revealed that 90% of the participants found conventional toothbrushes to be more comfortable to use.

According to Cohen (1973)[18], a trial period of three weeks is necessary to test the brush accurately and the findings of the present study showed the reducing plaque scores from baseline to one month for both the conventional as well as the charcoal toothbrush and improved periodontal health from baseline to two weeks and from two weeks to one month, thus, implying the benefits of charcoal toothbrush. However, a statistically significant difference in the plaque index, OHIS, and gain

in the clinical attachment levels at two weeks with conventional toothbrush revealed the better performance of the conventional toothbrush over the charcoal toothbrush.

Despite the present study being performed on the dental students, it was found that they preferred using a conventional toothbrush over the charcoal toothbrush, which implies that for any individual, may it be a dental health professional or a layman, it takes time to adapt to new changes, accept and implement it in their routine. Moreover, the sample sizes in both the test and control groups were 20 each. Further studies with large sample size need to be conducted so as to evaluate the beneficial properties of charcoal toothbrush.

Conclusion

Within the limitations of this study, it can be concluded that although charcoal toothbrush is effective in improving periodontal health, the conventional toothbrush is more effective in plaque removal than charcoal toothbrush.

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