ACTA SCIENTIFIC DENTAL SCIENCES (ISSN: 2581-4893)

Volume 2 Issue 10 October 2018

Research Article

A Randomized Controlled Trial to Evaluate the Effectiveness of Novel Polyphenolic Antioxidant Mouthrinse as an Adjunct to Scaling and its Effect on Total Antioxidant Capacity of Saliva in Patients with Plaque Induced Gingivitis along with Fixed Orthodontic Appliances-A Clinical and Biochemical Study

Lashika V Tambe*, Mala Dixit Baburaj, Sandeep Pimpale and Abhinav Deshpande

Department of Periodontology, Nair Hospital and Dental College, Mumbai, India

***Corresponding Author:** Lashika V Tambe, Department of Periodontology, Nair Hospital and Dental College, Mumbai, India.

Received: August 02, 2018; **Published:** September 04, 2018

Abstract

Background: Maintaining good oral hygiene during Fixed Orthodontic appliance therapy is important for gingival health. While a good brushing technique is important, mouthwashes are often recommended to help control plaque. The aim of this study was to assess the effectiveness of Novel Polyphenolic Antioxidant mouthrinse as an Adjunct to Scaling and its effect on Total Antioxidant Capacity of Saliva in Patients with Plaque induced gingivitis along with Fixed Orthodontic Appliances.

Method: This was a double blind Randomized Controlled trial. Fourty patients with plaque induced gingivitis along with Fixed Orthodontic Appliances were randomly assessed for Gingival index (Loe and Silness-1964), Papilla bleeding index (Muhlemann-1977), Plaque index (Silness and Loe, 1964), Total Antioxidant capacity (TAOC) of Saliva (FRAP test), Discoloration/Stain Index (Lobene -1968 and modified by Macpherson., *et al*. in 2000) at baseline. The participants were randomly divided in 2 groups:

- Group A: Ultrasonic scaling and Chlorhexidine mouthrinse for 1 month.
- Group B: Ultrasonic scaling and Polyphenolic Antioxidant mouthrinse for 1 month.

After 1 month, above mentioned clinical and biochemical parameters were re-evaluated.

Results: Intragroup analysis of both the groups showed statistically significant difference in Plaque, Gingival, Papilla bleeding index (< 0.001). However the Intergroup analysis were statistically non- significant in these clinical parameters (> 0.001). Intergroup analysis is statistically significant for Discolouration/Stain index (Group A > Group B) and Total Antioxidant capacity (Group A < Group B) (> 0.001).

Conclusions: This trial demonstrates that the Novel Antioxidant Mouthrinse has clinical effectiveness equal to Chlorhexidine and it also shows minimal side effects as compared to Chlorhexidine which is considered as Gold standard. Thus it is concluded that Novel Polyphenolic Antioxidant Mouthrinse is an effective therapeutic modality against Plaque induced gingivitis in patients with Fixed Orthodontic appliances.

Keywords: Antioxidant(s); Chemical Plaque Control; Gingivitis; Orthodontics

Introduction

The goal of Orthodontic treatment is to correct the dental irregularities and malocclusions which may allow better oral hygiene. A well-accepted rationale for orthodontic treatment is: to prolong the life of an individual's dentition [1]. However, it is seen that the "plaque retentive" properties of the appliance and/or the inability of the patients to adequately clean around them, contributes to the development of the inflammation" [2,3]. Orthodontic bands may allow accumulation of plaque similar to that caused by overhanging subgingival restorations [4]. In a longitudinal study, Leggott., *et al*. [5] followed 2 groups of patients - one group under 18 years and the other over 18 years of age; for 2 years after placement of their fixed appliances. They found a 2-fold to 3-fold increase in both the clinical indices and the number of motile organisms 6

months after appliance placement. Inadequate oral hygiene measures during fixed orthodontic therapy is considered a major factor in the accumulation of plaque and subsequent resultant inflammatory response. At present, mechanical plaque control method is considered to be the most effective method for preventing periodontal disease. However, mechanical plaque control by means of tooth brushing and flossing is not always completely effective as it is based on the dexterity and motivational level of individual. Chemical antiplaque agents may provide adjunctive benefit. These include the use of Chlorhexidine (CHX), Stannous fluoride, or Triclosan products [6]. Although Chlorhexidine is the gold standard, the side effects of Chlorhexidine such as tooth and tongue staining, taste alterations, and mucosal erosions limit patient compliance [7].

Periodontal disease can be described as one of the predominant poly-microbial infections affecting humans[8]. The pathological events which lead to the destruction of the periodontium during inflammatory periodontal disease have been related to the effect of the imbalance between oxidants and antioxidants in patients with periodontal disease. Reactive oxygen species (ROS) are generated predominantly by Polymorphonuclear cells (PMN) during an inflammatory response. It has been suggested that the bacterial species in subgingival plaques and the PMN response are important factors to assess the changes in periodontal disease status [9]. Therefore, Antioxidants are considered as emerging prophylactic and therapeutic agents which act by counteracting the overproduction of free radicals during periodontal disease.

Polyphenols (PPs) are plant metabolites characterized by the presence of several phenol groups (i.e. aromatic rings with hydroxyls), which derive from L-phenylalanine [10]. Periosciences AO Prorinse* is a novel Polyphenolic Antioxidant mouthrinse composed of combination of powerful polyphenolic compounds like - Ferulic acid, Tetrahydrocurcuminoids and Epigallocatechin gallate (EGCG). Ferulic acid presents a wide range of potential therapeutic effects useful in the treatments of cancer, diabetes, lung and cardiovascular diseases, as well as hepatic, neuro and photo-protective effects and anti-microbial and anti-inflammatory activities [11]. Of late, Tetrahydrocurcuminoids have been extensively studied for their anti-inflammatory, antioxidant [12-15] and anti-cancer [16-9] effects. In a recent study, Shahzad., *et al.* [20] reported an inhibitory effect of curcumin on the planktonic growth of periodontopathic bacteria, such as *Aggregatibacter actinomycetemcomitans, Fusobacterium nucleatum*, and *P. gingivalis*. Studies have reported that EGCG inhibits the activity of collagenase and gelatinase [21,22]. Administering a combination of antioxidants has been shown to act in concert and have a strong synergistic effect as compared to the action of a single antioxidant.

Hence, the present authors hypothesized that scaling in conjunction with daily use of Novel Polyphenolic Antioxidant mouthrinse in patients with Plaque induced gingivitis undergoing fixed orthodontic treatment might improve the clinical outcomes and improve the Total Antioxidant Capacity of saliva. The aim of the current study was to compare the adjunctive therapy of Polyphenolic Antioxidant mouthrinse with scaling and Chlorhexidine (Gold standard) with scaling over 1 month; and evaluate whether it improves the clinical parameters and Total Antioxidant Capacity of saliva in patients with plaque induced gingivitis during fixed orthodontic treatment.

Aim of Study

To evaluate a new formulation of mouthrinse(Antioxidant mouthrinse) which has efficacy equal to chlorhexidine mouthrinse with fewer side effects.

Objectives of the Study

1. To Compare the efficacy of Chlorhexidine mouthrinse (0.2%) and Anti-oxidant mouthrinse (Periosci ences AO Prorinse*) on plaque induced gingivitis.
2. To evaluate its effect on the Total Anti-oxidant capacity of saliva in plaque induced gingivitis patients.

Materials and Methods

This was a Randomized, Parallel Group, Active Controlled trial approved by Institutional Ethical Committee Nair Hospital Dental college, Mumbai India (CTRI/2018/01/011237).

Source of data

The sample population consisted of 40 healthy subjects between the age group of 15 - 45 years with Fixed Orthodontic appliances, recruited from Nair Hospital Dental College and Hospital. Audio video consent was taken prior to the study and if the patient was willing to discontinue the treatment procedure during the study, he or she was allowed to do so.

Protocol

Inclusion Criteria

1) Minimum of 20 teeth should be present in the dentition.
2) Patients with fixed orthodontic appliances for atleast 6 months.
3) Patients classified as stage II and stage III gingivitis based upon the gingival score given by Loe and Silness 1964.
4) Patient with clinical bleeding on probing present.
5) Patient willing to give the informed consent and willing to comply with the study were selected.

Exclusion Criteria

1) Allergy or hypersensitivity to Chlorhexidine or related compounds.
2) Use of antibiotics within last 3 months.
3) Periodontal pockets > 4 mm.
4) Systemic diseases.
5) Pregnancy.
6) Smoking.

Written consent was obtained from the patient prior to their participation in the study. All clinical examinations were performed by one examiner and assistant (post graduate student), with patients assigned to treatment groups without examiner's knowledge. A UNC-15 periodontal probe and mouth mirror was used to measure the probing depth (PD).The PD was measured from the gingival margin to the base of the pocket where the probe met resistance with light pressure.

The patients fitting in the inclusion criteria were divided into two groups using Computer assisted randomization – Group A and Group B.

a) Group A: Scaling along with Chlorhexidine mouthrinse (0.2%) (n = 20).
b) Group B: Scaling along with Polyphenolic Antioxidant mouthrinse (Periosciences AO Prorinse*) (n = 20).

Ultrasonic scaling was done for the patients in Group A and Group B by the examiner. A separate group of 20 healthy patients was selected to estimate the Total Antioxidant capacity of saliva in healthy subjects.

Clinical parameters

The following clinical parameters were recorded at baseline before ultrasonic scaling in every patient by the examiner:-1. Gingival index [23], 2. Papilla bleeding index [24], 3. Plaque index [25], 4. Total Antioxidant capacity of Saliva (FRAP test) [26], 5. Discoloration Index [27]. The Gingival index (GI) of Löe and Silness was recorded on the facial (mesiofacial, mid-facial, and distofacial) and lingual of all teeth. The mean for these four readings were tabulated for each tooth and a mean for the whole mouth was determined by averaging all teeth scored.UNC-15 periodontal probe was gently moved across the soft tissue wall of the entrance of the gingival crevice to assess the Papilla bleeding index as described in the Muhlemann index. The Silness and Loe Plaque Index (PI) was recorded on the patient's entire dentition. Plaque was disclosed using a cotton swab saturated in standard erythrosine dye Trace* to coat all areas of the teeth. The visual stain assessment (Discolouration index) of the buccal/labial and lingual/palatal aspects of the index teeth was done by dividing each aspect into 4 separate sites classified as: Gingival (G): 2 mm wide strip running parallel to the gingival margin. The limit towards the incisal edge given by the end of the interdental papilla; Body (B): Central area of buccal/lingual aspect, between gingival and distal/mesial sites, extending to incisal edge; Mesial (M): Visible area between line angle and adjacent tooth, ending at the interdental papilla and starting at gingival site; Distal (D): as for mesial (M) site. Stain was recorded using two separate characteristics, namely intensity and area (extent). The criteria and codes for intensity were: 0 = no stain present with the natural tooth coloration; 1 = slim stain; 2 = clearly visible stain, orange to brown; 3 = dark stain, dark brown to black. The area (extent) of the stain was recorded only if an intensity score of 2 or 3 was given. The area criteria and codes for proximal, gingival and body sites were: 1 = up to 1/3 of area affected; 2 = between 1/3 and 2/3 of area affected; 3 = more than 2/3 of area affected.

Total antioxidant capacity of saliva was detected by biochemical analysis using FRAP TEST method (ferric reducing ability of plasma) with the use of spectrophotometer (Figure 4 and 5). This test required collection of saliva by the following method-Subjects were instructed not to brush their teeth, or eat or drink one hour before the time of saliva collection. Unstimulated whole saliva was collected in between 9 am - 10 am to avoid diurnal variation. Subjects were asked to rinse mouth well with drinking water. 5 minutes af-

ter oral rinse patients were asked to drool saliva into a sterile container. Subjects needed to refrain from talking and making movements of oral cavity. Subjects were told to drop down head and let saliva flow naturally to the front of the mouth, hold for a while and drool into the sterile container for every minute for 10 minutes. 5 ml of saliva was collected and the collected samples were immediately taken for biochemical analysis. Transport of samples were done in an ice box. Samples were be freezed to prevent nucleic acid and protein degradation

Method of Estimation of Total Anti-oxidant capacity of saliva

The saliva samples were collected as per the method described above. The samples were kept in the dry ice containing box and were sent to Department of Biochemistry, Topiwala National Medical College, Mumbai India. Samples were kept in 4 degrees Celsius for 10 minutes. The level of antioxidant was calculated by FRAP method (ferric reducing ability of plasma) with the use of spectrophotometer. Whole antioxidants evaluation method is based on the capacity of saliva to reduce Fe^{+3} to Fe^{+2} in the presence of TPTZ (2,4,6,-tripyridyl-s-triazine). Fe^{+3}-TPTZ complex is reduced under acidic conditions by a reducing agent to form Fe^{+2}-TPTZ. The production of Fe^{+2}-TPTZ is easily detectable and measurable because of its intense blue colour with a maximum absorption at wavelength 593 nm. Therefore, the determining factor to evaluate the speed of Fe^{2-}TPTZ complex formation and production of blue colour is the reducing ability of samples. As a result, this method is able to determine every anti-oxidant component which has a reductive potential. Acetate buffers were prepared by mixing 3.1 grams of sodium acetate in 16 mL of acetic acid. Then, by adding distilled water the volume was increased to 1 liter; and the solution's PH was set to 3.6. The main reactive solution was a mixture of 2.5 mL of TPTZ, 2.5 mL of iron chloride plus 25 mL of acetate buffer. The reaction started by adding 30 microliter of gathered saliva. Absorption was measured at the beginning of the reaction and after 8 minutes.

Random distribution of mouthrinse

As this was a double blind RCT, the patient and the examiner were unaware of the mouthrinse provided to them. Therefore, Polyphenolic Antioxidant mouthrinse and Chlorhexidine mouthrinse were equally and randomly distributed in identical sterile opaque bottles by the assistant. After ultrasonic scaling and evaluation of the above mentioned clinical parameters, the patients were randomly provided with the mouthrinses by the assistant. Medium bristled toothbrushes and fluoride dentifrice were provided for each patient. They were advised to brush with modified Bass technique twice daily. The patients were instructed to rinse with 5 ml of mouthrinse for one minute, 30 minutes after tooth brushing. They were instructed to use the mouthrinse twice daily for 1 month. The patients were recalled after 1 month to record the Gingival Index, Plaque Index, Papillary Bleeding Index and Discolouration Index. Saliva samples were again collected after 1 month to measure the Total Anti-oxidant capacity of saliva.

Statistical Analysis

Analysis on Gingival index(GI) at baseline and after 1 month

Intragroup analysis (Figure 1A and 1B)

At baseline, the mean GI scores were statistically non- significant: Group A-1.8000 (n = 20) versus Group B-1.7450 (n = 20). At this point, patients were assigned to rinse groups. After 1 Month, GI decreased significantly in both groups Group A-0.5600 (n = 20) versus Group B-0.5625 (n = 20), indicating a significant therapeutic effect of both the mouthrinses (p value < 0.001).

Intergroup analysis (Figure 1A and 1B)

When results of both groups were compared, no statistically significant difference was observed (p value of GI after 1 month-0.96) (p value > 0.001). Thus it can be said that, there was no statistically significant difference observed when the two groups were compared to each other. This demonstrates that both the treatment modalities result in comparable reduction in the gingival index scores of the patients.

Analysis on Plaque index (PI) at baseline and after 1 month

Intragroup analysis (Figure 1A and 1B)

At baseline, the mean PI scores were statistically non- significant: Group A-1.8200 (n = 20) versus Group B-1.7575 (n = 20). After 1 Month, PI decreased significantly in both groups Group A-.5600 (n = 20) versus Group B-0.5625 (n = 20), indicating a significant therapeutic effect of both the mouthrinses (p value < 0.001).

Intergroup analysis (Figure 1A and 1B)

When results of both groups were compared, no statistically significant difference was observed (p value of GI after 1 month-0.96) (p value > 0.001).Thus it can be said that, there was no statistically significant difference observed when the two groups were compared to each other. This demonstrates that both the treatment modalities result in comparable reduction in the Plaque index scores of the patients.

Analysis on Papillary bleeding index (PBI) at baseline and after 1 month

Intragroup analysis (Figure 1A and 1B)

At baseline, the mean PBI scores were statistically non- significant: Group A-2.1000 (n = 20) versus Group B-2.0750 (n = 20). After 1 Month, PBI decreased significantly in both groups Group A-0.6750 (n = 20) versus Group B-0.6000 (n = 20), indicating a significant therapeutic effect of both the mouthrinses (p value < 0.001).

Intergroup analysis (Figure 1A and 1B)

When results of both groups were compared, no statistically significant difference was observed (p value of PBI after 1 month-0.49) (p value > 0.001).Thus it can be said that, there was no statistically significant difference observed when the two groups were compared to each other. This demonstrates that both the treatment modalities result in comparable reduction in the Papilla bleeding index scores of the patients.

Analysis on Discolouration/Stain index(DI/SI) at baseline and after 1 month

Intragroup analysis (Figure 1 A and 1B)

At baseline, the mean DI scores were statistically non- significant: Group A-0.0000 (n = 20) versus Group B-0.0000 (n = 20). After 1 Month, DI increased significantly in both group A-.56330 (n = 20) versus Group B-0.0000 (n = 20), indicating a significant discolouration effect due to Chlorhexidine (p value < 0.001).

Intergroup analysis (Figure 1A and 1B)

When results of both groups were compared, statistically significant difference was observed (p value < 0.001). Thus it can be said that, there was statistically significant difference observed when the two groups were compared to each other. This demonstrates that the treatment modality provided to Group A resulted in comparable increase in the Discolouration index scores of the patients.

Analysis on Total Antioxidant capacity (TAOC) at baseline and after 1 month

Intragroup analysis (Figure 1A and 1B)

At baseline, the mean TAOC scores were statistically non- significant: Group A-20.6500 (n = 20) versus Group B-20.6750 (n = 20). After 1 Month, TAOC increased significantly in both group A-33.0000 (n = 20) versus Group B-43.1750 (n = 20), indicating a significant therapeutic effect of both the mouthrinses (p value < 0.001).

Intergroup analysis (Figure 1A and 1B)

When results of both groups were compared, statistically significant difference was observed (p value < 0.001). Thus it can be said that, there was statistically significant difference observed when the two groups were compared to each other. This demonstrates that the treatment modality provided to Group B resulted in comparable increase in the Total Antioxidant Capacity scores of the patients.

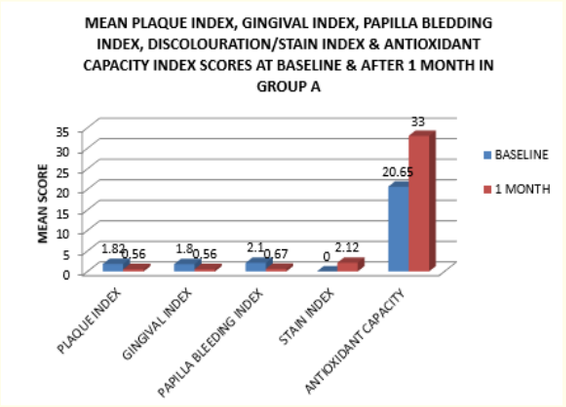

Figure 1A: Mean Plaque Index, Gingival Index, Papilla Bleeding Index, Discolouration/Stain Index and Total Antioxidant Capacity Index scores at baseline and after 1 month in Group A.

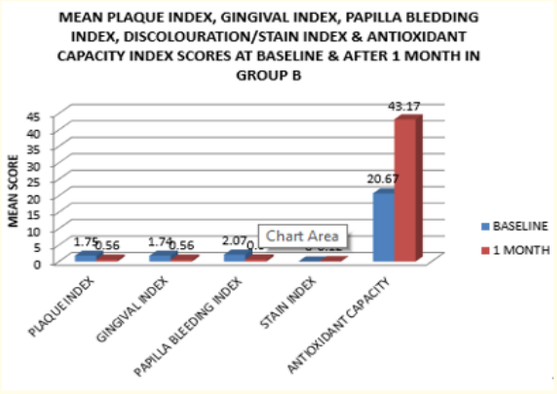

Figure 1B: Mean Plaque Index, Gingival Index, Papilla Bleeding Index, Discolouration/Stain Index and Total Antioxidant Capacity Index scores at baseline and after 1 month in Group B.

		Mean	N	SD	P Value
Plaque Index	Baseline	1.8200	40	.35892	< 0.001
	1 month	.5600	40	.22280	
Gingival Index	Baseline	1.8000	40	.37417	< 0.001
	1 month	.5600	40	.22280	
Papilla Bleeding Index	Baseline	2.1000	40	.59052	< 0.001
	1 month	.6750	40	.47434	
Stain Index	Baseline	.0000	40	.00000	< 0.001
	1 month	2.1250	40	.56330	
Antioxidant Capacity	Baseline	20.6500	40	1.83345	< 0.001
	1 month	33.0000	40	2.05064	

Table 1: Comparison of mean plaque index, gingival index, papilla bleeding index, stain index and antioxidant capacity index scores at baseline and after 1 month in group A.

		Mean	N	SD	P Value
Plaque Index	Baseline	1.7575	40	.42781	< 0.001
	1 Month	.5625	40	.23717	
Gingival Index	Baseline	1.7450	40	.42964	< 0.001
	1 Month	.5625	40	.23390	
Papilla Bleeding Index	Baseline	2.0750	40	.61550	< 0.001
	1 Month	.6000	40	.49614	
Stain Index	Baseline	.0000	40	.00000	< 0.001
	1 Month	.1250	40	.33493	
Antioxidant Capacity	Baseline	20.6750	40	2.00496	< 0.001
	1 Month	43.1750	40	1.39390	

Table 2: Comparison of mean plaque index, gingival index, papilla bleeding index, stain index and antioxidant capacity index scores at baseline and after 1 month in group B.

Discussion

Orthodontic treatment with a fixed multibracket appliances has been associated with a troubling side-effects like development and retention of plaque [3,29,30]. Exposure of teeth to plaque for a critical period of time results in demineralization and caries formation [31]. When a patient is fitted with fixed appliances, this brings about an alteration of the oral environment along with difficulties keeping the teeth clean [32], leading to an increase in plaque accumulation [33] and a change in composition of the bacterial flora [34]. The effective prevention program includes strategies like patient motivation, professional oral prophylaxis and adjunctive use of chemical plaque control agent like chlorhexidine. The reported side effects of CHX are alteration in taste, increase of calculus formation, staining of teeth and mucous membranes and, more rarely, oral mucosa desquamation and parotid swelling [35]. However, the most obvious and important local side effects are the brown staining of the teeth, restorative materials and dorsum of the tongue [36] as well as supragingival calculus formation [37]. Non-enzymatic browning (Maillard reactions) and formation of pigmented metal sulfides are considered the possible mechanisms of tooth discolorations due to Chlorhexidine application [38]. However, clinical and laboratory studies provided strong evidence that staining is caused by interaction or precipitation of dietary chromogens with locally adsorbed CHX [38].

Chlorhexidine mouthrinse has been associated with various side effects incapacitating their long term use, so new formulation of equal efficacy and fewer side effects need to be evaluated. In order to fulfil this goal, it was decided by the authors to evaluate the effectiveness of a Novel Polyphenolic Antioxidant mouthrinse consisting of a combination of various natural ingredients having minimal side effects. The results of this study showed no statistically significant difference observed when the two groups were compared to each other after 1 month. This demonstrates that both the treatment modalities resulted in comparable reduction in the Plaque index, Gingival index and Papilla Bleeding index scores of the patients. Thus polyphenolic mouthrinse has equal therapeutic effectiveness as compared to Chlorhexidine(CHX) mouthrinse. However, the Discolouration index score was statistically significant in Group A as compared to Group B after 1 month (Figure 2 and Table 3). This showed that Chlorhexidine caused discolouration of teeth after regular use for 1 month. Thus Chlorhexidine mouthrinse need to be discontinued after 1 month. In contrast to this, Polyphenolic mouthrinses do not cause stains and thus can be effectively used for long term in patients with fixed orthodontic appliances.

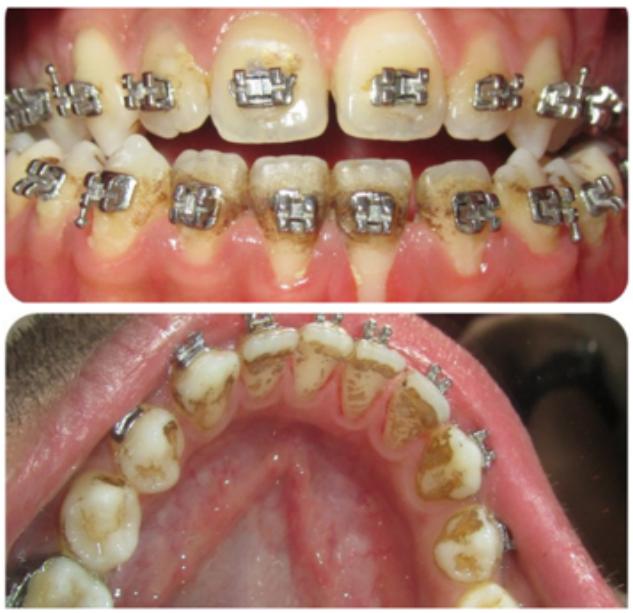

Figure 2: Chlorhexidine stains around the brackets on labial and lingual surface after 1 month.

	Groups	N	Mean	Std. Deviation	P Value
PI_BL	Group A	40	1.8200	.35892	0.48
	Group B	40	1.7575	.42781	
PI_30	Group A	40	.5600	.22280	0.96
	Group B	40	.5625	.23717	
GI_BL	Group A	40	1.8000	.37417	0.54
	Group B	40	1.7450	.42964	
GI_30	Group A	40	.5600	.22280	0.96
	Group B	40	.5625	.23390	
PBI_BL	Group A	40	2.1000	.59052	0.85
	Group B	40	2.0750	.61550	
PBI_30	Group A	40	.6750	.47434	0.49
	Group B	40	.6000	.49614	
SI_BL	Group A	40	.0000	.00000[a]	1.00
	Group B	40	.0000	.00000[a]	
SI_30	Group A	40	2.1250	.56330	< 0.001
	Group B	40	.1250	.33493	
ANTIOX_BL	Group A	40	20.6500	1.83345	0.95
	Group B	40	20.6750	2.00496	
ANTIOX_30	Group A	40	33.0000	2.05064	< 0.001
	Group B	40	43.1750	1.39390	

Table 3: Comparison of mean plaque index, gingival index, papilla bleeding index, stain index and antioxidant capacity index scores between group A and group B at baseline and after 1 month.

Numerous attempts have been made to limit tooth discolouration by adding chemical reagents to CHX such as M239 -144, monoperoxyphthalic acid and most recently ascorbic acid and sodium metabisulfite (Antidiscolouration system, ADS) [39,40]. ADS-enriched CHX has shown efficacy equal to that of CHX without ADS in terms of reduction of gingival inflammation in post-operative patients [41]. However, contradictory results have been found in terms of plaque control [42,43]. Therefore, the benefit of adding ADS to CHX remains unclear.

Saliva composition, naturally or under certain conditions, varies in different individuals (Reyes., *et al.* 2014). Total antioxidant capacity (TAOC) is the total material in bodily fluids which possess antioxidant properties [44]. Saliva contains antioxidant similar to other bodily fluids. TAOC of saliva is comprised of enzyme elements such as superoxide dismutase, peroxidase, and non-enzyme elements including uric acid, vitamin C, reduced glutathione, and oxidized glutathione [45]. There is a direct relationship between saliva and serum antioxidants [46]. The FRAP assay has some advantages [26]:

- No need of highly specialized equipment or skills, or strict control of timing and reaction conditions.
- Quick and simple to perform and can be easily automated.
- Reagents are inexpensive and sample pre-treatment is not required.
- Highly reproducible over a wide concentration range.

The limitation of this test is that it does not measure the antioxidants containing thiol groups and only measures the reducing capability based upon the ferric ion [47]. Group B showed statistically significant increase in the TAOC of saliva as compared to Chlorhexidine mouthrinse (Table 3). The rise in TAOC of saliva after 1 month is comparable to the TAOC of saliva in healthy patients. The study demonstrated the strong synergistic effect of the combination of different polyphenols-Ferulic acid, Epigallocatechin and Tetrahydrocurcuminoids.

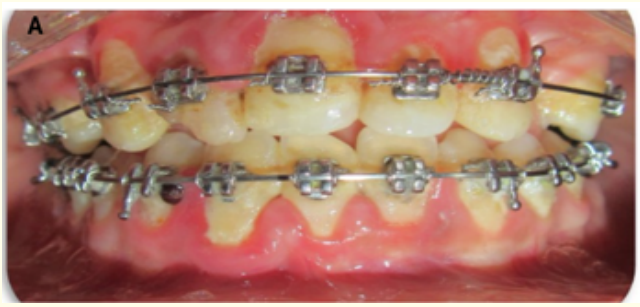

Figure 3A: Pre-operative image of Plaque induced gingivitis.

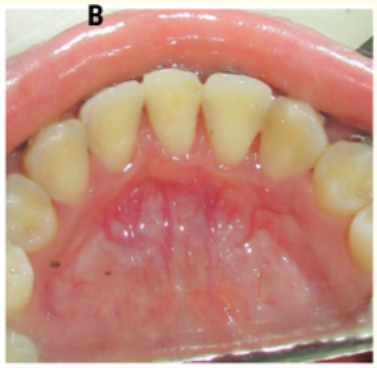

Figure 3B: Post-operative after 1 month use of Polyphenolic Antioxidant mouthrinse–Lingual surface.

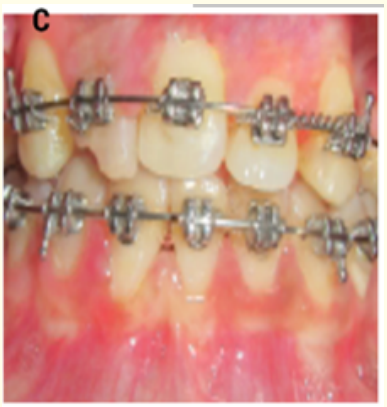

Figure 3C: Post-operative after 1 month use of Polyphenolic Antioxidant mouthrinse -Labial surface.

Figure 4: Collection of Unstimulated saliva in sterile container.

Figure 5: FRAP test conducted on the saliva samples.

Conclusion

Based on the results of this study, the following conclusions may be drawn when patients with Fixed Orthodontic appliances rinse twice daily for 1 month with either Polyphenolic antioxidant mouthrinse (Periosciences prorinse) or Chlorhexidine mouthrinse: 1) Neither mouthrinse was more effective than the other in reducing the gingival, plaque index and papilla bleeding index over a period of 1 month; 2) Both rinses had a statistically significant effect on decreasing gingival inflammation. 3) Polyphenolic antioxidant mouthrinse (Periosciences prorinse) did not cause discolouration of teeth (Figure 3A, 3B and 3C). 4) Polyphenolic antioxidant mouthrinse (Periosciences prorinse*) significantly improved the antioxidant capacity of saliva as compared to Chlorhexidine mouthrinse.

Thus the authors supports the use of Novel Polyphenolic Antioxidant mouthrinse containing combination of various naturally obtained powerful antioxidants to treat plaque induced gingivitis in patients with fixed orthodontic appliances.

Acknowledgements

The authors acknowledge the Research and Development team, Periosciences* for providing the mouthrinse samples for the study. The authors also acknowledge, Department of Biochemistry, BYL Nair Ch. Hospital and T. N. Medical College, Mumbai for their cooperation. Authors acknowledge Dr. Jayati Shah (MDS) and Dr. Shraddha Kode (Postgraduate student) for their immense support throughout the study. Lastly, a big thankyou to all the participants of this study.

Bibliography

1. Kessler M. "Interrelationships between orthodontics and periodontics". *American Journal of Orthodontics* 70.2 (1976): 154-177.

2. Zachrisson S and Zachrisson BU. "Gingival condition associated with orthodontic treatment". *Angle Orthodontist* 42.1 (1972): 26-34.

3. Zachrisson BU. "Cause and prevention of injuries to teeth and supporting structures during orthodontic treatment". *American Journal of Orthodontics* 69.3 (1976): 285-300.

4. Lang NP., *et al*. "Clinical and microbiological effects of subgingival restorations with overhanging or clinically perfect margins". *Journal of Clinical Periodontology* 10.6 (1983): 563-578.

5. Leggott PJ., *et al*. "Gingival disease patterns during fixed orthodontic therapy: Adolescents vs. adults". *Journal of Dental Research* 63 (1984): 309.

6. Addy M., *et al*. "Chemical plaque control in the prevention of gingivitis and Periodontitis". In: Lang NR Karring T, eds. Proceedings of the 1st European Workshop on Periodont.

7. Mathur S., *et al*. "Chlorhexidine: The gold standard in chemical plaque control". *National Journal of Physiology, Pharmacy and Pharmacology* 1.2 (2011): 45-50.

8. KA Brogden., *et al*. "Human polymicrobial infections". *The Lancet* 365.9455 (2005): 253-255.

9. Boudet AM. "Evolution and current status of research in phenolic compounds". *Phytochemistry* 68.22-24 (2007): 2722-2735.

10. I Borges Jr., *et al*. "Proinflammatory and oxidative stress markers in patients with periodontal disease". *Mediators of Inflammation* (2007): 45794.

11. Lívia Brenelli de Paiva., *et al*. "Ferulic acid and derivatives: molecules with potential application in the pharmaceutical field". *Brazilian Journal of Pharmaceutical Sciences* 49.3 (2013).

12. Ammon HP., *et al*. "Mechanism of anti-inflammatory actions of curcumine and boswellic acids". *Journal of Ethnopharmacology* 38.2-3 (1993): 113-119.

13. Chainani-Wu N. "Safety and anti-inflammatory activity of curcumin: A component of turmeric (Curcuma longa)". *Journal of Alternative and Complementary Medicine* 9.1 (2003): 161-168.

14. Ramirez-Bosca A., *et al*. "Effects of the antioxidant turmeric on lipoprotein peroxides: Implications for the prevention of atherosclerosis". *Age (Omaha)* 20.3 (1997): 165-168.

15. Sugiyama Y., *et al*. "Involvement of the b-diketone moiety in the antioxidative mechanism of tetrahydrocurcumin". *Biochemical Pharmacology* 52.4 (1996): 519-525.

16. Ruby AJ., *et al*. "Anti-tumour and antioxidant activity of natural curcuminoids". *Cancer Letters* 94.1 (1995): 79-83.

17. Motterlini R., *et al*. "Curcumin, an antioxidant and anti-inflammatory agent, induces heme oxygenase-1 and protects endothelial cells against oxidative stress". *Free Radical Biology and Medicine* 28.8 (2000): 1303-1312.

18. Aggarwal S., *et al*. "Inhibition of growth and survival of human head and neck squamous cell carcinoma cells by curcumin via modulation of nuclear factor-kappaB signaling". *International Journal of Cancer* 111.5 (2004): 679-692.

19. LoTempio MM., *et al*. "Curcumin suppresses growth of head and neck squamous cell carcinoma". *Clinical Cancer Research* 11 (2005): 6994-7002.

20. Shahzad M., *et al*. "Selected dietary (poly)phenols inhibit periodontal pathogen growth and biofilm formation". *Food and Function* 6.3 (2015): 719-729.

21. Makimura M., *et al*. "Inhibitory effect of tea catechins on collagenase activity". *Journal of Periodontology* 64.7 (1993): 630-636.

22. Demeule M., *et al*. "Matrix metalloproteinase inhibition by green tea catechins". *Biochimica et Biophysica Acta* 1478.1 (2000): 51-60.

23. Löe H and Silness J. "Periodontal disease in pregnancy". *Acta Odontologica Scandinavica* 21 (1963): 533-551.

24. Muhlemann HR and Son S. "Gingival Sulcus Bleeding: A Leading Symptom in Initial Gingivitis". *Helvetica Odontologica Acta* 15.2 (1971): 107.

25. Loe H. "The Gingival Index, the Plaque Index and the Retention Index Systems". *Journal of Periodontology* 38.6 (1967): 610-616.

26. Benzie IF and Strain JJ. "The ferric reducing ability of plasma (FRAP) as a measure of "antioxidant power": the FRAP assay". *Analytical Biochemistry* 239.1 (1996): 70-76.

27. Lobene RR. "Effect of dentifrices on tooth stains with controlled brushing". *Journal of the American Dental Association* 77.4 (1968): 849-855.

28. Macpherson LM., *et al*. "Comparison of a conventional and modified tooth stain index". *Journal of Clinical Periodontology* 27.11 (2000): 854-859.

29. Gorelick L., *et al*. "Incidence of white spot formation after bonding and banding". *American Journal of Orthodontics* 81.2 (1982): 93-98.

30. O'Reilly MM and Featherstone JD. "Demineralization and remineralization around orthodontic appliances: an in vivo study". *American Journal of Orthodontics and Dentofacial Orthopedics* 92.1 (1987): 33-40.

31. Zachrisson BU and Zachrisson S. "Caries incidence and orthodontic treatment with fixed appliances". *Scandinavian Journal of Dental Research* 79.3 (1971): 183-192.

32. Olympio KP., *et al*. "Effectiveness of a chlorhexidine dentifrice in orthodontic patients: a randomized-controlled trial". *Journal of Clinical Periodontology* 33.6 (2006): 421-426.

33. Pender N. "Aspects of oral health in orthodontic patients". *British Journal of Orthodontics* 13.2 (1986): 95-103.

34. Lundström F and Krasse B. "Streptococcus mutans and lactobacilli frequency in orthodontic patients the effect of chlorhexidine treatments". *European Journal of Orthodontics* 9.2 (1987): 109-116.

35. Flötra L. "Different modes of chlorhexidine application and related local side effects". *Journal of Periodontal Research. Supplement* 12.3 (1973): 41-44.

36. Addy M., *et al*. "The effect of single morning and evening rinses of chlorhexidine on the development of tooth staining and plaque accumulation. A blind cross-over trial". *Journal of Clinical Periodontology* 9.2 (1982): 134-140.

37. Cancro LP., *et al*. "Effects of a chlorhexidine gluconate mouthrinse on dental plaque and calculus". *Journal of Periodontology* 43.11 (1972): 687-691.

38. Eriksen HM., *et al*. "Chemical plaque control and extrinsic tooth discoloration. A review of possible mechanisms". *Journal of Clinical Periodontology* 12.5 (1985): 345-350.

39. Charbonneau DL and Snider AG. "Reduced chlorhexidine tooth stain coverage by sequential administration of monoperoxyphthalic acid in the beagle dog". *Journal of Dental Research* 76.9 (1997): 1596-1601.

40. Wade WG., *et al*. "The antibacterial and anti-staining properties of the novel anti-adherent agent M239, 144 alone and in combination with chlorhexidine". *Journal of Clinical Periodontology* 21.6 (1994): 438-440.

41. Cortellini P., *et al*. "Chlorhexidine with an anti discoloration system after periodontal flap surgery: a cross-over, randomized, triple-blind clinical trial". *Journal of Clinical Periodontology* 35.7 (2008): 614-620.

42. Bernardi F., *et al*. "Chlorhexidine with an anti discoloration system. A comparative study". *International Journal of Dental Hygiene* 2.3 (2004): 122-126.

43. Arweiler NB., *et al*. "Differences in efficacy of two commercial 0.2% chlorhexidine mouthrinse solutions: a 4-day plaque regrowth study". *Journal of Clinical Periodontology* 33.5 (2006): 334-339.

44. Shafer WG., *et al*. "A TEXT Book of Oral Pathology. 6th edition". Philadelphia W. B: Saunders Company (2009): 569-589.

45. Bakhtiari S., *et al*. "Effect of Vitamin C on Salivary Total Antioxidant Capacity in Smokers". Iranian Journal of Pharmaceutical Research 11.4 (2012): 1045-1049.

46. Malekirad A., *et al*. "The comparison of total antioxidant capacity of serum and saliva between patients with type-2 diabetes mellitus and control". *Journal of Shahrekord University of Medical Sciences* 7.3 (2005): 69-74.

47. Prior RL and Cao G. "In vivo total antioxidant capacity: comparison of different analytical methods". *Free Radical Biology and Medicine* 27.11-12 (1999): 1173-1181.

Volume 2 Issue 10 October 2018