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Research article

## DENTAL AIR FORCE HOME DENTAL CLEANING SYSTEM: A REVOLUTIONARY ORAL HYGIENE DEVICE TO PREVENT SYSTEMIC DISEASES CAUSED BY PERIODONTAL INFECTION

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### ABSTRACT

**Aim :** The study outlined to estimate the clinical, laboratory and microbiological efficacy of Dental Air Force home dental cleaning system of adult chronic periodontitis patients. **Material and Method:** 50 adult chronic periodontitis subjects were recruited volunteers for this study. Clinical (plaque index, gingival index and clinical attachment loss), Laboratory (C-reactive protein levels and Glycated Hemoglobin) and Microbiological parameters were measured prior to phase-1 therapy; at 3<sup>rd</sup> and 6<sup>th</sup> month post phase 1 therapy. Comparative assessment was done among all the patients that were divided into two groups with student paired 't' test and ANOVA. **Results:** The results of this study showed that there was significant decrease in clinical, laboratory and microbiological parameters from baseline to 6 months in both the groups ( $p < 0.01$ ). The subjects under groups using Dental Air Force home dental cleaning system showed a highly significant reduction to all the parameters as compared to subjects under groups using a toothbrush. **Conclusion:** The regular use of Dental Air Force home dental cleaning system as oral hygiene device is most advantageous for suppressing both periodontal infection and associated markers like CRP, HbA1c for systemic diseases as compared to conventional tooth brushing.

**Key Words:** CRP, Periodontitis, HbA1c, Diabetes

### INTRODUCTION

The mouth acts as a window to lot of systemic diseases and serves as a port of entry of the various infections that can alter and affect the immune status of the person. The oral cavity has the potential to harbor at least 600 different bacterial species, and in any given patient, more than 150 species may be present, surfaces of teeth can have as much as billion bacteria in its

attached bacterial plaque.<sup>1</sup> Periodontitis has been proposed as having an etiological or modulating role in cardiovascular, cerebrovascular disease, diabetes, respiratory disease and adverse pregnancy outcome; several mechanisms have been proposed to explain or support such theories. One of these is based around the potential for the inflammatory

phenomenon of periodontist to have effects by the systemic dissemination of locally produced mediators such as C-reactive protein (CRP), interleukins -1 beta (IL-1 ) and -6 (IL-6) and tumor necrosis factor alpha (TNF- ).<sup>2</sup> Periodontal diseases are recognized as infectious processes that require bacterial presence and a host response which are further affected and modified by other local, environmental, and genetic factors. The oral cavity works as a continuous source of infectious agents, and its condition often reflects the progression of systemic pathologies. Periodontal infection happens to serve as a bacterial reservoir that may exacerbate systemic diseases. <sup>[3]</sup> So, this study was outlined to determine the efficacy of Dental Air Force home dental cleaning system on chronic periodontitis patients as a potential oral hygiene device to prevent systemic diseases caused by periodontal infections.

## **MATERIALS AND METHOD**

The present study was conducted in the department of Periodontology, Pravara Institute of Medical Sciences, Loni, Maharashtra, India. The research protocol was approved by the University research and ethics committee. Verbal and written informed consent was obtained from all subjects prior to their voluntarily enrollment in the study.

### **Study Population**

The subjects enrolled in this study were selected from the Out Patient Department of Periodontology, Rural Dental College and Hospital, Loni, Ahmednagar, Maharashtra, India. The study included a total of 50 subjects with chronic periodontitis. All the 50 subjects were grouped into two categories and each group was comprised of 25 subjects each as illustrated in table 1. Exclusion criteria for the patient enrolled in the study were : (1) Presence of any systemic neurological disorder (e.g., epilepsy or schizophrenia), (2) Presence of a

disease with possible effects on the immune system (e.g., chronic infections or cancer), (3) Patient who have received antibiotics or NSAIDS (like Ibuprofen) in past 9-11 weeks, (4) Patients who have received periodontal treatment in past 6 months, (5) Pregnant and lactating mother, (6) Patient with artificial prosthesis, (7) Patients who smokes or consumes tobacco in any form, (8) Patients suffering with Arthritis, (9) Patient with any type of heart disease (MI, CHD, etc), (10) Female patient using intrauterine birth control devices or birth control pills, (11) Obese Individuals (30 & above range as per WHO BMI cut off for weight categories for Asians), (12) Presence of Diabetes Mellitus (13) Participants not willing to participate in the study.

### **Clinical Protocol**

After the enrollment of the subjects in the study, phase 1 therapy (Scaling and root planing) was done by similar EMS ultrasonic scaler by the same operator to all the 50 subjects at first visit/base line only. After phase 1 therapy, subjects under group A were advised to use Dental Air Force home dental cleaning system (technique demonstrated to each subject) twice daily for 5 minutes. After phase 1 therapy, subjects under group B were advised to brush twice daily for 5 minutes by modified bass method (technique demonstrated to each subject) and similar medium bristle toothbrush and toothpaste is provided to each of the subjects during the study course. Recall visits were scheduled for all the subjects belonging to both the groups (A and B) on third and sixth month and no phase 1 therapy (scaling and root planing) was done at the recall visits. All the clinical, laboratory and microbiological parameters of 50 subjects enrolled in the clinical trial were recorded at the base line, third and six month.

### **Estimation of Clinical parameters**

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Clinical parameters of periodontal disease that were evaluated were gingival index (GI), plaque index (PI) and clinical attachment Loss (CAL).

### **Gingival Index**

The teeth selected as Index teeth were 16, 12, 24, 32, 36 and 44. The tissues surrounding each tooth were divided into four gingival scoring units: disto-facial papilla, facial gingival margin, mesio-facial papilla and the entire lingual gingival margin. A blunt instrument such as a periodontal probe was used to assess the bleeding tendency of the tissues. The index for each index tooth was recorded and then calculated by dividing total number of index teeth examined. This provided the gingival index for the individual.

### **Gingival Index**

All teeth were examined on four surfaces (i.e. Mesio Buccal, Buccal, Distobuccal and Lingual/palatal) after using a disclosing agent

Total Plaque Score

Plaque Index (PI) = -----

No. of surfaces examined

### **Clinical Attachment Loss**

The clinical attachment level was examined with William's graduated probe. Clinical attachment level represents distance from cemento-enamel junction to the base of gingival sulcus or periodontal pocket. Average clinical attachment loss of the person is calculated by dividing the total clinical attachment level by the number of teeth examined. Chronic periodontitis is sub classified as mild or slight, moderate and severe periodontitis based on clinical attachment loss according to AAP 1999 classification of periodontal diseases. If gingival recession is present then loss of attachment is calculated by the distance between the cemento-enamel and gingival margin to be added to pocket depth.

### **Estimation of C-reactive protein (CRP)**

RHELAX CRP slide test kit was used for the in vitro detection of CRP in human serum by qualitative and quantitative rapid latex slide test. RHELAX CRP slide test for detection of CRP is

based on the principle of agglutination. If CRP concentration is greater than 0.6 mg/dl a visible agglutination is observed. If CRP concentration is less than 0.6 mg/dl, then no agglutination is observed.

### **Estimation of Glycated Hemoglobin (HbA1c)**

The venous blood was subjected to an assessment of HbA1c test using NycoCard® HbA1c is a boronate affinity assay. The NycoCard HbA1c test is a 3 minute point of care test for measurement of HbA1c. NycoCard HbA1c provides an accurate and reliable method to monitor metabolic control for Diabetes Mellitus.

### **Estimation of Microbiological Pathogens**

Subgingival plaque samples were collected for specific bacterial examination i.e. *Aggregatibacter actinomycetemcomitans*, *Fusobacterium nucleatum*, *Porphyromonas gingivalis* and *Prevotella intermedia*. Subgingival plaque samples were then collected from the sample sites using the standardized paper point (Dentsply)® which were inserted to the depth of the periodontal pocket until resistance was felt. The paper points were retained for 20 seconds in the collection sites. The samples site selected was maxillary first molar in all the cases to maintain the standard protocol. After 20 seconds the paper point was removed from the sample site and immediately transferred into the Robertson's cooked meat transport (RCM) in a test tube for specific bacterial culturing. In the laboratory the Robertson's cooked meat medium (RCM) was subjected to vortex homogenization for 60 seconds before incubated anaerobically (Gas pack system) for 2-3 days

### **Dental Air Force home dental cleaning system**

Dental Air Force home dental cleaning system used in this study is approved by FDA Vide No K001493 as safety device for plaque removal in order to prevent gingivitis. It is an electrical delivery device that uses a 1/8<sup>th</sup> HP oil-less electric air compressor air source with twin

pistons connected to a handpiece by a pneumatic cord directed through a handpiece and tip where air at 40 psi through a .020 size orifice has the introduction of a slurry of dental cleaner. This produces a jet stream of wet abrasive whereby the user directs the cleaner components and air into the sites between the teeth and below the gum line. One normal application uses one teaspoon of dental cleaner. The cleaner ingredients include sodium bicarbonate, the most widely accepted and totally natural buffering agent that promotes a neutral environment. It also contains mint flavoring, Xylitol and Stevia as natural sweeteners. The formula is free of sodium laurel sulfate, the ingredient in most toothpaste that causes sensitivity and irritation.<sup>4</sup>

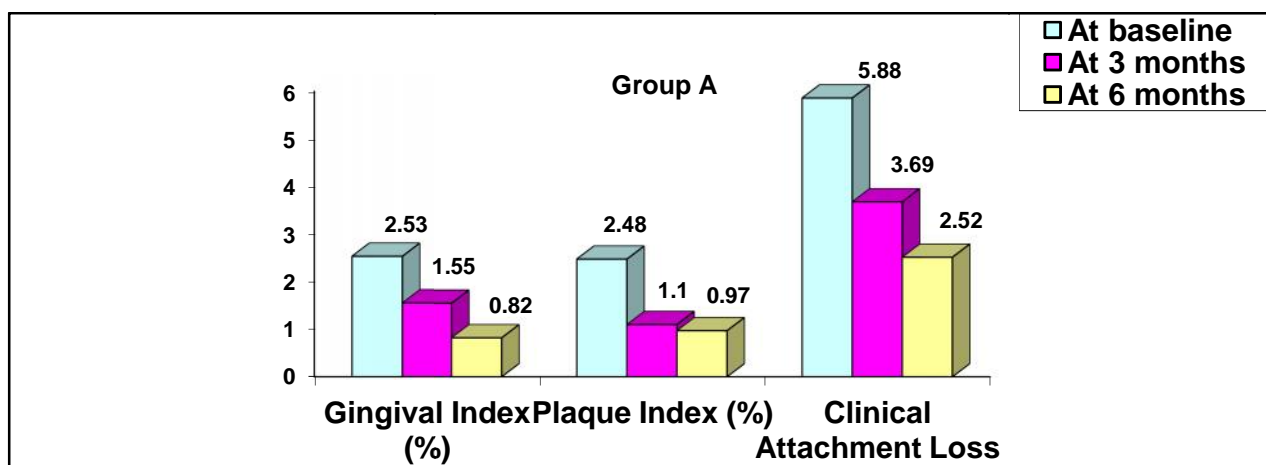
## RESULTS

Distribution of mean and standard deviation values of all the clinical, laboratory and microbiological parameters of both the groups

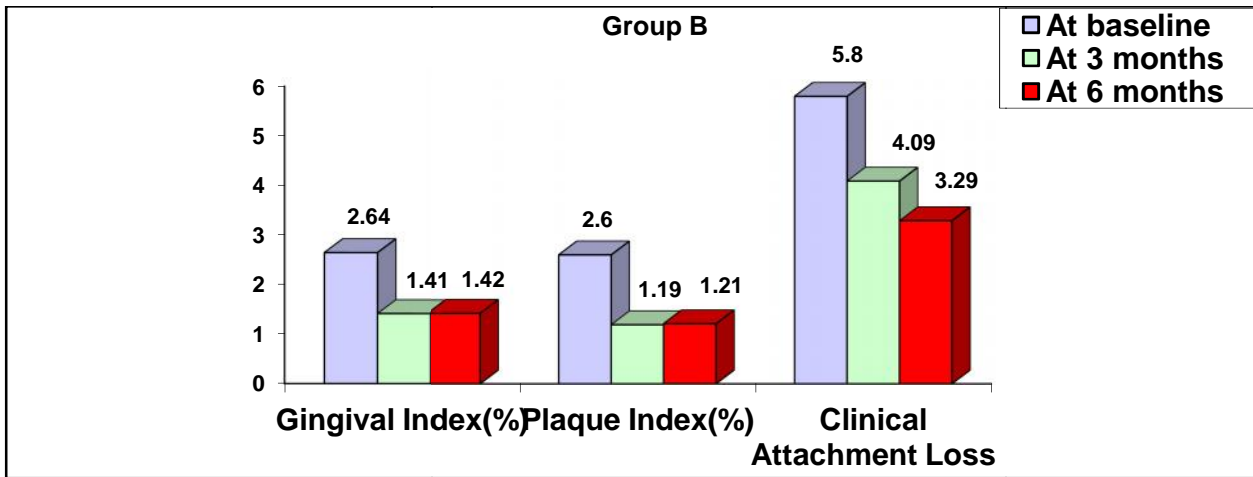
(A and B) were illustrated in Figure 1 to 3. After applying Student's Paired 't' test there was a highly significant decrease in clinical, laboratory and microbiological parameters from baseline to 6 months in groups A and B (i.e.  $p < 0.01$ ). It was observed that group A showed more significant decrease as compared to group B (i.e.  $p < 0.01$ ). Also by applying Student's Unpaired 't' test there was a highly significant difference between mean values of all clinical, laboratory and microbiological parameters in group A v/s B (i.e.  $p < 0.01$ ). It was concluded that the mean clinical, laboratory and microbiological parameters in group A showed larger decrease than group B ( $p < 0.01$ ) as shown in Table 4, 5 and 6 (A v/s B). By applying two way ANOVA (Tukey-Kramer Multiple Comparison Test) test there was a significant difference between group A and B when compared together in respect to clinical, laboratory and microbiological parameters ( $p < 0.05$ ).

**Table.1: Distribution of chronic periodontitis patients in study groups**

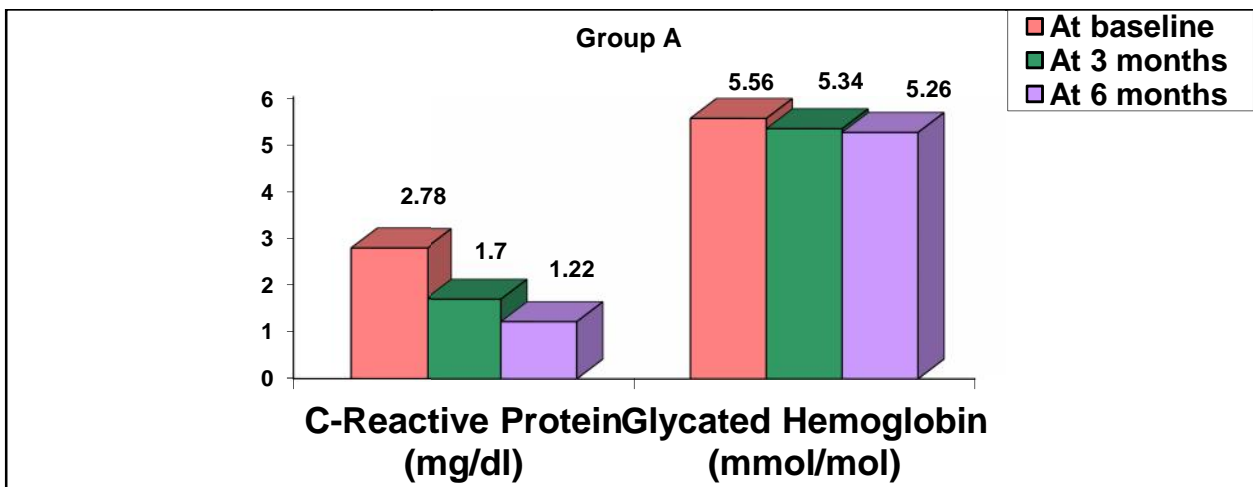
Groups	Patient Clinical Protocol	No. of Subjects
Group A	Chronic periodontitis patients receiving phase I therapy at base line followed by use of Dental Air Force home dental cleaning system as regime for oral hygiene.	25
Group B	Chronic periodontitis patients receiving phase I therapy at base line followed by conventional use of tooth brush and tooth paste as regime for oral hygiene.	25



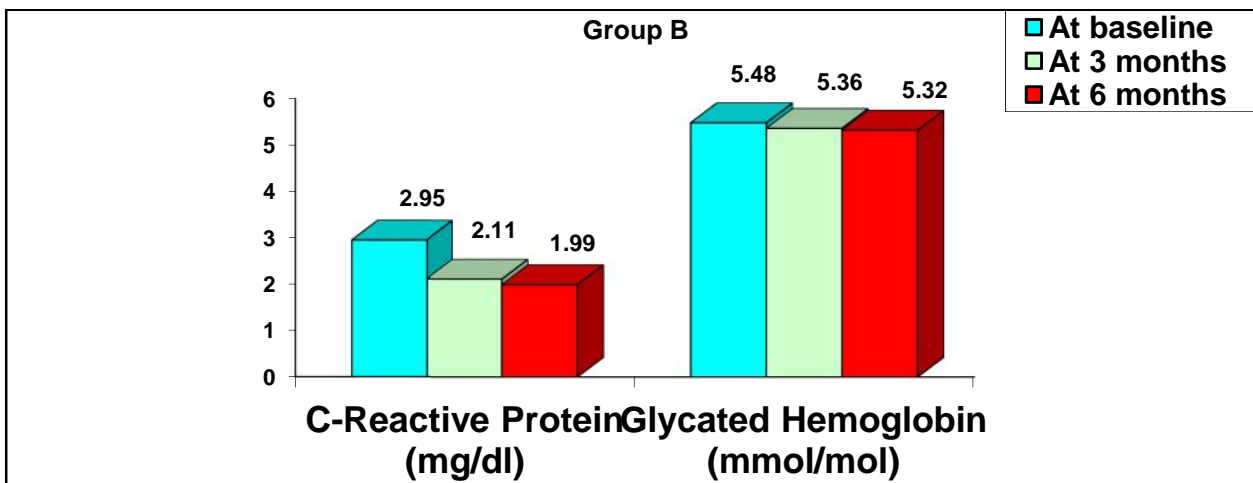
**Fig. 1:** Distribution of mean values of all clinical parameters in Group A



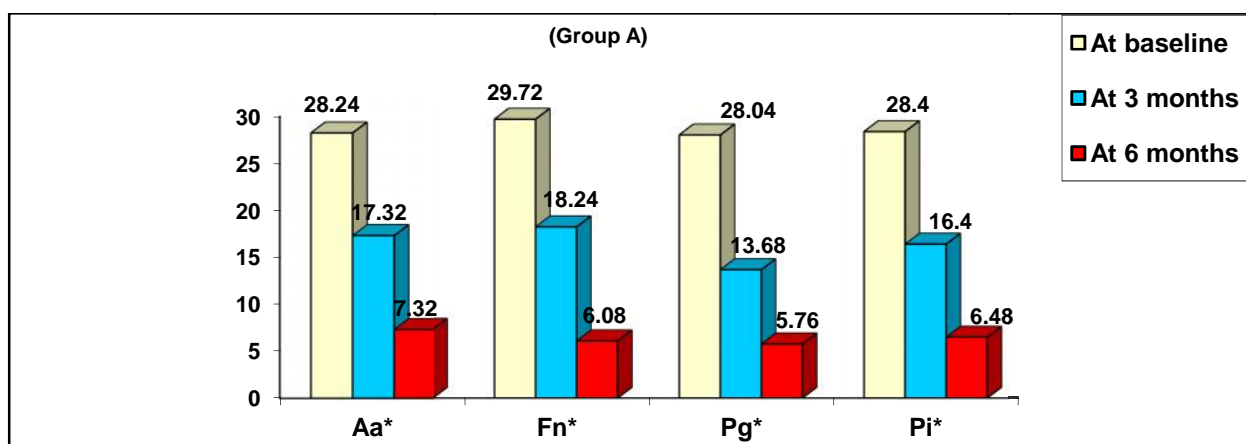
**Fig. 2:** Distribution of mean values of all clinical parameters in Group B



**Fig. 3:** Distribution of mean values of all CRP and HbA1c in Group A

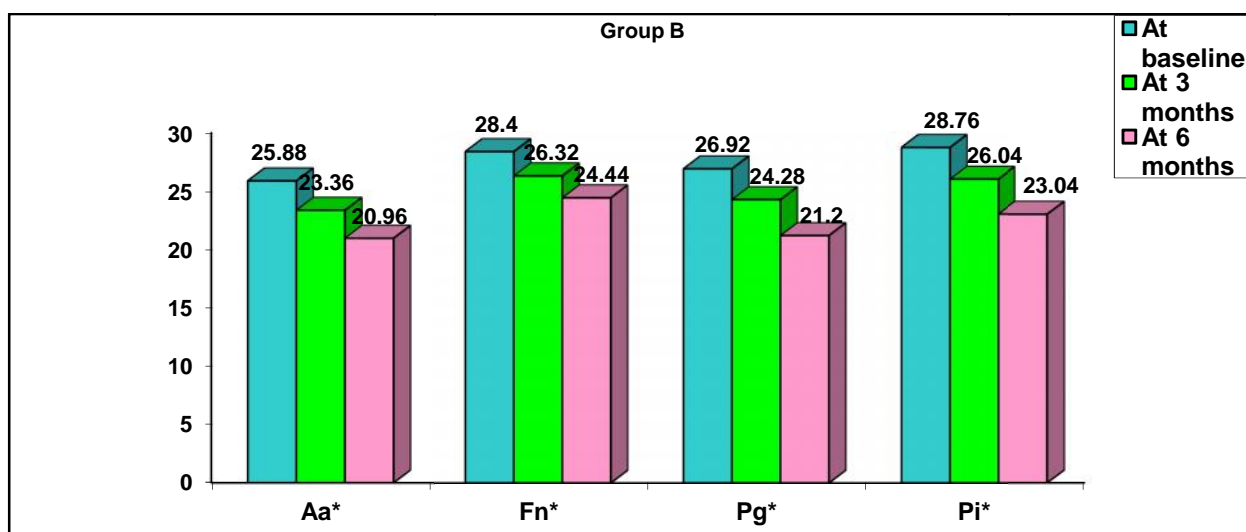


**Fig. 4:** Distribution of mean values of all CRP and HbA1c in Group B



**Fig.5:** Distribution of mean values of all microbiological parameters in Group A

\*Aa: *Aggregatibacter actinomycetemcomitans*, Fn: *Fusobacterium nucleatum*, Pg: *Porphyromonas gingivalis* and Pi: *Prevotella intermedia*.



**Fig.6:** Distribution of mean values of all microbiological parameters in Group B

\*Aa: *Aggregatibacter actinomycetemcomitans*, Fn: *Fusobacterium nucleatum*, Pg: *Porphyromonas gingivalis* and Pi: *Prevotella intermedia*.

## DISCUSSION

Dental plaque biofilm cannot be eliminated. However, the pathogenic nature of the dental plaque biofilm can be reduced by reducing the bioburden (total microbial load and different pathogenic isolates within that dental plaque biofilm) and maintaining a normal flora with appropriate oral hygiene methods.<sup>5</sup> The clinical data of this study showed that subjects using Dental Air Force home dental cleaning system as regular oral hygiene device showed significant reduction of clinical parameters from base line to six months as compared to subjects in Group B

using conventional tooth brush. Thus there is huge potential of this device in combating the colonization of microbial biofilm in the oral cavity. The results of this study showed that there was significant mean reduction in CRP level from  $2.78 \pm 0.57$  to  $1.22 \pm 0.74$  in the subjects using Dental Air Force home dental cleaning system as regular oral hygiene device. This will conclude that the cardiovascular diseases associated with increased level of CRP can be prevented by regular use of this device. In case of subjects using toothbrush there was not

significant reduction in CRP levels from baseline to six month i.e.  $2.95 \pm 0.42$  to  $1.99 \pm 0.87$  thus with increased level of CRPs possibilities of periodontitis associated atherosclerosis as well as cardiovascular events exists in these subjects. Many clinical studies have been published describing the bidirectional inter-relationship exhibited by diabetes and periodontal disease. Studies have provided evidence that control of periodontal infection has an impact on improvement of glycemic control evidenced by a decrease in demand for insulin and decreased HbA1c.<sup>6-9</sup> In this present study subjects under group A showed more reduction in HbA1c from base line to six month i.e. From  $5.56 \pm 0.51$  to  $5.26 \pm 0.52$  as compared to group B. These results further highlighted the potential benefits of using Dental Air Force home dental cleaning system in controlling the blood glucose level. The microbiological evaluation of key four pathogens associated with periodontitis i.e. *Aggregatibacter actinomycetemcomitans* (Aa), *Fusobacterium nucleatum* (Fn), *Porphyromonas gingivalis* (Pg) and *Prevotella intermedia* (Pi) were also significantly reduced in subjects using Dental Air Force home dental cleaning system as compared to conventional tooth brush. The possible mechanism of greater efficiency as compared to toothbrush is that Dental Air Force home dental cleaning system uses air and a dental cleaner with water to break through the plaque barrier. The air oxygenates the spaces between teeth and along the gum line, making it difficult for the anaerobic plaque-causing bacteria to live. Sodium bicarbonate is a neutralizing agent that acts on the acids produced by the bacteria. It is an abrasive that breaks up the plaque's sticky film. It also removes the odor caused by the plaque. The water flushes away the bacteria and debris off the surfaces of the teeth. Dental Air Force home dental cleaning system with access to subgingival area lead to removal of biofilm and prevent further proliferation of periodontopathic microorganisms.

## CONCLUSION

This study confirmed that there was strong relation between localized periodontal infections to systemic health. There was an encouraging correlation with non surgical phase 1 periodontal therapy on lowering the systemic health markers. This study also established the scientific magnitude of Dental Air Force home dental cleaning system as a true choice for lowering possibilities of systemic diseases (Cardiovascular disease and diabetes mellitus) initiated by periodontal infections. The regular use of Dental Air Force home dental cleaning system as oral hygiene device is optimal for suppressing both periodontal infection and associated systemic diseases as compared to conventional tooth brushing.

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