

A comparative evaluation of plaque-removing efficacy of air polishing and rubber-cup, bristle brush with paste polishing on oral hygiene status: A clinical study

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Abstract

Objectives: Over the years, professional dental prophylaxis has involved the use of rubber-cup, bristle brush, and abrasive paste for coronal polishing. Although air polishing is an excellent alternative for removal of tooth stain and dental plaque, very few studies have compared their efficacy *in vivo*. The present study attempts to evaluate and compare the efficacy of air polishing (test) alone versus rubber-cup polishing (control). **Materials and Methods:** A total of 35 individuals having generalized mild to moderate gingivitis were enrolled as the study population after obtaining their informed consent. Before commencement of the study, all subjects underwent scaling to remove calculus deposits (if any), following which the ipsilateral quadrant of the patient's mouth was randomly assigned as the test side and the contralateral quadrant of the same arch was assigned as the control side for polishing procedures. Time employed for both methods of polishing was held constant at 5 min for each technique. Subjects were assessed before and immediately after polishing and again after 15 days following treatment, for plaque and gingival status along with gingival bleeding. **Results:** Overall, the results of the intra-group comparison of both the polishing procedure sites indicated similar but significant plaque and gingival status changes, whereas the inter-group comparison showed no significant difference between the efficacies of both the groups. **Conclusions:** Air polishing and the rubber-cup, bristle brush with paste polishing demonstrated equivalent efficacy regarding removal of supragingival plaque and in reducing gingival inflammation.

Key words: Dental polishing, dental prophylaxis, gingivitis, plaque

INTRODUCTION

As accumulation of bacteria on tooth surfaces is the primary cause of gingivitis and periodontitis, regular mechanical removal of bacterial plaque from all non-shedding oral surfaces is considered the

primary means to prevent and stop the progression of periodontal disease. In spite of all the potentially harmful effects involving routine scaling and polishing techniques,^[1-3] it still remains as an integral part of

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periodontal therapy. The ultimate goal of professional dental polishing is complete removal of plaque and stains; however, the use of traditional rubber-cup and abrasive paste is often laborious, time consuming, and ineffective in completely removing supragingival deposits, particularly in the inaccessible interdental areas and around bonded orthodontic appliances.^[4] Also, routine use of rubber-cup with prophylaxis paste has been shown to remove the fluoride-rich outer layer of the enamel and cause significant loss of cementum and dentin over time.^[3]

In spite of numerous techniques and materials being available for getting rid of the plaque and extrinsic stains, none has qualified as a gold standard treatment modality till date. Routine home dental polishing done with powered toothbrush^[5,6] and whitening paste,^[7,8] although effective, still lacks efficiency in inaccessible areas, thus necessitating a more efficient professional polishing other than conventional rubber-cup polishing.

With the growing body of evidence to support alternative tooth polishing methods, air polishing (APP) has shown more promising results not only for supragingival polishing^[9-13] but also for effective subgingival plaque removal.^[3,14]

Even though there is conclusive evidence that APP can be used on a routine basis to polish teeth, its widespread use has not occurred among clinicians.^[15] Failure to adopt this alternative method of polishing teeth may be due to a lack of knowledge regarding the proper use of the device. It may also be due to several unsubstantiated misconceptions surrounding air polishers.

Considering the fact that since 1945, APP has been effective in rapid removal of tooth stains and plaque, and causing less invoked hypersensitivity, less operator fatigue, and improved access to pit and fissures, very few studies have compared the efficacy of traditional rubber-cup bristle brush with prophylaxis paste polishing (RCP) and APP for routine coronal polishing.^[11-13] In light of all the above aspects, an attempt has been made in this study to compare the efficacy of APP and RCP in a split-mouth design with respect to whole mouth plaque, total marginal and papillary gingivitis, along with bleeding from gingival sulcus.

MATERIALS AND METHODS

A clinical split-mouth study was carried out at the Department of Periodontics to evaluate the comparative effectiveness of APP alone (test side) and rubber-cup,

bristle brush with abrasive paste (control side) on supragingival plaque and gingivitis.

The study population consisting of a total of 35 individuals (18 males and 17 females) within the age range of 18–65 years, having all teeth except third molars and a probing depth of not more than 3 mm, and suffering from chronic marginal/papillary gingivitis was selected, among which 5 patients dropped out during the study.

Subjects with history or signs of periodontitis, systemic disorder, or contagious disease, pregnant/lactating women, chronic illness/condition (hypertension, diabetes, respiratory diseases, etc.), and those who had undergone radiotherapy or chemotherapy were excluded. Also, subjects who had taken dental prophylaxis 1 month prior to inclusion in the study or antibiotics for at least 3 months before baseline visit, or having any plaque retentive factors like orthodontic brackets, defective restorations, etc., were not included. The study protocol was approved by the institutional ethical committee and Maharashtra University of Health Sciences, Nashik, Maharashtra (India), and it was explained to each patient. Those who consented and met the selection criteria were enrolled in the study.

The relevant data pertaining to the case history was recorded in a special proforma. Before commencement of the study, all subjects underwent ultrasonic scaling for removal of calculus deposits (if any), immediately following which each quadrant of the patient’s mouth was randomly assigned and polished as TEST SIDE and the other quadrant of the same arch as CONTROL SIDE and vice versa for the opposite arch by coin toss method. In the present study, split-mouth design was used [Figure 1] to assess supragingival plaque, gingival bleeding, and gingivitis.

In the test group, APP system (Air Prophy unit®; Compass international, Guangdong, China) with sodium bicarbonate powder (cleaning powder for Prophy

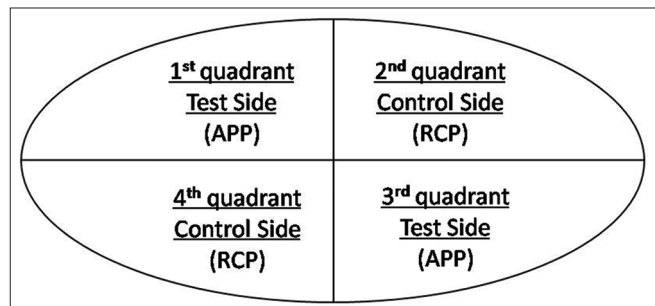


Figure 1: Split-mouth design

unit; Greeloy, Shanghai, China) was used (particle size standardized up to 250 µm). The technique used for APP involved positioning the nozzle 5–6 mm away from the tooth surface^[16] with the spray directed toward the middle third of the crowns of two to three teeth at one time, cleansed with a constant circular motion.^[17,18] Since the APP device generates aerosol, a mask and protective eyewear were used.^[19] In the control group, the bristle brush followed by rubber-cup with prophylaxis paste (ShineNSmile®; ICPA Health Products Ltd, Gujarat, India) was used in circular motion for polishing. Time employed for both procedures was held constant at 5 min for each technique.^[11]

Among the three clinical parameters, for a comprehensive dental plaque assessment with better objectivity, Turesky–Gilmore and Glickman modification of Quigley Hein plaque index (PI)^[20] using two-tone plaque disclosing agent (AlphaPlac®; Dental Products of India, Mumbai, India) was used on the facial and lingual surfaces of all teeth (except third molars). Whereas to assess the severity of gingival bleeding and gingivitis, sulcus bleeding index (SBI) by Muhlemann^[21] and gingival index (GI) by Loe and Silness^[22] were used, respectively. The measurements were assessed thrice for each subject, i.e. at baseline, immediately postoperative, and 15 days postoperatively. All individuals were asked to continue with their own routine oral hygiene procedures.

All the steps in this study were carried out by a single operator. The power of the study was calculated by considering 95% confidence interval. The entire data

obtained from the study population at all the three time intervals were put to statistical analysis (SPSS software package 16), and the mean, standard deviation, standard error and paired *t*-test were calculated to derive an evidence based scientific interpretation.

RESULTS

Out of 35 individuals, a total of 30 individuals including 16 males and 14 females with a mean age of 27 and 24 years, respectively, were assessed in this study. The clinical parameters were compared between the test (APP) sites and the control (RCP) sites [Table 1].

Furthermore, an intra-group comparison was carried out using *t*-test (i.e., between baseline, immediately post-op, and 15 days post-op of each group). All 30 patients completed the study with no adverse event reported by any subject during the study.

Intra-group comparison within each group with respect to PI, GI, and SBI [Graph 1] at baseline, immediately postoperative, and 15 days postoperatively showed a statistically significant difference (*P* = 0.000) [Table 2].

But inter-group comparison between APP and RCP with respect to PI, GI, and SBI [Graph 1] at baseline, immediately postoperative, and 15 days postoperatively did not show any statistical significance (*P* > 0.01) [Table 3].

Overall, the results of the intra-group comparison of both the APP and RCP sites indicated similar but

Table 1: Mean and SD of PI, GI, and SBI at baseline, immediate post-op, and 15 days post-op in test and control group

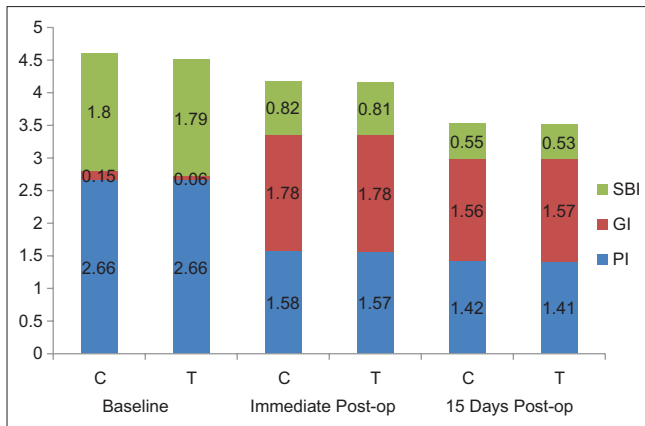
Group	Control (RCP)			Test (APP)		
	Baseline	Immediate post-op	15 days post-op	Baseline	Immediate post-op	15 days post-op
Mean PI	2.66±0.37	0.15±0.14	1.8±0.45	2.66±0.39	0.06±0.07	1.79±0.48
Mean GI	1.58±0.59	1.78±0.49	0.82±0.46	1.57±0.58	1.78±0.46	0.81±0.48
Mean SBI	1.42±0.84	1.56±0.77	0.55±0.45	1.41±0.83	1.57±0.77	0.53±0.46
Mean age and sex (N=30)	25.2±8.8 years Male=16, female=14					

SD=Standard deviation, PI=Plaque index, GI=Gingival index, SBI=Sulcus bleeding index, RCP=Rubber cup polishing, APP=Air polishing

Table 2: Intra-group comparison PI, GI, and SBI at baseline, immediate post-op, and 15 days post-op in test and control groups

Group	APP						RCP					
	PI		GI		SBI		PI		GI		SBI	
	<i>t</i>	<i>P</i>	<i>t</i>	<i>P</i>	<i>t</i>	<i>P</i>	<i>t</i>	<i>P</i>	<i>t</i>	<i>P</i>	<i>t</i>	<i>P</i>
Baseline	33.0	0.000	3.60	0.001	4.96	0.000*	34.3	0.000	8.42	0.000	4.41	0.000*
Immediate post-op	20.0	0.000	10.41	0.000	10.1	0.000*	7.75	0.000	7.02	0.000	6.45	0.000*
15 days post-op	8.05	0.0001	7.41	0.000	7.91	0.000*	10.2	0.000	5.55	0.0001	7.22	0.0001*

*Statistically significant. PI=Plaque index, GI=Gingival index, SBI=Sulcus bleeding index, RCP=Rubber cup polishing, APP=Air polishing



Graph 1: Comparison of mean of PI, GI, and SBI between test (T) and control (C) groups at baseline, immediate post-op, and 15 days post-op

significant plaque and gingival status changes, whereas the inter-group comparison showed no significant difference in the efficacy of both the groups.

DISCUSSION

The present study compared the clinical efficiency of APP and RCP in removing supragingival plaque, and also aimed to study their effects on gingival status in a split-mouth design. The results indicated that when comparing the effectiveness of polishing treatments, there was no statistically significant difference in plaque removal or gingival status within the established time interval. Also, both the treatment modalities showed a significant change in plaque accumulation and gingival status from baseline, immediate post-op, to 15 days post-op.

There was a significant reduction in plaque scores from baseline to immediate post-op in both the treatments (APP and RCP), but there was a considerable increase in GI and SBI scores from baseline to immediate post-op period. This finding could be attributed to the increase in gingival bleeding in the immediate post-op period as compared to the baseline scores, due to the therapy performed. At 15 days of follow-up, there was a substantial increase in plaque as compared to the immediate post-op findings, but there was a remarkable reduction in gingival and bleeding scores. This observation could not be attributed to either of the treatment modalities (APP or RCP), as this could entirely be credited to supra- and subgingival scaling alone. But the improvement in the gingival status from immediate post-op period to 15 days postoperatively indicated that although both the polishing methods were traumatic, their effects on the soft tissues were temporary.

Table 3: Inter-group comparison of PI, GI, and SBI at baseline, immediate post-op, and 15 days post-op in test and control groups

APP vs. RCP	PI		GI		SBI	
	t	P	t	P	t	P
Baseline	0.992	0.329	0.737	0.468	1.57	0.127
Immediate post-op	0.052	0.958	0.775	0.445	1.29	0.208
15 days post-op	1.0	0.325	0.282	0.78	1.92	0.064

PI=Plaque index, GI=Gingival index, SBI=Sulcus bleeding index, RCP=Rubber cup polishing, APP=Air polishing

The design of the APP system uses a mixture of air, water, and sodium bicarbonate powder to deliver a controlled stream of sodium bicarbonate particles onto the tooth surface. This slurry of powder and water polishes the surface by removing deposits attached to it or smoothing its texture. The APP powder used in this study was the sodium bicarbonate powder, which is readily available, biocompatible, and is relatively soft and only mildly abrasive.^[23]

Patients with exposed roots were excluded from this study as the abrasive effect of sodium bicarbonate powder on the root surfaces was observed to be detrimental by previous studies.^[24-26] Most investigators agree that intact enamel surfaces are not damaged when stain removal is accomplished with an air polisher. Even after exposure to enamel for the equivalent of a 15-year recall program, the surfaces were not altered.^[27]

A similar split-mouth study was conducted in 1991^[11] to compare the effectiveness of polishing techniques using indices to measure plaque, stain, and gingival trauma prior to and after the polishing treatment in 30 adult subjects, with comparable numbers of teeth contralaterally exhibiting observable plaque and stain. One side of a subjects' mouth was polished with a rubber-cup and flour of pumice and the other side was polished with the Prophy-jet APP device; plaque, stain, and gingival trauma measurements were assessed prior to and following both polishing treatments. The split-mouth design used in this study accounted for some possible confounding factor/variability due to assignment of one side of patient's mouth to APP treatment and the other side to RCP treatment. In this case, bias may occur on the basis of patient's brushing habit and mastication. For example, if the patient is right handed, it more likely that the left side would present less plaque as compared to the right side; also, if the patient has unilateral mastication, plaque accumulation would differ on either side of the patient's mouth. To

eliminate this possible variable in the present study, split-mouth design was modified, i.e. one quadrant of a patient's mouth was assigned to RCP and the other quadrant of the same arch was polished by APP and it was vice versa for the other arch [Figure 1]. The results of the present study are found to be in accordance with those of the 1991 study.^[11]

Smoking or tobacco chewing habit was noted in three males in the present study. As smoking has least effect on plaque accumulation, it did not affect the plaque scores. Although the gingival status shows significant changes in smokers as compared to non-smokers, the split-mouth design helps to eliminate the variable. Another observation made in the present study was that in patients with malaligned teeth or teeth exhibiting crowding, the RCP seemed to be less efficient in eradicating plaque and stain from the malaligned teeth surfaces, whereas APP presented as a more efficient modality in such cases due to better accessibility.

Almost all the patients in this clinical trial were comfortable with both the treatment modalities and no patient suffered from any adverse effect of any sort. There was no complaint of any discomfort/sensitivity from any patient after APP or RCP at 15 days post-treatment. Overall, APP has proven to be causing less operator fatigue, is less time consuming, and is equally efficient as the conventional rubber-cup polishing with respect to plaque removing efficacy.^[28]

Lack of negative control being a limitation of the current study, future research should include randomized controlled trials that directly compare the effects of air polishers; sonic, ultrasonic, and piezo-scalers; and rubber-cup polishers and hand instruments on all tooth surfaces. In addition, these studies should attempt to control the variables of quantity of stain, abrasiveness of polishing pastes, and amount of pressure applied to each surface.

CONCLUSIONS

Based on the findings of this study, the following conclusions were reached:

APP and the rubber-cup, bristle brush with paste polishing (RCP) demonstrated equivalent efficacy regarding removal of supragingival plaque for a single-visit setting.

Over a period of 15 days, both APP and RCP (along with scaling) demonstrated equivalent efficacy in

reducing gingival inflammation. Both APP and RCP exhibited significant increase in bleeding from gingival sulcus immediately after therapy. But after 15 days, a significant reduction in gingival bleeding was presented by both the treatment sites.

It can be concluded that other factors, in addition to effectiveness and time efficiency, should be considered when selecting rubber-cup polishing with paste or an APP device.

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Conflicts of interest

There are no conflicts of interest.

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